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CONSTRAINTS TO ORGANISED RECYCLING IN DEVELOPING COUNTRIES: A CASE STUDY OF GABORONE, BOTSWANA

By

Benjamin Bolaane, BEng. MSc.

A Doctoral Thesis Submitted in Partial Fulfilment of the Requirements for the Award of Doctor of Philosophy of Loughborough University

January 2004

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DEDICATION

This thesis is dedicated to my wife Ponatshego and my son Boemo for their patience and endurance of staying without a husband and father respectively during the period of this research. I would also like to dedicate this work to my late brother, Molihanka Bolaane, who passed away during the period of this research. May his soul rest in peace.
ACKNOWLEDGEMENTS

This research work has been made possible by assistance and advice of a number of people both at Loughborough University and in Gaborone. First, I am deeply indebted to my supervisor Dr Syed Mansoor Ali for his guidance, advice and useful comments throughout the research process. Dr Ali’s open door policy made it easy to discuss issues relating to the research as and when they arouse. I would also like to thank my co-supervisor, Dr Andrew Cotton who made extremely useful comments on the initial draft of the thesis. Secondly, I would like to thank the University of Botswana for the financial support that made this research possible. I would also like to thank the staff at the Water, Engineering and Development Centre (WEDC), Loughborough University, particularly Mrs Tricia Jackson for helping me immensely both in identifying the relevant literature material in the resource centre and in proof reading the thesis.

A number of people in Gaborone helped me during the data collection phase. I am particularly thankful to all the households that participated in the household waste sampling survey. I would like to thank officials at the Gaborone City Council for immeasurable cooperation and assistance. In particular, I would like to thank Mr Frank Molaletsi, Mr G. Sithole and Mr Rutherford. My special thanks go to Mrs R. Chikanda of the Department of Sanitation and Waste Management for always promptly responding to my e-mail enquiries. I would also like to thank the Chief Executive Officer of Somareleng Tikologo for the valuable assistance they gave me.

I am also grateful to my fieldwork research assistants for their commitment and dedication. These are: Tshoganetso, Chipo, Thabo, Maipelo, Molefe, Boitumelo, and Tumedi. I also acknowledge the camaraderie support of fellow Batswana students (Herman, Masike, Boitshepo, Lesedi, Khumo and Sebetlela) at Loughborough University during my time here. Lastly but not least, special thanks go to Dr J.M. Chuma for making fieldwork follow-ups on my behalf when I had returned to Loughborough.
ABSTRACT

The continued growth of waste generation rates and the general concern for its impact on the natural environment have resulted in a search for solutions to contain the problem before it spirals out of control. One such solution is organised recycling, the practice whereby municipalities require waste generators to set aside post-consumer materials so that they do not enter the mixed waste for collection and delivery to the markets. The practice is popular in developed countries, with municipalities engaging in household waste source separation schemes to meet statutory targets set by higher authorities. In developing countries too, NGOs, municipalities and national governments have started to include source separation in waste management policy and legislation. But this approach will present a new set of challenges to municipalities and waste generators alike, particularly when it is not preceded by a proper analysis of practical constraints on the ground. The purpose of this research is to develop workable recycling guidelines for cities in developing countries with similar characteristics to Gaborone from analysis of such constraints. The study began as an exploratory research process that evolved into a case study. A cross-sectional survey methodology was used including survey techniques such as waste characterisation sampling surveys for household and commercial waste, questionnaire-based interview surveys, semi-structured interviews with key informants representing stakeholders, and market survey for post-consumer materials. The research is directed by the hypothesis that: Despite the projection of organised recycling as an effective means to enhance waste recycling, its practicality as a waste management strategy in developing countries is constrained by the realities on the ground. The research found that, the major constraints to organised recycling are lack of practical official support for recycling, failure of public awareness to translate into participation in recycling initiatives, the attitude of municipal officials that favours maintenance of the status quo and relatively high recovery rates achieved by the existing recycling initiatives. The research concludes that under the prevailing conditions, it would not be practical to organise recycling schemes in the format used in developed countries and proposes guidelines that take into consideration the established constraints.

Key words: Solid waste, organised recycling, constraints, guidelines, Gaborone, developing countries, markets, stakeholder perceptions and attitudes
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</thead>
<tbody>
<tr>
<td>BHC</td>
<td>Botswana Housing Corporation</td>
</tr>
<tr>
<td>BWMS</td>
<td>Botswana Waste Management Strategy</td>
</tr>
<tr>
<td>CBO</td>
<td>Community-Based Organisation</td>
</tr>
<tr>
<td>CEDA</td>
<td>Citizen Entrepreneurial Development Agency</td>
</tr>
<tr>
<td>DSWM</td>
<td>Department of Sanitation and Waste Management</td>
</tr>
<tr>
<td>EHSD</td>
<td>Environmental Health and Sanitation Department</td>
</tr>
<tr>
<td>GCC</td>
<td>Gaborone City Council</td>
</tr>
<tr>
<td>GoB</td>
<td>Government of Botswana</td>
</tr>
<tr>
<td>MRF</td>
<td>Material Recovery Facility</td>
</tr>
<tr>
<td>MSW</td>
<td>Municipal Solid Waste</td>
</tr>
<tr>
<td>MSWM</td>
<td>Municipal Solid Waste Management</td>
</tr>
<tr>
<td>NIMBY</td>
<td>Not In My Back Yard</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-Governmental Organisation</td>
</tr>
<tr>
<td>P</td>
<td>Pula (Botswana Currency = International Denomination BWP)</td>
</tr>
<tr>
<td>SHHA</td>
<td>Self-Help Housing Agency</td>
</tr>
<tr>
<td>WHM</td>
<td>Waste Management Hierarchy</td>
</tr>
</tbody>
</table>
1  INTRODUCTION

1.1  General

Rapid population growth and its concentration in cities around the world are affecting the long-term viewpoint for humanity. In addition to the burdens imposed by problems of growth, cities are increasingly subject to dramatic crises especially in developing countries. Unemployment, environmental degradation, lack of urban services, deterioration of existing infrastructure and lack of access to land, finance and adequate shelter are the main areas of concern (UNCHS 2001). One of the most serious environmental consequences of urbanisation, coupled with increasingly affluent lifestyles, is the ever-growing amount of solid wastes generated by cities. The increasingly affluent lifestyles cause changes in consumption patterns that increase per capita quantities and alter composition of the urban solid waste stream (UNCHS 1994). The problem is further exacerbated by past governmental policies that did not aim at minimising such growth, but instead focused on identifying more and more disposal facilities where the waste could be dumped and allowed to dilute and disperse out of sight from the generators (Jindal et al. 1997). This research aims to contribute towards the search for sustainable waste management solutions by developing guidelines for organised recycling in cities in developing countries with similar characteristics to Gaborone. In particular, the research identifies possible constraints for organised recycling that should be taken into consideration when formulating recycling strategies in such cities.

1.2  Solid waste- a global problem

Municipal solid waste production continues to grow in per capita and overall terms. In 1999, the urban areas of Asia alone produced about 2.8 million tonnes of municipal solid waste (MSW) per year and the figure is expected to increase to 657 million tonnes per year by 2025 (The World Bank 1999). The problem of solid waste cuts across both developed and developing countries. On a global scale, it was estimated that in 1990
approximately 1.3 billion metric tonnes of municipal solid waste were generated (van Beukering et al. 1999). However, developed countries account for the larger proportion of the solid waste generated. For example, during the latter part of the 1990s annual waste production ranged from 300-800 kg per person in more developed countries to less than 200 kg per person in the least developed countries (UNCHS 2001). Furthermore, the composition of waste differs between developed and developing countries.

The continued growth of waste generation rates and the general concern for its impact on the natural environment have resulted in a search for solutions to contain the problem before it spirals out of control. The search for solutions has taken different directions both in developing and developed countries. In developed countries, the search involves identifying more efficient and economic solid waste collections programs; establishing new partnerships with communities and private sector; new economic policy instruments, such as recycling credits, landfill disposal levies, and product charges (WRI 1997).

However, the solid waste management problems in developing countries are quite different from those in developed countries, generally because of the social, economic and institutional set up (UNEP 2000). This puts into question the applicability of waste management concepts used in developed countries to developing countries, without adaptation on the basis of the conditions on the ground.

1.3 Solid waste management in developing countries

The problems of solid waste management in developing countries are remarkably different from those in developed countries. While in developed countries the challenge is to reduce the cost of disposal by reducing the quantity of waste disposed, the challenge in developing countries is to increase the collection coverage and to identify and develop sanitary disposal facilities (UNCHS 2001). But with lack of institutional competence and financial resources compared to those in developed countries, this makes the challenge a tall order. The lack of financial resources is further exacerbated by the inability of the
population that is being serviced to pay for the service provided and an ever-increasing demand on other urban services (van Beukering 1999).

In recent years, there has been a growing interest in promoting recycling as a strategy to address some of the problems of waste management in developing countries. Promotion of recycling as a waste management strategy has been given impetus by the international renowned waste management hierarchy (WMH). The waste management hierarchy is an ordered list of approaches to deal with MSW, which ranks the options according to their environmental acceptability, with waste reduction the most preferred, and landfill the least preferred (McDougall et al. 2001). Promotion of recycling as a waste management strategy, has taken different formants, including support for informal recycling activities as well as municipal sponsored recycling schemes. Many of these efforts are driven by NGOs or CBOs, but are generally on a small scale (see Lardinois and Furedy 1999).

1.4 Organised recycling

This study is about organised recycling in developing countries. Organised recycling here refers to the practice whereby municipalities require waste generators to set aside post-consumer materials so that they do not enter the mixed waste stream but can be collected and delivered to the markets. The main objective of such a practice is to provide cleaner materials for recycling (Waite 1995) which will in turn reduce the quantity of waste destined for disposal. Organised recycling has become part of a shift in paradigm in waste management from conventional collection and disposal. It is mainly motivated by environmental obligations of limiting the quantity of waste destined for disposal and conserving natural resources. Other concerns addressed by organised recycling are spiralling waste disposal costs and the inability of the planet's natural sinks to absorb and convert waste generated pollution into harmless compounds (Shah 2000).

However, there is scepticism over its potential success in developing countries (Furedy 1993; UNEP 2000). The issues that are often cited, as possible constraints cut across institutional, waste composition and socio-economic considerations. These issues raised
do not appear to be based on any objective examination of the practical conditions in these countries. This has led to a continued debate over the appropriateness of organised recycling in developing countries. Evaluation of organised recycling schemes in Indonesia, Brazil and Malaysia that could give credibility to some of the arguments above is still at an early stage and preliminary results do not present a clear picture.

1.5 Justification of the research

Solid waste recycling is one of the preferred options of waste management. It is seen as a means by which humanity seeks to minimise the environmental impact of both raw material production and waste disposal as well as deriving value from wastes (Waite 1995). In an effort to achieve this objective, many international organisations and national governments in developed countries have set recycling targets to increase the level of material recovery for recycling. Municipal authorities have been given responsibilities to formulate recycling strategies that will meet targets set by national governments (DETR 2000). In return, local governments are responding to the challenge by developing recycling strategies with emphasis on municipal collection of recyclables to increase waste recovery rates in line with the set targets.

The activities of municipalities in the developed world of setting up source separation schemes have not gone without notice by environmental activists and governments in developing countries. National governments, Municipalities and NGOs in these countries have also developed interest in organised recycling programmes as the key to addressing their waste management problems (Lardinois and Furedy 1999). For example the Botswana Waste Management Act of 1998 requires municipalities to formulate recycling plans as part of their waste management plans (GoB 1998b). In addition, some municipalities in Indonesia and The Philippines have embarked on source separation schemes that are intended to reduce the quantity of waste to be disposed (UNCRD 1999; Salaverria 2002). But this approach will present a new set of challenges to municipal authorities and waste generators alike, particularly when it is not preceded by a proper analysis of practical constraints on the ground.
Considerable research on recycling has been undertaken mainly in Asia and Latin America aimed at understanding the role of the informal recycling sector in waste management activities in developing countries and their possible linkages with the official authority (Ali 1997; Lardinois and Furedy 1999). However, not much work has been done in developing countries to understand the appropriateness and practicality of the organised recycling sector. This has made it necessary to understand more closely the practical constraints of organised recycling schemes in developing countries in order to mitigate against the possible implementation of strategies that are destined to fail.

1.6 Purpose of the research

The purpose of this research is to develop workable guidelines for organised recycling based on practical conditions on the ground, for cities in developing countries with similar characteristics to Gaborone. The emphasis of the research is on identifying constraints to organised recycling in such cities.

Sections 3.2 to 3.4 in chapter 3 gives a detailed explanation of objectives, guiding hypothesis and research questions governing the thesis.

1.7 Scope of the research

This research limits itself to the waste stream that is the responsibility of municipal authority to collect and dispose safely, which includes household and commercial waste. The research also acknowledges that there are other fundamental blocks that can either limit or support organised recycling, but limits itself to the three critical blocks of:

- Quantity and quality of recyclables in the waste stream
- Stakeholder perceptions and attitudes
- Post-consumer material markets.
The research is based on a case study approach and therefore has the accompanying limitations associated with generalising from the findings. Research findings are specific to Gaborone and in some aspects urban Botswana. Thus, they are not necessarily applicable countrywide or in developing countries as a whole. However, the findings of the study might be applicable to other cities in developing countries with similar characteristics to Gaborone. In particular, the findings and recommendations of the study could be valid in other cities in Southern Africa and other parts of the developing world with similar characteristics to those summarised in Table 1.1 that are considering organised recycling as a waste management strategy. However, it is beyond the scope of this thesis to prove this beyond reasonable doubt. In its recommendations, therefore the thesis does not offer a blueprint but rather general guidelines, particularly with respect to municipal involvement in organised recycling.

1.8 Background information of the study area

Gaborone is the financial and administrative capital of Botswana (see Figure 1.1). It is also the headquarters of the Southern African Development Community (SADC). Gaborone has a population of 186,000 and at an annual growth rate of 3.4 percent (CSO 2001). The average household size is 4.8 persons per household. Table 1.1 summarises some of the key characteristics of Gaborone.

The average real GDP growth was estimated at 6.4 percent in 2002 (GoB 2002). The main economic activities in Gaborone are civil service employment, construction, wholesale and retail trade. In 2002, national unemployment rate was estimated at 15.8 percent (UNDP 2002). Industrial activity is limited, with manufacturing representing 1.1 percent of economic activities (CSO 2002). Manufacturing is mainly dominated by light industrial activities such as clothing and fabrication of metal products excluding machinery.

The Botswana Waste Management Strategy is the policy instrument that directs waste management activities in Gaborone (GoB 1998a). The main legislation that regulates
waste management is the Waste Management Act of 1998 (GoB 1998b). These two policy and regulatory instruments are discussed in detail in chapter 4.

The main generators of solid waste in Gaborone are households and commerce. The landfill-weighing programme shows that refuse which refers to household and commercial wastes, constitute the largest proportion of the waste stream at 54.4 percent (GCC 2000). The local authority, Gaborone City Council, is the designated waste collection and disposal authority. A more detailed discussion of waste collection, recycling and disposal is contained in chapter 4.

Table 1.1: Some characteristics of Gaborone

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>186 000</td>
</tr>
<tr>
<td>Population growth rate</td>
<td>3.4%</td>
</tr>
<tr>
<td>Population density</td>
<td>1 100 people/km²</td>
</tr>
<tr>
<td>Waste management authority</td>
<td>Local authority</td>
</tr>
<tr>
<td>Main waste generators</td>
<td>Households and commerce</td>
</tr>
<tr>
<td>Waste generation rates</td>
<td>Relatively low (see chapter 5)</td>
</tr>
<tr>
<td>Disposal method</td>
<td>Landfill</td>
</tr>
<tr>
<td>Informal recycling activities</td>
<td>Relatively low</td>
</tr>
<tr>
<td>Private sector recycling activities</td>
<td>Exist as intermediate markets</td>
</tr>
<tr>
<td>Reprocessing industries</td>
<td>Limited</td>
</tr>
<tr>
<td>National population density (Botswana)</td>
<td>3 people/km²</td>
</tr>
</tbody>
</table>
Figure 1.1: Map of Gaborone and its regional location
1.9 Structure of the thesis

The thesis has been structured to provide a logical order of issues investigated, findings, recommendations and conclusions. Chapter 1 introduces the subject area, the scope and the context of the research. Chapter 2 reviews both local, international, published and unpublished literature in recycling and more specifically on possible constraints of organised recycling in developing countries. Research design and methods for gathering data are established in Chapter 3. Chapter 4 discusses the findings of the exploratory research methodology as an overview of waste management in Gaborone and sets a context for discussions in the following chapters. Primary analysis and implications of waste characterisation and sampling surveys, stakeholder perception and attitudes surveys and interviews and market surveys are presented in chapters 5, 6, and 7 respectively. Chapter 8 highlights the major findings of the thesis and their implications. The chapter also proposes guidelines for organised recycling in cities in developing countries with similar characteristics to Gaborone that takes into account the established constraints. Chapter 9 concludes the thesis with a summary of major conclusions and insights of constraints of organised recycling in Gaborone.

1.10 Summary

Confronted with growing waste generation rates, particularly in urban settlements, there is a need to search for sustainable solid waste management solutions. Solid waste recycling emerges as one of the alternatives to address waste management problems. The focus of this research is to evaluate the possible constraints of organised recycling as a strategy to manage solid waste in cities in developing countries with similar characteristics to Gaborone.

The study leads to an understanding of the constraints to organised recycling in developing countries. It proposes guidelines for organised recycling in, which will be more likely to be effective. There is recognition that unless a more rigorous evaluation of constraints of organised recycling schemes is undertaken, poorly designed schemes will
come into being. The likelihood is that when this occurs, it will undermine the drive towards sustainable waste management.
2 LITERATURE REVIEW

2.1 Introduction

Chapter 1 introduced the broader and narrow areas of this research, and defined its objective. This chapter critically reviews the body of knowledge on waste recycling. The literature reviewed covers a wide variety of sources being international, regional and local as well as published and unpublished. In the study area very little work has been done on recycling, particularly organised recycling, and this has limited the availability of local literature. In addition, solid waste studies do not have established theoretical underpinnings, so theories from other areas such as economics, management are used to understand and explain some of the technical data, organisational processes and case studies. The key issues from the literature review are distilled and summarised at the end of the chapter.

This chapter is organised into the literature review process, the concerns over waste; the concept of sustainable waste management; organised recycling; constraints of organised recycling in developing countries; organised recycling strategies frameworks, technical options in organised recycling and a critique of Botswana’s national waste recycling strategy.

2.2 The literature review process

The process of literature review started by identifying literature sources and materials in the parent field of solid waste management as well as the immediate field of solid waste recycling. After identifying the literature sources, the literature review introduced and discussed developments in the parent discipline of solid waste management. The process narrowed down to critical examination of the immediate discipline of waste recycling to identify research questions not answered by previous research.
Several literature sources were identified both in the parent field and immediate field. In particular, the journals listed below were found to be very useful in providing published academic articles in both the parent and immediate disciplines. These journals included, but not exclusively;

- Warmer Bulletin
- Resources, Conservation and Recycling
- Journal of Environmental Management
- Journal of Solid Waste Technology and Management
- Waste Management and Research – publications of this journal were followed from its 1996 edition to the present.

The worldwide web pages of some international organisations provided useful country-specific data. Some of these web pages contained published academic papers and reports that can be downloaded free of charge. The web pages visited regularly included, but not exclusively;

- [http://www.wri.org](http://www.wri.org) - World Resources Foundation
- [http://www.unep.org](http://www.unep.org) - United Nations Environment Programme

However, caution must be exercised in using these information sources for country-specific data. Some of the information they contain is not up to date. It is always important to cross-check this information with local area data. In this study, most statistics relating to Gaborone and Botswana were obtained from the Government of Botswana’s web page at [http://www.gov.bw](http://www.gov.bw).

Other useful sources of information are solid waste management professional associations. These professional associations include among others, waste management associations and recycling forums. In this study, the web page of The Institute of Waste Management of Southern Africa ([http://www.iwmsa.co.za](http://www.iwmsa.co.za)) was a useful resource for information as well as establishing regional contacts.
The identified literature sources were managed by using ENDNOTE4.

2.3 Theoretical framework

Solid waste recycling has gained popularity as one of desirable options to achieve sustainable waste management in both developed and developing countries. A variety of approaches have been used to improve and/or increase the level of recycling. Some of the approaches are strategic in nature, while others are carried out on an ad hoc basis as a reaction to the situation on the ground. In developing countries, the emphasis of the research has been on supporting and improving recycling initiatives by the informal recycling sector (Lardinois and Furedy 1999; Kirai 2001).

The recent emergence of the concept of sustainable waste management (McDougall et al. 2001) has led to emphasis on a strategic approach to all aspects of waste management including recycling. The strategic approach enables waste managers and planners to set both short and long term goals. In developed countries, recycling strategies have mainly focused on increasing the level of recycling through municipal sponsored separate collection of recyclables (UNEP 2000). As a way of supporting this approach, In England and Wales, the Department of the Environment has set out some guidelines for municipalities to follow in preparing recycling strategies (DoE 1991). The key components of the guidelines include:

- Survey of local waste stream
- Identify markets for recyclables
- Assess collection and processing methods
- Determine equipment requirements
- Financial and economic appraisal
- Publicity/consultation and education
- Implementation.
Many municipalities in England and Wales closely follow this guidelines in formulating their recycling strategies (Roberts and Glynn 2003; GMWDA 1998). The strategies usually involve municipalities collecting recyclables through various technical options as discussed in section 2.8. This approach of municipally sponsored collection of recyclables relies on institutional competence and voluntary efforts of the general public in participating in source separation schemes. In addition, the approach usually requires additional funding over and above the existing waste management activities. The additional funding usually comes from municipal budgets, government grants and user fees (LBH 2002; Defra 2002).

Despite the differences in waste quantity and composition, socio-economic conditions and institutional competence, some municipalities in developing countries are adopting the recycling guidelines used in developed countries (BRC 1996; Noor 1996; Salaverria 2000). However, there is continuing debate on the appropriateness of municipal sponsored separate collection of recyclables in developing countries. The debate is usually centred around the varying of practical conditions on the ground. For example, UNEP (2000) argues that municipalities in developing countries may already be overburdened with duties of waste collection and disposal. In addition, there is recognition that municipalities in developing countries may not have the necessary resources and expertise to sponsor material recovery schemes (Noor 1996; GARNET 2000).

In recognition of these possible constraints, UNEP (2000) proposes recycling guidelines that could be appropriate for cities and towns in developing countries. The suggested framework, as shown in Table 2.1, places cities and towns in developing countries on a continuum according to their existing level of recycling. The emphasis of the guidelines as shown on the table is that because of the great variety among cities and towns in developing countries, recycling policies and strategies should depend on the existing
level of recycling. The main emphasis of Table 2.1 is that before developing a recycling strategy, municipalities must first establish the existing level of recycling by various stakeholders. Taking the existing of recycling into consideration, the municipality can establish specific policy emphasis more appropriate for their situation. Even though the guidelines proposes partnership with environmental and community organisations, the bulk of the responsibilities still remains with the municipal authority.

Table 2.1: Policy emphases for waste reduction by recycling level, developing countries

<table>
<thead>
<tr>
<th>Policies</th>
<th>Current recycling level of City/Town</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>1. Public education/information</td>
<td>●</td>
</tr>
<tr>
<td>2. Waste and recycling research</td>
<td>●</td>
</tr>
<tr>
<td>3. Support for source separation</td>
<td>●</td>
</tr>
<tr>
<td>4. Assistance for enterprises</td>
<td>●</td>
</tr>
<tr>
<td>5. Assistance to pickers, buyers</td>
<td>●</td>
</tr>
<tr>
<td>6. National waste reduction legislation</td>
<td>○</td>
</tr>
<tr>
<td>7. Recyclables export (if economical)</td>
<td>○</td>
</tr>
<tr>
<td>8. Promotion of innovative reuse</td>
<td>●</td>
</tr>
</tbody>
</table>

● emphasis ○ selective trial

Source: UNEP (2000)

Based on the theoretical understanding available, this research explores the following hypothesis, ‘Despite the projection of organised recycling as an effective means to enhance recycling, its practicality as a waste management strategy in developing countries is constrained by the realities on the ground’. The exploration is intended to contribute towards sustainable solid waste management through developing recycling guidelines that are practical in developing countries.
2.4 The concerns over waste

The word 'waste' refers to something that is 'no longer serving a purpose', something without value (Concise Oxford Dictionary). Waste can be classified into a multitude of schemes such as physical state (liquid, solid and gaseous); physical properties (compostable, combustible, recyclable), by origin (household, commercial, industrial etc.) or by safety level (hazardous, non-hazardous) (McDougall et al. 2001). Household and commercial wastes that are usually the responsibility of the municipalities for collection, transport and final disposal are often referred collectively as municipal solid waste (MSW). MSW solid waste is at the centre of most waste management activities mainly because it occurs in the immediate environs of the general public and has some high political profile. In addition, household waste is the hardest to manage effectively because of its heterogeneity (Waite 1995).

Municipal solid waste production continues to grow both in per capita and overall terms. For example, in 1997 waste production in Rio de Janeiro, Brazil was 8,042 tonnes/day from 6,200 tonnes/day in 1994 representing a 30 percent increase (The World Bank 1999). In the USA the production rate increased from 202 million tonnes in 1992 to 210 million tonnes in 1995 representing a 4 percent increase (Franklin Associates 1997). The growing volume of waste generated by the consumption inherent in city life is a formidable challenge to cities in developed and developing countries alike. For low-income cities, the main solid waste problem is how to extend collection services to the poor; often 50 percent of the population is without service (UNCHS 2001). Improving efficiency in these cities is key, because waste management often accounts for 30 to 50 percent of operational budgets, yet collects only 50 to 80 percent of the refuse generated (UNCHS 2001; WRI 1997). In middle-income and high-income cities, collection often reaches 95 to 100 percent of the population, but disposing of ever-greater quantities of waste emerges as the key challenge (WRI 1997). These concerns over waste have led concerted effort by researchers and practitioners alike to search for sustainable waste management solutions.
2.5 The concept of sustainable waste management

The concept of sustainable development is defined by the Brundtland Commission as 'development that meets the needs of the present without compromising the ability of future generation to meet their own (WCED 1987). The commission introduced the concept of 'more with less' – the need to produce more value from goods and services with less raw material and energy consumption, and less waste and emission production. The concept of sustainable waste management also calls for ‘more with less’ – more valuable products recovered from the waste with less energy and space consumption and less emissions (McDougall 2001). Concerns over the environmental impacts of waste production and the drive to conserve resources has led to the development and adoption of the international renowned waste management hierarchy as a sustainable waste management strategy. The waste management hierarchy is an ordered list of approaches to deal with MSW, which ranks the options according to their environmental acceptability, with waste reduction the most preferred and landfill disposal the least preferred (Pescod 1993; Barret and Lawlor 1997; Shah 2000).

Despite being generally acceptable, there is a school of thought that the rigid use of the hierarchy will not always lead to environmentally and economically sustainable systems (McDougall et al. 2001; Lave et al. 1999). With realisation that in order to achieve sustainable waste management, no single waste management option would be satisfactory, Integrated Solid Waste Management (ISWM) has emerged as a leading concept (Palmisano and Barlaz 1996; van Beukering et al. 1999; McDougall et al. 2001). The broader concept implies that decisions on waste handling should take into account, environmental, social, economic and institutional dimensions. The integrative aspect of this approach lies in the trade-off between the four dimensions (van Beukering 1999). A key component of both the waste management hierarchy and ISWM is solid waste recycling.
2.5.1 Solid waste recycling

Recycling refers to specifically separating a given waste material from the waste stream and processing it so that it may be used again as a raw material for products which may or may not be similar to the original (Rogoff and Williams 1994). There are two basic types of recycling: formal and informal. The key stakeholders in the two systems of recycling are shown in Figure 2.1. The figure shows that households, NGOs and the recycling industry are significant players in both forms of recycling.

![Diagram of key stakeholders in formal and informal recycling]

Figure 2.1: Key stakeholders in formal and informal recycling
Source: Adapted from Ali (1997) and GMWDA (1998)

Formal recycling is more common in developed countries while informal recycling is generally popular in developing countries. In informal recycling, separation of saleable materials takes place at household level, transfer stations and disposal areas, and the
separated materials go through a process of itinerant buyers, dealers, and wholesalers until they reach the recycling industry (Ali 1997; UNCHS 1994). Materials that are separated for recycling include glass, plastics, metals, paper (Ali 1997; Muttamara 1996). Informal recycling in developing countries had existed for a long time mainly because of economic and cultural reasons, but without much recognition from solid waste management authorities (Lardinois and Furedy 1999; UNCHS 2001).

However, the concept of sustainable waste management has led to a new outlook to informal activities of waste pickers. The recognition of the value of informal recycling activities to urban functioning and socio-economic well-being of waste pickers has led to efforts to integrate them in the urban formal economy (WRI 1997). Many of these efforts are driven by NGOs or Community-based organisations. Support for informal recycling initiatives takes different formats. For example, in Nairobi, the Mukuru Recycling Centre has been established through organising waste pickers into a Community-Based Organisation that earns a living from waste picking as well as improving urban waste management. The project partners include Habitat, recycling industry, Nairobi City Council and the national government (Kirai 2001). In Sao Paulo, NGOs assisted waste pickers to form co-operatives as a means of earning income. The co-operative members were able to earn a salary twice the minimum wage in Brazil (BRC 1996).

The emphasis on recycling as sustainable waste management strategy has represented a shift in paradigm from conventional collection and disposal. Source separation of materials before they enter the mixed waste stream is widely seen as enhancing recycling (Lardinois and Furedy 1999; Choon and Poon 1994; Dennison et al. 1992). In an effort to increase the level of recycling through source separation, many municipalities in developed countries have responded by setting up organised recycling schemes that require households to separate their waste prior to collection (Simmonite 1990; Dennison et al. 1992; DoE 1991). Development of organised recycling schemes has not gone unnoticed in developing countries. Some national governments, local authorities, and
NGOs in developing countries are embracing organised recycling as a viable strategy for sustainable waste management. For example, some local authorities in Indonesia, Brazil and The Philippines have engaged in organised recycling schemes to minimise the quantity of waste destined for disposal (Furedy 1993; BRC 1996; Lardinois and Furedy 1999; UNEP 2000; Salaverria 2002).

2.6 Organised recycling

Organised recycling refers to the practice whereby municipalities require waste generators to set aside post-consumer materials so that they do not enter the mixed waste stream but can be collected and delivered to the markets. This practice of setting aside materials at the source of generation, which precedes recycling, is known as source separation (Lardinois and Furedy 1999). The term 'organised recycling' is meant to distinguish it from customary source separation, which is more informal (Schenk and Baud 1994; van Beukering et al 1999). This section discusses the motivations of organised recycling and the associated legal and institutional frameworks.

2.6.1 Motivations for organised recycling

Several reasons are often advanced for participating in and/or promoting organised recycling in developed countries. The general consensus among professionals and researchers (see Listyanwan 1996; Muttamara 1996; White et al. 1995; Noehammer and Byer 1997) is that the overriding factors in promoting source separation are that it;

- Provides higher value cleaner materials to recyclers
- Reduces the total amount of waste that is disposed of

The arguments on reduction of the amount of waste to be disposed of are further augmented by The Economist (1991); van Beukering et al. (1999) and GARNET (2000) that in high income countries source separation for recycling is largely motivated by the high cost of disposal which is attributed to:
• The scarcity of land
• The unwillingness of the public to have landfills located in 'their backyard'
• Stringent regulatory standards of waste disposal such as the EC Landfill Directive in Europe
• Landfill tax in cases where they have it as in the United Kingdom

However, the motivations for organised recycling schemes in developing countries appears to be going through a transition period. The initial objectives of source separation schemes sponsored by NGOs were socio-economic and environmental, mainly focusing on improving income and working conditions for the poor through recovery of cleaner and more valuable materials for the recycling industry (Lardinois and Furedy 1999; GARNET 2000). In addition, individuals participated in source separation in recognition of waste as a resource rather than for its reduction before disposal (van Beukering et al. 1999; Schenk and Baud 1994; Lardinois and Furedy 1999). However, the objectives of municipal sponsored organised recycling schemes in developing countries are similar to that of establishing organised recycling in developed countries. The main objectives of municipal sponsored organised recycling schemes in developing countries are to improve waste management services by reducing the quantity of waste to be collected and disposed (BRC 1996; UNEP 2000; Salaverria 2002).

Whatever the objectives of organised recycling are, it appears they are not prioritised. Prioritisation of the objectives could enable municipalities to focus their efforts on aspects from which they will derive maximum benefit in their waste management activities. For example, municipalities that are facing landfill shortage are likely to focus on meeting diversion targets with little or no regard for cost. But for those areas where landfill space is not a constraint they can concentrate on developing a balance between cost and effectiveness in their recycling programme (Noehammer and Byer 1997). Setting the priority of objectives to be achieved by organised recycling could also clarify a number of issues pertaining to materials that must be targeted for recycling. For
example, diversion of materials of low degradability, as is the case now, will conserve landfill space, but at the same time continuation of the disposal of the inherently biodegradable component of waste will not minimise the environmental problems associated with landfill disposal (Westlake 1995).

2.6.2 Legislative and institutional frameworks

The legislative framework sets out the desired results that waste management services should achieve, establish enforceable standards as well as assigning responsibilities to the official institutions and other stakeholders. Failure of municipal solid waste management services in developing countries has often been attributed to weak and outdated institutional patterns as well as ineffective legislation (Jindal et al. 1997; van Beukering et al. 1999).

The institutional framework identifies institutions involved in waste management, their responsibilities and linkages. The linkages of institutions involved are critical for the establishment of potential partnerships between stakeholders. Jindal et al. (1997) argue that failure of waste management services in developing countries in Asia is usually due to fragmented management and institutional structure, with solid waste management activities being managed by more than one municipal department.

The existing legislative framework in developed countries is that national or state governments set up recycling targets, and the responsibility to achieve the set targets is assigned to municipalities (O'Brien 1992; Parkes and Proctor 1992; Hennepin County 2000). Municipalities respond to the set targets by organising source separation schemes for household waste (GMWDA 1998; ACWMA 2000). The participants in these source separation schemes are usually households.
Similar to developments in developed countries, the legislative framework in developing countries assigns the responsibility to recycle waste to municipal authorities through direct involvement or involvement of other stakeholders such as NGOs and private sector recyclers (RoP 2000; GoB 1998b). For example, The Ecological Solid Waste Management Act of 2000 in The Philippines requires inclusion of NGOs and recycling industry representatives in all waste management boards, whose principal objective is to promote recycling (RoP 2000). Municipalities in some developing countries have also responded to legislative requirements as well as other waste management problems by setting up household waste source separation schemes (BRC 1996; Salaverria 2002). The participants in these source separation schemes are usually households.

Experience in Pakistan, Brazil, Argentina, The Philippines and China show that NGOs could be pioneers and leaders in supporting and organising recycling in developing countries (Lardinois and Furedy 1999, Fung 2000). The successes of organised recycling schemes in these areas have been attributed to the role played by NGOs in carrying out public education programmes to promote recycling. In addition, some NGOs often facilitated establishment of source separation projects.

2.6.3 Summary

The key points from the above discussion are that:

- The motivation of municipal involvement in organising recycling schemes is to improve waste management through reduction of quantity of waste to be collected and disposed
- The key stakeholders in organised recycling schemes are municipal officials, NGOs and households
2.7 Constraints of organised recycling in developing countries

Despite the general embracement of organised recycling as sustainable waste management strategy, there are various arguments for and against its practicality in developing countries by waste management researchers and practitioners alike. The arguments cut across technical, socio-economic, post-consumer material markets and institutional issues. Some of the lessons that form the basis of such arguments have been learnt through working with the official authority and the informal sector in these countries. However, evaluation of some of the organised recycling schemes in developing countries such as Brazil, The Philippines, Malaysia and Indonesia is still at an early stage to make these arguments credible. But the preliminary investigation show mixed findings (Salaverria 2002, Furedy 1993, BRC 1996; Noor 1996). Furedy (1993) argue that these mixed findings could be a result of implementation of western models without a good knowledge of local conditions.

2.7.1 Waste quantity and composition issues

An understanding of waste quantity and composition is fundamental for planning and execution of organised recycling schemes. This understanding is motivated by the fact that the viability of recycling schemes is dependent on the availability of high volumes of recyclable material in order to take advantage of the economics of scale (Barrett and Lowler 1997, NZIER 1999). Apart from that, the quantity and composition of waste would give an indication of what materials when targeted for recycling would represent a significant diversion from disposal.

The quantity of the recyclable content of the waste stream is dependent upon the quantity and composition of the total waste stream. But the quantity and composition is influenced by a combination of factors prompting variation from one area to another. These factors include among others (Shah 2000, Huysman and Baud 1994):
• Socio-economic characteristics
• Degree of salvaging at source
• Technological changes
• Life style changes

A comparative analysis of typical waste quantity and composition between developing and developed countries is shown in Table 2.2. The table shows that the proportion of the inorganic content of paper, metal, glass, plastic and textile is relatively higher in developed countries. On the other hand, putrescible waste is relatively higher in developing countries. In addition, waste generation rates are generally below 0.60 kg/capita/day for developing and more than 1kg/capita/day in developed countries (Diaz et al. 1993; Palmer Development Group 1996; WRI 1997). The variation of waste quantity and composition between developing and developed countries brings into question the relevance and potential success of waste management strategies that work in developed countries to developing countries.

GARNET (2000) and UNEP (2000) argue that cities where waste generation rates are lower might not experience significant pressure on disposal facilities to prompt a shift in emphasis from efficient collection and disposal to recycling. Furthermore, municipalities that are not experiencing scarcity of disposal space, might not have much incentive to be concerned about recycling. These arguments are convincing, particularly where the main motive for organising recycling is to reduce the quantity of waste disposed. Apart from that, municipalities with lower population densities might have available land for disposal.
Table 2.2: Comparison of waste quantity and composition in developing and developed countries (percentage by wet weight)

<table>
<thead>
<tr>
<th>Material category</th>
<th>Shasha Settlement, Nigeria</th>
<th>Asuncion, Paraguay</th>
<th>Berkely, USA</th>
<th>Broward County, USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Putrescible</td>
<td>76.0</td>
<td>60.4</td>
<td>39.0</td>
<td>39.8</td>
</tr>
<tr>
<td>Paper</td>
<td>6.6</td>
<td>12.2</td>
<td>40.1</td>
<td>37.8</td>
</tr>
<tr>
<td>Metal</td>
<td>2.5</td>
<td>2.3</td>
<td>3.0</td>
<td>5.6</td>
</tr>
<tr>
<td>Glass</td>
<td>0.6</td>
<td>4.6</td>
<td>7.6</td>
<td>6.7</td>
</tr>
<tr>
<td>Plastic/rubber/latex</td>
<td>4.0</td>
<td>4.4</td>
<td>6.3</td>
<td>9.0</td>
</tr>
<tr>
<td>Textile</td>
<td>1.4</td>
<td>2.5</td>
<td>1.7</td>
<td>-</td>
</tr>
<tr>
<td>Generation rate</td>
<td>0.17</td>
<td>0.62</td>
<td>1.36</td>
<td>1.67</td>
</tr>
</tbody>
</table>

Source: Diaz et al. (1993)

Furedy (1993) argues that reduction of waste volumes by magnitude of about 10 percent if separation is extended may not be significant to authorities that are already unable to effectively deal with several hundred tonnes of waste daily. This argument is convincing but raises another issue of: what would represent a significant diversion rate? This is likely to vary from one municipality to another. A cost-benefit analysis of the different waste management options could assist in establishing the optimum scenario.

It is also argued that in many cases, source separation sponsored by municipalities will not necessarily reduce the amounts of waste that must be disposed by the authorities (UNEP 2000; Jindal et al. 1997; Furedy 1993). The rationale behind this argument is that most valuable recyclables are already removed from the municipal waste stream by generators, through private and/or informal systems of waste trading and recycling. In such cases, the solid waste departments will not be able to recoup the high cost of separate collection of recyclables by selling the residual materials that are not sold by the waste pickers, generators and private entrepreneurs. Failure to recoup the money invested in organised recycling schemes can further strain municipal solid waste management budgets (Gotoh 1989; Jindal et al. 1997). Even though, this argument sounds convincing, it is not clear if the limiting factor to recouping the money invested could be solely attributed to the existing recycling ventures or there are other contributing factors such as quantity of inorganic waste and/or market for recyclables. Apart from that, it appears
there is no established methodology of establishing the quantity of waste diverted by informal systems. The reported case studies show mixed results. For example:

- Even where local recovery networks have declined, municipalities that collect materials for recycling have not been able to recover costs, as discovered in parts of Sao Paulo and Rio de Janeiro (UNEP 2000).
- A recycling venture in the Durban Metropolitan Area known as ‘Greensavers’ was stopped at the end of 1994 as Durban Solid Waste found that the waste stream was only being reduced by 1 percent to 2 percent and the operating company, Mondi was finding the venture not economically viable (Palmer Development Group 1996).
- It is reported that waste separated by collection workers and dumpsite scavengers in Petaling Jaya Municipality, Malaysia represented about 6 percent of diversion from disposal (Hassan et al. 2000; Malek et al. 1994)
- A source separation scheme operated by Petaling Jaya Municipality was diverting about 1.5 percent of municipal waste in 1994 (Noor 1996).
- It is reported that a source separation scheme operated by the Municipality of Surabaya, Indonesia diverted 23.13 percent of the total waste stream of both wet and dry waste, but 10.8 percent when only the dry recyclables were taken into consideration (UNCRD 1999).
- An organised recycling scheme operated by Metro Manila Development Authority was expected to divert 60 percent of municipal of municipal waste from disposal; however, the scheme was reported to have managed to divert only 14 percent at a considerable cost (Salaverria 2000).
- There are indications that producer initiated recovery rates are achieving relatively high diversion rates for the materials they are targeting. For example; Brazil and South Africa respectively are reported to be recovering 80 percent and 63 percent of beverage metal cans through buy schemes established by the packaging industry (Astor 2000; Nampak 1999).
Despite the effort to improve the quality of recyclables through source separation schemes, the more heterogeneous household waste continues to be the predominant target by such schemes in both developed and developing countries as opposed to the more homogeneous commercial waste (O'Brien 1992; UNCHS 1994; Noor 1996; Corbitt 1998). This persistence is a result of seeing separate collection of recyclables from households as ensuring the highest recovery of clean recyclables as well as representing a higher diversion from disposal, since household waste constitutes a larger proportion of the municipal waste stream (UNCHS 1994; UNCRD 1999; DoE 1991).

The existing challenge is to know what materials in the waste stream are capable of being recycled and how much of these materials are there. But how much of the municipal waste stream is recyclable? This is not an easy question to answer: for instance an environmental idealist might say all solid waste is recyclable, but this is essentially not true (Cerrato 2001). In practice not all materials can be recycled for a number of reasons (Waite 1995):

- Some material is too contaminated, in particular by food waste;
- Some materials exist as mixed products, for example composite packaging, and therefore cannot be recycled as individual materials;
- Some items are physically too small to be economically separated at a sorting plant;
- Even though the materials can be separated, there is no available market for it.

However, the extent to which different fractions of household waste can be recycled depends to a large extent on their degree of contamination. Jindal et al. (1997) are of the view that organised recovery of municipal waste in developing countries is limited by that the quality of the useful materials recovered from waste is heavily contaminated. This argument would be particularly valid if recovery takes place at disposal sites. In addition, because of the high organic content in the waste stream, contamination of the inorganic components might be high. However, recovery at the source of generation through organised recycling schemes is intended to improve the quality of recyclables.
This means that getting source separation correct is an essential feature of minimising contamination and thereby increasing the proportion of waste that could be recycled.

In the UK, work carried out at Warren Spring Laboratory give indicative results of the proportion of household waste that can potentially be recycled after taking contamination into consideration (Atkinson and New 1993). The model results are based on practical source separation schemes. Atkinson and New (1993) estimated that taking into consideration the effects of contamination, 62 percent of household waste in the UK is potentially recyclable. These estimates are shown in Table 2.3.

Table 2.3 also serves to highlight the difficulty of trying to estimate the quantity of potentially recyclable materials, because it does not consider other parameters that make the materials recyclables. For example, the model does not take into consideration the availability of markets for the 'clean' materials. The model also assumes total participation by householders, although results from source separation schemes suggest that 50 percent and 75 percent is more realistic (Atkinson and New 1993; Dennison et al. 1992). Taking public participation and markets into consideration could further reduce the proportion of waste available for recycling. Even though the model shown in Table 2.3 may vary from one area to another, it serves as a good indicator because it is based on practical source separation schemes.
Table 2.3: The recyclable content of household waste in UK

<table>
<thead>
<tr>
<th>Material</th>
<th>Percentage by weight (A)</th>
<th>Clean material as a percentage of (A)</th>
<th>Clean material as a percentage of total waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper and board</td>
<td>33.2</td>
<td>60.0</td>
<td>19.9</td>
</tr>
<tr>
<td>Plastic film</td>
<td>5.3</td>
<td>60.0</td>
<td>3.2</td>
</tr>
<tr>
<td>Dense plastic</td>
<td>5.9</td>
<td>70.0</td>
<td>4.1</td>
</tr>
<tr>
<td>Glass</td>
<td>9.3</td>
<td>90.0</td>
<td>8.4</td>
</tr>
<tr>
<td>Ferrous metal</td>
<td>5.7</td>
<td>80.0</td>
<td>4.6</td>
</tr>
<tr>
<td>Aluminium</td>
<td>1.6</td>
<td>70.0</td>
<td>1.1</td>
</tr>
<tr>
<td>Textiles</td>
<td>2.1</td>
<td>50.0</td>
<td>1.1</td>
</tr>
<tr>
<td>Dry recyclables sub-total</td>
<td>63.1</td>
<td></td>
<td>42.4</td>
</tr>
<tr>
<td>Putrescibles and other</td>
<td>36.9</td>
<td></td>
<td>20.2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>100.0</strong></td>
<td></td>
<td><strong>62.2</strong></td>
</tr>
</tbody>
</table>


There has been no systematic sampling of commercial waste (Corbitt 1998), which makes it difficult to know the quantity of recyclable waste in this stream. If we use contamination as the main criteria for establishing the recyclable content of the waste stream, then for the relatively homogeneous commercial waste a large proportion of it could potentially be recyclable. In the Life Cycle Inventory Model (IWM-2), McDougall et al. (2001) assume that 100 percent of commercial waste is potentially recyclable with 8 percent of it being potentially lost at Material Recovery Facilities (MRFs). However, this assumption is problematic because, as with household waste, some commercial waste consists of composite packaging and may be contaminated by food waste, particularly from grocery stores, hotels and restaurants. Even though it might be a conservative estimate, it appears the model for estimating the recyclable content of household waste might be applicable for commercial waste, particularly where the commercial sector is dominated by grocery stores, restaurants hotels.

It can be concluded that the quantity and quality of recyclables in the waste stream influences the amount of waste that could be diverted from disposal by organised recycling schemes. On the basis of data reported from case studies in developing countries, the results of diversion rates that could be achieved by organised recycling schemes over and above the existing formal and informal recovery schemes are not
conclusive. Apart from that, the proportion of waste that is diverted by informal systems is also not clear. There are some clear indications that formal producer responsibility initiatives that offer incentives to waste generators such as deposit refund schemes, achieve high diversion rates for the materials they target. However, it appears lower diversion rates from disposal could be a disincentive for municipalities in developing countries to organise recycling schemes.

2.7.2 Municipal issues

There is a general concern that solid waste departments in developing countries are already overburdened with responsibilities coupled with restrained budgets to be able to cope with an added responsibility of organising recycling. UNCHS (1994) argue that waste management authorities in developing countries have other burning priorities in waste management, which might work against their involvement in organised recycling. Such priorities include extending collection coverage and providing sanitary disposal facilities. In support of this argument, GARNET (2000) argue that municipalities in developing countries usually do not have the capability to adopt policies for separate collection of recyclables or mount expensive educational campaigns. This argument is convincing because collection and marketing of recyclables demands financial and human resources which some municipalities in developing countries may not have. However, the argument is not supported by any comprehensive study but is based on insinuations from various international reports.

There is also a general concern that there is limited practical knowledge in organising recycling schemes by municipal officials in developing countries. For example;

- In reporting the results of an organised recycling scheme in Malaysia, Noor (1996) concluded that improving recycling in Malaysia is restricted because local authorities officials do not have sufficient and practical knowledge related to organised recycling schemes.
• Gotoh (1989) and Jindal et al. (1997) argue that municipalities in Asian countries fail to recognise the importance of organised recycling because they believe that source separation programmes are impractical for large cities with populations of more than a million.

• In arguing for social considerations in solid waste management in Asian countries, Furedy (1989) opines that experiences in these countries do not yet provide clear success stories of waste recovery because organised recycling schemes require municipalities to undertake functions in which they have no experience.

These arguments about lack of practical knowledge about organised recycling schemes are probably true but concerning. The truth of this arguments lies in that organised recycling is a new and evolving concept, and like any other technology new practitioners must be trained on it. The concern for lack of practical knowledge lies in that it could lead to design and implementation of inefficient organised recycling schemes that would eventually fail. For example, Scheinberg (1999) observed that due to limited knowledge and practical understanding, recycling in Central and Eastern Europe has been poorly conceived and had often shown miserable results. Importing and dropping recycling banks in housing estates without even changing labels to the local language demonstrated this. This led to lower participation rates, insignificant revenues and ultimate closure of the projects. In addition, pilot source separation schemes had often been based on small samples over periods too short to enable proper evaluation of real performance parameters.

There are arguments that municipal officials in municipalities experiencing low financial resources are more inclined to support the maintenance of the status quo and not engage and support waste management reforms. For example;

• Gotoh (1989) and Furedy (1993) reported that there was reluctance by municipalities to work in partnership with the informal sector engaged in solid waste recycling. The authorities consider that the activities of waste pickers spread litter, create an odour
nuisance and interfere with their operations and therefore believe that the informal sector should be discouraged. This is supported by a study in Karachi by Ali (1997) that there was an inclination by municipal officials to support the status quo, which in itself is a major constraint to development of new initiatives such as organised recycling. Municipal officials felt that they were not in a position to initiate recycling activities that involved the informal sector, but felt such steps should be undertaken by NGOs.

- Scheinberg (1999) argues that the attitude of public officials in Central and Eastern Europe to maintain the status quo was the main barrier to waste related reforms. The mindset of public officials was that nothing could be accomplished in modification of waste management behaviour because of lack of resources. This attitude was demonstrated by poorly designed pilot projects that often conveyed negative information about source separation.

The inclination of municipal officials to maintain the status quo and lack of practical knowledge is further demonstrated by organised recycling projects that failed due to lack of official support. Furedy (1990) documented cases of organised recycling initiatives that failed as a result of lack of official support. For example;

- Bandung's Ecovilles, a project pioneered by the Centre for Environmental Studies (PPHL) of the Bandung Institute of Technology aimed to establish cooperatives for sorting recyclables and composting organic materials in their settlements, leaving residual materials for picking by municipal staff. The centre was not able to initiate this experiment in Bandung since the municipality was not persuaded of its practicality.

- Waste Processing Zones, Jakarta, a project proposed by PPHL aimed to encourage waste pickers to collectively rent a space to which they will bring their gathered materials for sorting, processing and trading. The project failed due to lack of official support.
The reluctance of municipalities in developing countries to embrace waste management reforms is understandable because most reforms could have resource implications. Apart from that, municipal officials are human and are bound to have the fear of the unknown. It might be difficult for them to change their engrained waste management habits without continuous training.

It can be concluded that despite the legal authorisation of municipalities to organise recycling schemes, there are reservations on the appropriateness of such developments in developing countries. These reservations emanate from the inability of municipalities in developing countries to embrace waste management reforms as result of the perceived or actual resource constraints. There are also indications that municipal officials are more inclined to preserve the traditional role of the local authority of waste collection and disposal, which they are more familiar with. However, the reported inability of municipal officials to embrace waste management reforms has mainly been focused on their failure to work in partnership with the informal sector in recycling. But the current form of municipal involvement of recycling required by legislation and undertaken by some municipalities is of a different nature. Municipal officials are expected to be pioneers and leaders in recycling. Against this background, it is important to thoroughly understand the perception and attitudes of municipal officials as key stakeholders in planning and implementation of organised recycling schemes.

2.7.3 Public support issues

Public participation is considered the touchstone for the success of organised recycling schemes. Households are usually expected to participate in source separation schemes and do the separation correctly according to the required components (Dennison et al. 1992; Chung and Poon 1999). Opponents of organised recycling schemes in developing countries are of the view that they may lack wider public support (UNCHS 1994; UNEP 2000; Noor 1996). Public support for source separation is often related to factors such as
awareness of recycling, participation and willingness to participate in recycling, public attitudes to recycling, availability and convenience of the recycling system and motivational aspects (UNCHS 1994; Noor 1996).

UNCHS (1994) is of the opinion that lack of public participation in source separation schemes is likely to work against establishment of organised recycling schemes. The rationale behind this argument is that while the low-income groups may not be willing to participate in something that gives them no direct monetary benefits, the middle and high-income groups may consider waste separation to be below an acceptable level of social dignity. This argument is based on the understanding that the low-income households are already source separating valuable materials to earn a living.

Studies on household support for source separation schemes in developing countries are few and far between. Chung and Poon (1999) found that in Guangzhou, China, the majority of people (84 percent) were willing to participate in voluntary source separation of household waste schemes. It was also found that the majority of people were willing to separate materials that are easy to separate such as paper, metal cans and rigid plastic. Noor (1996) found that the majority of general public (83 percent) in Petaling Jaya, Malaysia were willing to participate in voluntary source separation schemes that involved kerbside collection of recyclables. El- Hawi (2002) found that only 32 percent of households in Gaza Strip were willing to participate in source separation schemes. In India, it is reported that the majority of people (70 percent) were against source separation of household waste because they considered it inconvenient, time consuming and dirty (Anschütz, 1996). Even though some of the studies are not based on statistically designed surveys, the general results pertaining to public support for source separation schemes are equivocal.

A summary of results of studies in Petaling Jaya and Guangzhou as shown in Table 2.4 indicates that above 80 percent of the general public are willing to participate in source
separation schemes. It is however not clear how willingness to participate compares with actual participation. The results of the two studies listed in Table 2.4 were carried out before the establishment of source separation schemes. It is possible that the high willingness to participate in source separation schemes could be a result of that the general public did not have first hand experience of source separation and its practical implications.

Chung and Poon (1994) concluded that with 31 percent of Hong Kong citizens already source separating their waste in the absence of a convenient recycling network compared with 76.7 percent of them willing to participate in source separation schemes, it was reasonable to assume that actual participation would be more than 30 percent. This may not be necessarily true. Possibly, the best way to test if people’s willingness to participate in source separation schemes represents actual behaviour would be to introduce pilot source separation schemes.

Willingness to participate also varies with materials fractions. It has been found that similar to the case of informal recycling activities, the majority of households are willing to separate glass bottles, metal cans, paper and plastic bottles (Chung and Poon 1994; Chung and Poon 1999). This is understandable because these materials are easy to separate.

Table 2.4: Comparison of willingness to participate in source separation schemes from different studies

<table>
<thead>
<tr>
<th>Sources</th>
<th>Place and year of survey</th>
<th>Sample size</th>
<th>Target population</th>
<th>% Willingness to participate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noor (1996)</td>
<td>Petaling Jaya, Malaysia, 1990</td>
<td>Not indicated</td>
<td>General public</td>
<td>82.9</td>
</tr>
</tbody>
</table>
Despite the high willingness of the general public to participate in source separation schemes in some areas, there are indications that participation could be affected by a variety of factors. For example, low separation rate achieved in an organised source separation scheme in Malaysia was reported to have been due to ingrained social habits that working with waste was socially demeaning (Noor 1996). A 'bring' scheme, designed to collect glass in Gaborone through some 21 bottle banks placed at strategic points including schools was not successful. The lack of success for the scheme was attributed to lack of public interest (GoB 1998c). Lack of public interest is understandable because source separation requires a change in behaviour. The change in behaviour may not happen overnight and could be affected by a variety of factors including literacy.

In order to change the ingrained social habits and develop public interest, proponents of organised recycling schemes have identified public education as key. For example, the success of a source separation scheme in Petaling Jaya Municipality has been attributed in part to an aggressive public education (Noor 1996). Rabinovitch (1992) reported on the success of a source separation programme in Curitiba Metropolitan Area, Brazil. The programme encourages city residents to separate organic and inorganic garbage for recycling and collection. Over 70 percent of the community participate in the programme and its success is largely attributed to a city-wide environmental education programme, which highlights the benefits of recycling.

Even though the success of the above source separation schemes has been attributed largely to public education, there are indications that there are other factors that would enhance participation along side public awareness. These other factors include accessible recycling centres and incentives. For example;
• Noor (1996) found that in Petaling Jaya Municipality, the absence of any obvious and direct benefits to residents, and unfamiliarity with correct separation procedures often resulted in poor response by residents.

• The results of a study conducted in Durban found that provision of accessible collection centres, as well as information and education programmes helped the general public to participate in recycling (Waste Response 1999).

• A study in Malaysia found that people maintained ‘throw-away’ habits because there were no recycling programmes in their area, and there were no obvious and direct benefits to residents (Noor 1996).

• An evaluation of Mexican projects showed that economic benefits had more influence on source separation behaviour than environmental education. For example, economic benefits were found to influence source separation behaviour, compared to environmental education, which accounted for 10 to 30 percent of change in user habits (Anschutz 1996).

• Due to economic reforms in China, prices of some raw materials decreased, which led to a considerable decline in the number of waste purchasing shops and eliminated demand for some secondary materials in Beijing. The reduced demand for some materials meant a decrease in economic incentives to waste sellers. People began to feel it to be burdensome to recover materials that did not have a direct economic gain and started discarding them (Yang 1989).

• Chung and Poon (1994) and Chung and Poon (1999) found that generally people were willing to separate materials that had known markets and financial incentives.

It appears that even though public education is central in getting the general public to appreciate recycling and its potential benefits, it would not necessarily get them to participate in recycling initiatives. However, simultaneous approach of raising public awareness, provision of visible recycling systems and direct incentives appear more likely to realise participation in recycling.
UNCHS (1994) argue that obvious constraints to realisation of full benefits of recycling in developing countries are:

- Lack of incentives to households to separate recyclables
- Lack of disincentives to discourage those who generate large amounts of waste

This argument is convincing if incentives were expected to come from municipalities because; firstly municipalities in developing countries would probably have limited financial resources to enable provision of incentives to individual households to promote recycling. Secondly, the price of solid waste services is mostly not based on marginal cost pricing principles but rather on flat rate taxes (UNCHS 1994; Kgathi and Bolaane 2001). However, incentives from some of the recovery schemes such as buy back and deposit refund schemes often come from the private sector (Astor 2000, Nampak 1999; GoB 1998c).

It can be concluded that households are key to the success of source separation schemes. However, the willingness of households to participate in source separation schemes is equivocal. This has been attributed to lack of public awareness. This has led to a concerted effort towards getting them to participate in recycling through public awareness campaigns. However, it appears public awareness on its own is not enough to encourage the public to recycle. Success of source separation schemes seems to lie between creating public awareness and translating it into participation. It is therefore important to investigate and reaffirm relationships between awareness and other parameters that may encourage participation and willingness to participate in recycling.

2.7.4 NGO issues

Most of the documented recycling cases involve NGOs initiating, supporting and sponsoring community recycling initiatives (Lardinois and Furedy 1999; Jindal et al. 1997; Fung 2000).
• EXNORA has been promoting the concept of source separation as a means towards Zero Waste Management (GARNET 2000). The main objective of the EXNORA’s initiative is to reduce the quantity of waste that has to be handled by municipal corporations as well as improve the working condition of waste pickers.

• UNEP (2000) reported that NGOs active in municipal solid waste management train waste handlers from the informal sector in the safe handling of municipal solid waste for pre-collection, sorting for recycling, and composting. For example, The Cape Recycling Network of South Africa is involved in training and awareness of community organisations.

• In Brazil, NGOs such as Fraternal Assistance Organisation (OAF) have been central to training waste pickers to form recycling cooperatives (BRC 1996).

• Fung (2000) reported that the success of organised recycling schemes in Beijing was partly attributed to public education programmes to promote recycling carried out by the local NGO.

• Anschutz (1996) opines that NGOs usually set up community-based solid waste management initiatives as development projects with their role mainly limited to training, financial assistance and other technical support.

• The Ecological Waste Act of 2000 of the Philippines recognises NGOs as stakeholders in organised recycling, with their main role being to raise public awareness on recycling (RoP 2000).

NGOs are involved in variety of roles in waste management in developing countries. In particular they have the ability and experience to work with Community Based Organisations (CBOs) to raise environmental awareness and improve working conditions for waste pickers. However, official authorities seem to appreciate and value their ability to carry out public education programmes. It is however not clear if such NGOs are resigned to the role envisaged by local authorities or have the requisite knowledge to carry out practical source separation projects with local authorities. The awareness,
practical knowledge and attitude to source separation by NGOs might be critical to the success of organised recycling programmes. An evaluation of these parameters could enable a proper evaluation of possible partnerships between NGOs and official authorities in organising recycling schemes.

2.7.5 Socio-economic issues

UNEP (2000) argues that an additional impediment to municipally sponsored materials recovery arises from the fact that many individuals and small enterprises in developing countries make a living by recovering and trading recyclables. If source separated materials were set out for collection, it is highly likely that these would be stolen before the municipality could claim them. This is reported to have already occurred in pilot schemes in both developed and developing countries. The issue of theft may not be entirely correct in other settings because it assumes that the materials separated would be placed in open places for easy access. But the reality is that the materials separated could be let out only on the day of collection.

There are also arguments that municipal sponsored organised recovery schemes in developing countries would have socio-economic implications of reducing jobs provided by waste recovery and waste trading by transferring these to the public sector (Furedy 1993; van Beukering et al. 1999; GARNET 2000). This is envisaged to deprive waste pickers of their livelihood. This argument is convincing. Experience in South Africa shows that each waste picker can earn between R30 and R50 per day by selling materials to buy back centres (Waste Response 1999). In Brazil, it is reported that recycling cooperatives that were made up of waste pickers increased their income by 50 percent (BRC 1996).

The weakness of these arguments lies in that they assume that every developing country has an established waste-picking network and there are available markets for the
recyclables. However, UNEP (2000) established that informal systems have shrunk and/or have never been widespread in some African countries as well as in some parts of Brazil.

It can be concluded that some of the social-economic concerns of organised recycling schemes may be genuine where there is extensive dependence on recyclables for livelihood. However, such socio-economic impacts may vary from one area to another and may warrant area specific detailed investigations.

2.7.6 Waste collection and disposal costs issues

UNEP (2000) argues that in many developed countries, source separation programmes are heavily subsidised by municipal governments, private industries and foundations. The likely scenario is that when municipal funding is withdrawn, the scope of materials recovered may be greatly reduced. Provision of subsidies could be a problem to many governments and municipalities in developing countries that may not have the necessary financial resources. The argument of cost as a deterrent to municipal involvement in organised recycling is convincing because municipalities in developing countries are reported to be operating under limited funds (UNEP 2000; UNCHS 1994). Moreover, a large proportion of municipal waste management budgets are spent on collection and disposal, which themselves are not carried out in an effective manner.

Schertenleib and Meyer (1992) argue that relatively low disposal costs could provide little economic incentives for municipalities to reduce the volume of municipal solid waste by recycling. This argument is convincing since organised recycling scheme have been found to be more expensive than conventional disposal (Dennison et al. 1992; BRC 1996; Barret and Lawlor 1997; Lave et al. 1999; GARNET 2000). The collection costs of a source separation scheme in Sao Paulo were estimated at $400 per ton while that of regular waste collection was estimated at $25 per ton (BRC 1996). The relative difference
in cost between disposal and organised recycling schemes would even be higher where disposal options are dominated by open dumping, as is the case in some developing countries (UNCHS 1994; The World Bank 1999).

Some of the reported successful recycling ventures in developing countries have been attributed to their low cost of operation as a result of low wages and external support. For example Palmer Development Group (1996) reported on the following recycling ventures in South Africa that owe their success largely to low cost of operation;

- One successful venture has been established in Alexandra where a company called the South African National Can Recycling created employment for 48 people. The success of the venture was largely attributed to two key factors: low wages paid to workers and external support in terms of resources such as a truck donated by Collect-A-Can for collection and delivery of recyclables.

- Schools around the country have been involved in recycling activities. The activities are coordinated by regional affiliates of Keep South Africa Beautiful. These ventures were successful because wage costs are minimal and they are generally conducted for educational and fundraising purposes.

It can be concluded that even though the relative costs of disposal and organised recycling are likely to differ from one area to another, the general trend is that the cost for latter are relatively high. The relatively high cost of organised recycling schemes is likely to be a disincentive for municipal involvement in developing countries. But because of the variation of waste management conditions in different countries, it is important that each municipality must carry a proper analysis of these costs before embarking on organised recycling.
2.7.7 Post-consumer material markets

The importance of viable markets for the sale of recyclable materials that are recovered through organised recycling schemes cannot be overemphasised. The continued participation of waste generators in source separation schemes and the performance of the entire recycling sector will depend largely on the availability of a steady and reliable market for recyclables (UNCHS 1994; Noor 1996). For example, if the objective of the recycling scheme is to divert material from landfill disposal, materials that are diverted must have sustainable markets (Rogoff and Williams 1994; Waite 1995; LDEQ 1999).

By using demand and supply curves, Rogoff and Williams (1994) argue that the demand for recyclables by end-user markets is relatively inelastic. They further argue that legislation that establishes recycling goals may lead to dramatic increases in supply of recyclable material available to an industry, which may not have the production capacity to utilise such materials. This could lead to a dramatic decrease in prices paid for recyclables, resulting in the disposal of surplus recovered materials. This effect was demonstrated in Europe with the introduction of new laws in Germany that forced producers to take back their packaging paper resulting supply surpassing the available local capacity. The increased recovery of paper in Germany lead to a decline in price of paper, and almost a collapse of the waste recovery sector in the region (van Beukering and Curlee 1998). In addition the supply of recyclables to end-users is extremely elastic because it is relatively easy and inexpensive to get into the supply side of the recycling business (Rogoff and Williams 1994).

Palmer Development Group (1996) documented the following recycling ventures in South Africa that failed due to lack of markets for secondary materials.

- A recycling plant built at Kya Sands Disposal Site as a joint venture between Randburg Municipality and the private sector with an investment of over R9 million was forced to close down. The plant was not financially viable essentially due to the lack of a sustainable market.
• A recycling plant of the same scale as the Randburg plant was built at the Robinson Deep Disposal Site. It closed down because of the lack of a sustainable market for recyclables.

• A Soweto community based recycling company known as the Green Team has been forced to change focus of activities to conventional waste collection as it has not been able to find a sustainable market for its recyclables.

However, the reported market failures in South Africa are not material specific. There are indications that demand varies between different material fractions. For example, the current market favours strong demand materials such as glass and metal cans (The Economist 1991; Waite 1995). The variability of market demand with material fraction would therefore warrant a thorough assessment of post-consumer markets before a wholesale recovery of material fractions. This could mean that recovery of materials should first and foremost focus on materials that have established markets.

Market development for secondary materials in developing countries could be undermined by a variety of factors. Some of the key issues that are reported to be undermining market development include:

• Lack of reliable supply of post-consumer materials

van Beukering (1994) found that paper and plastic recyclers in Bangalore were operating below capacity as a result of lack of input. In addition, a plastic recycling industry in Sri Lanka closed down because of lack of regular supply of post-consumer plastic that often resulted in loss of production (GARNET 2000). Lack of reliable supply is attributed to:

  o Low volume of recyclables. Kohrs (1996) found that development of recycling plants in Namibia was not feasible because of low volumes of recyclable materials available. This has led to the recycling industry being dominated by the collectors and processors who recover glass and metal cans for export to South Africa.
Inefficient collection. van Beukering (1997) found that inefficient collection of recyclables in developing countries resulted in unreliable supply to the recycling industry, often leading to failure of the reprocessing industry.

Variable incentives for different materials. Jindal et al. (1997) reported that in Asian cities waste pickers usually get very little money for the low grade plastic they pick from disposal sites, hence they prefer picking other materials that attract more monetary value such as hard plastic.

The lack of reliable supply as a result of low volume of recyclables is convincing because the large proportion of waste is putrescible. It is however not clear what causes inefficient collection because most developing countries are reported to be having extensive collection networks.

- Competition

Competition for limited materials could affect the ability of some recyclers to realise economies of scale. This was experienced in developed countries like New Zealand when establishment of material recovery schemes by municipalities competed with private recycling initiatives and undermined their ability to realise the economies of scale (NZIER 1999). A glass recycling company in Sri Lanka that operated by issuing loans to the poor to collect post-consumer glass collapsed because they were unable to collect sufficient quantities to pay off their loans (GARNET 2000). In addition, competition from large established industrial developments in India was found to limit development of recycling industry in Nepal (van Beukering and Badrinath 1995). For example, a glass recycling industry in Nepal closed down because of competition from large-scale recyclers of glass in India in the recycled glass market. This has led to stoppage of collection of cullet in Nepal (van Beukering and Badrinath 1995).

Furedy (1990) documented a case study of organised recycling activity that failed partly because of competition. Manila’s Eco-Centres, a pilot project under the Department of
Human Settlements in the late 1970s, aimed to promote waste collection at source and give collectors the opportunity for better earnings by bypassing the middlemen. Thirty such eco-centres were set up and traded materials to a single recycling corporation. The project ran into financial, management and marketing reclaimed waste difficulties. Reasons for failure were attributed to competition with the informal waste recovery sector as well as resistance of the middlemen who lost their profit making due to the scheme.

NZIER (1999) also argue that international competition could limit the ability of collectors and processors to manipulate prices in the local market in cases where they have to purchase post-consumer materials from their sources.

Competition for secondary materials appears to be having both positive and negative effects. On the positive side, it can ensure recovery of most of the materials generated while on the negative side, it can undermine the ability of recyclers to realise the economies of scale and lead to their collapse.

Other factors that have been found to be limiting the development of post-consumer materials in developing countries include;

- Low demand for recycled products: van Beukering and Badrinath (1995) found that the development of recycling industry in Nepal was restricted by low demand for locally recycled products as a result of cheaper products from India.
- Lack of incentives: UNEP (1994) argue that the inability of authorities in developing countries to offer incentives to recyclers tend to constrain the development of secondary material markets.
- Transportation costs: Transportation costs have been found to be limiting development of recycling in both developed and developing countries. In New Zealand transportation costs were found to be limiting the export of high volume low value post-consumer materials from South Island to North Island where there was a
high concentration of recycling industries (NZIER 1999). In addition, transportation costs were also found to be limiting recovery of low volume materials in Namibia for recycling in South Africa (Kohrs 1996).

Market creation and development for post-consumer materials in developing countries have largely been driven by the private sector either for profit making or as producer-initiated schemes. This has resulted in variable demand for different materials. UNCHS (1994) argue that in developing countries the demand driven nature of recyclable waste, because of the surplus labour, gives industries, particularly the larger ones, an upper hand in determining prices and being selective in recycling the waste in terms of quality and quantity. This has led to lower prices for certain recyclables and limited demand for some. For example, van Beukering and Badrinath (1995) reported that the experience in Nepal showed that there was intensive competition and increased entry on the supply side in recovery of materials that were profitable and had established end-user markets such as LPDE, PVC, paper and non-ferrous metals. However, a glass recycling company closed its operations because it was not profitable. This has led to stoppage of glass collection.

Experience in South Africa and Brazil showed that producer responsibility initiatives such as deposit refund schemes and buy back schemes created substantial markets for the specific material fractions they targeted. For example, non-profit association founded by multinational companies and major Brazilian corporations to promote recycling set up a recycling co-operative that collected recyclables equivalent to half the amount collected by the entire official Sao Paulo city recycling programme but at a much lower cost (BRC 1996). In South Africa, the Collect-A-Can initiative increased collection of metal cans from 18 percent in 1993 to 63 percent in 1998 (Nampak 1999). However, deposit-refund schemes are often criticised for creating markets and achieving high diversion rates for a relatively smaller proportion of the total waste stream at relatively high costs for the operators (DoE 1992; NZIER 1999; NSDA 2000).
It can be concluded that post-consumer material markets are mainly driven by economic motives of the private sector. Because of this, the demand for post-consumer materials varies between different material fractions. There are also reported market failures primarily related to imbalances between supply and demand of post-consumer material markets. However, parameters that lead to imbalance between supply and demand are not very clear. Before embarking on organised recycling schemes, it is important to clearly understand these parameters as well as the nature and capacity of post-consumer markets available to absorb materials to be recovered by the schemes.

2.7.8 Summary

The above discussion indicates that the key fundamental blocks to the success of organised recycling schemes are related to: quantity and quality of recyclables in the waste stream; perception and attitudes of key stakeholders of municipal officials, households and NGOs; post-consumer material markets. However, assessment of these fundamental blocks in different areas and their impact on the success of organised recycling schemes appear to yield mixed results. In particular, there are indications that:

- The quantity and quality of recyclables in the waste stream influences the amount of waste that could potential be diverted from disposal by organised recycling schemes. The quantity of waste that could be diverted from disposal by organised recycling schemes could be an incentive or a disincentive for municipal involvement. However, in developing countries, the diversion rates that could be achieved by organised recycling schemes over and above the existing recovery rates are not clear.

- Perceptions and attitudes of key stakeholders of municipal officials, households and NGOs are likely to influence the success or failure of organised recycling schemes. However, these perceptions and attitudes as well as the factors that influence them in developing countries are not well understood. For example, it is assumed that
municipal officials will embrace organised recycling as part their waste management responsibilities.

- Market failures undermine the recovery of post-consumer materials in developing countries primarily because of imbalances between supply and demand. However, parameters that lead to such imbalances are not very clear.

2.8 Technical options in organised recycling

Recycling is carried out in three basic stages of collection, processing and reprocessing. Recent recycling schemes have mainly focused on the methods of collection and to a lesser degree on the subsequent processing operations; many have given little consideration to the final reprocessing facilities (Waite 1995). However, it is worth noting that these three operational stages are inextricably linked. For example, the degree of separation at the point of generation will have implications on collection, processing and market acceptability (McMillen 2001). But it is the design of the collection system that requires a great deal of consideration because it affects the existing waste collection arrangement and has immediate impact on the generator (Waite 1995; McMillen 2001). This section discusses and compares the different collection options for recyclables that are often employed by the recycling schemes.

There are two basic collection options for recyclable materials: 'bring' systems and kerbside systems (Waite 1995, Rogoff and Williams 1994). There are variations to these two basic approaches as clearly distinguished by Waite (1995) and Rogoff and Williams (1994) and discussed below:

2.8.1 Bring systems

'Bring' or drop-off systems involve generators taking selected materials to designated collection points. 'Bring' systems are presently the most popular method of collection in
the UK primarily because they can be introduced on a small scale and they require minimal capital investment (Coopers and Lybrand 1993a). The form of 'bring' system is determined by the two characteristics: the type of collection container and the density of the collection points. A higher concentration of collection points usually has a higher diversion rate\(^1\) (DoE 1991). A variation of 'bring' systems is buy-back centres, which offer an incentive to generators who bring their recyclables to the recycling centre.

'Bring' systems and buy-back centres can be designed to collect a broad range of materials, including glass, newspaper, aluminium and even high-grade paper (Waite 1995). A comparison of 'bring' systems and buy-back centres shows that buy-back centres are more likely to recover more materials because of the incentive that is offered to the participants. This comparison is shown in Table 2.5.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Bring system</th>
<th>Buy-back system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participation rate (%)</td>
<td>5-20</td>
<td>Higher</td>
</tr>
<tr>
<td>Diversion rate (%)</td>
<td>1-10</td>
<td>Higher</td>
</tr>
<tr>
<td>Cost</td>
<td>Relatively lower</td>
<td>Relatively higher</td>
</tr>
</tbody>
</table>

Source: Rogoff and Williams (1994)

2.8.2 Kerbside systems

Kerbside collection involves collection of recyclable materials from individual households for further processing (Waite 1995). There are a number of variations of kerbside collection systems (DoE 1991) including:

- Collect source separated (without central processing) or 'Green Bin': requires householders to sort recyclables and place each category in separate containers or

\(^1\) A measure of the amount of waste diverted for recycling compared with total amount that was generated
sections of a container. The collector then empties the contents of each container into separate compartments of the collection vehicle.

- Collect source separated (with central processing) or ‘Green Bag’: requires the householders to place all recyclable materials in one container, the collector empties the container into the vehicle, and the materials are sorted at a central sorting plant.

- Collect mixed (with kerbside sorting) or ‘Blue Box’: requires householders to place recyclable materials in one container for sorting by the collector when the materials are collected.

Kerbside systems are designed to collect a variety of materials including paper, plastics, metals, glass, textiles and others. ‘Blue Box’ schemes require the use of a second vehicle to visit each household in addition to the normal refuse collection vehicle while ‘Green Bin’ and ‘Green Bag’ do not.

2.8.3 Comparison of Kerbside and Bring systems

The recyclables collection systems are not mutually exclusive (DoE 1991). In any particular area, a combination of systems may be used. However, the choice of the appropriate method(s) of collection is a complex process, requiring a diversity of factors to be taken into consideration, such as (DoE 1991; Waite 1995):

- The existing methods of refuse collection
- The types of housing to be serviced
- The likely level of public acceptance, and hence use, of any proposed system
- The range of materials to be collected
- The scope of partnerships with voluntary groups and industries
- Collection costs
Table 2.6 compares the characteristics of the different collection options. The table shows that kerbside collection systems achieve higher diversion rates than ‘bring’ systems. However, kerbside collection systems have higher capital costs than ‘bring’ systems.

Table 2.6: Summary comparison of ‘Bring’ and ‘Kerbside’ collection systems

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Bring</th>
<th>Kerbside collect options</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Blue Box</td>
</tr>
<tr>
<td>All potentially recyclable material collected</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Ease of use</td>
<td>Good</td>
<td>Moderate</td>
</tr>
<tr>
<td>Efficiency of collection</td>
<td>Good</td>
<td>Poor</td>
</tr>
<tr>
<td>Suitable for all housing types</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Estimated diversion rate achievable (after processing at MRF where applicable) (%)</td>
<td>1-10</td>
<td>15-20</td>
</tr>
<tr>
<td>Capital cost</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>

Source: Rogoff and Williams (1994); Waite (1995)

The key points that emerge from the discussion of organised recycling technical options are that:

- Various recyclable waste collection strategies are often employed, usually used in combination.
- Assessment of which system to use is usually influenced by several factors including; convenience, desired recovery rates, population density, cost and others.

2.9 Botswana’s National Waste Recycling Strategy

Waste recycling in Botswana is given impetus by:

- Botswana’s Strategy for Waste Management – this strategy adopts the Waste Management Hierarchy as one of the guiding principles, with recycling as a major component of the hierarchy
• Waste Management Act, 1998 – requires the local authorities to prepare, as part of their waste management plans, a waste recycling plan with respect to controlled waste\(^2\) in their area

The above policy and legislative instruments resulted in two separate but related recycling strategies, even though their titles do not suggest so, of:

• Study on the Recycling of Metal Wastes
• Waste Management Botswana: Paper, Glass, Packaging Waste

The key recommendations of the two strategies are that there must be cooperation between local and national authorities, the commercial sector and NGOs in:

• Establishing small and medium sized recycling facilities
• Source separation of materials by household, commerce and institutions
• Establishment of pilot projects in three main centres of Maun, Francistown and Gaborone. The proposed key components of the pilot project in Gaborone were:
  o Pick-up system for recyclable material from the supermarkets, wholesalers, offices etc.
  o Pick-up system for recyclable material from the households (collection in bins)
  o Drop-off system for recyclable material (main depot and small buy-back centres)
  o Manual sorting of recyclable material from mixed household waste on landfill (simple sorting plant)
• Extensive public awareness programme

Overall, the strategic guidelines adopted is similar to that used in developed countries with local authorities given the responsibility to implement the pilot recycling projects. The major distinction between the frameworks is the proposition of regional recycling centres as opposed to single municipality recycling schemes.

\(^2\) Includes the waste defined as household, industrial, commercial, clinical or hazardous waste
The following key points emerge from a critical examination of the two strategies.

- At the time of formulation of the two strategies, there was no legal framework that supported them. This led to them having no clearly set objectives.
- The approach towards establishment of pilot recycling projects in major regional centres was based on considerations of transport costs and population density. However, there was no regional based waste quantity and composition data to support planning of such projects.
- Even though the strategies acknowledge the existence of some private sector recycling initiatives, they do not have specific proposals on how to take them on board in the proposed pilot projects, but propose to duplicate and compete with them. Experience in Asian cities has shown that by-passing the existing recycling system can lead to failure of schemes organised by municipalities (UNEP 2000).
- The strategies fail to realise that materials that are recovered by private sector recycling initiatives are already achieving relatively high recovery rates. There is likelihood that recovery of materials through the recycling centres could limit the ability of the existing recycling industries to realise the economies of scale.
- The strategies acknowledge the existence of the key voluntary recycling initiatives by industry, such as the deposit refund scheme for refillable beverage bottles and the buy back scheme for beverage metal cans. They however propose to pass regulations that will enforce such schemes to ensure their continued existence as opposed to offering incentives. This appears negative, considering that the schemes were initiated and are operated on voluntary basis.
- The strategies do not propose incentives and/or disincentives for local authorities to organise recycling. They however propose incentives for recyclers such as reduced taxation, provision of suitable land and 'recycling credits' for avoided disposal costs. Buy back schemes are expected to provide financial incentives for household to source separate waste. However, there were no prior studies on the willingness of
household to participate, possible participation rates and levels of incentives that could induce return of materials to such facilities.

- Despite the proposals for setting up small and medium scale end-user industries, there was no policy to support the use of recycled products. In addition, it was established that the government, who are the main users of printing paper, did not intend to use recycled paper because of its perceived inferior quality (GoB 1998c). This also disregards the objectives of the Waste Management Strategy.

- Overall, it appears the strategies were formulated without much stakeholder consultation, particularly households and recyclers who are critical to the success of the planned pilot projects and any other projects that might be planned in the future.

- The strategies were published in 1996 and 1998, but by 2003 none of the planned pilot projects were in place. This could indicate lack of implementation capacity. Apart from that, there were no funding mechanisms proposed for the implementation of the projects. Even though the projects were planned before the Waste Management Act of 1998, the responsibility for implementation was assigned to the local authority.

- Even though the strategies recommend stakeholder cooperation, they do not define and assign responsibilities to the different stakeholders nor do they propose linkages between them.

2.10 Literature summary and synthesis

Several literature sources were reviewed, which included both local and international literature, published and unpublished. The focus of the reviewed literature was on the possible constraints of organised recycling schemes in developing countries based on case studies and experiences of practitioners and researchers. Overall, more than 200 documents were read, analysed and/or used for knowledge acquisition on the broader area of solid waste management but with particular emphasis on recycling. Some of the literature reviewed is cited in the text throughout the thesis and appears in full detail under Bibliography.
The literature review shows that there is a general consensus that recycling is an appropriate waste management strategy to achieve some objectives of sustainable waste management. In order to enhance recycling, municipalities in developed countries are undertaking separate collection of recyclables. To this end, a variety of literature has been developed in these countries that focus on optimising separate collection of recyclables. The review also shows that some municipalities in developing countries are undertaking schemes that collect source separated materials for recycling in the same format as those in developed countries. However, there is limited literature on the success and failures of such schemes in developing countries mainly because their evaluation, where they exist, is still at an infancy stage or has never been done. But there is a literature consensus that separate collection of recyclables by the municipalities in developing countries may not be appropriate because of institutional, technical and socio-economic differences. However, this consensus does not appear to be based on an objective examination of these differences. Despite the reservations on the appropriateness of organised recycling strategies in developing countries, development for recycling strategies that would be appropriate for developing countries is still at an early stage.

There are few publications that have covered the issue of the constraints of municipal organised recycling in developing countries. In particular;

- No substantive information was found which relates to the recyclable content of the waste stream and how it could impact on municipal organised recycling.
- The review indicates that public support for organised recycling schemes is equivocal.
- There is literature emphasis on public education programmes to create awareness and develop public interest in recycling, but it is not clear from the literature if this awareness translates into participation in recycling initiatives.
- There is an assumption in the literature that because municipalities, as solid waste managers, would directly benefit from recycling, municipal officials would support organised recycling strategies. There is limited work directed towards
understanding perceptions and attitudes of municipal officials towards organised recycling.

- There is emphasis in the literature on identifying markets for recyclables targeted by organised recycling schemes. But there is limited work directed towards establishing the capacity of markets and factors that influence it, and how the available capacity could impact on the demand for materials recovered by organised recycling schemes.

These gaps in knowledge and practice are used to help define the key research questions as stated in chapter 3 section 3.5.

This thesis gives further insight into the possible constraints of organised recycling in developing countries. These constraints are discussed throughout the thesis around the guiding hypothesis stated in chapter 3. The discussions are centred on the identified key fundamental blocks of recyclable content of the waste stream, stakeholder perceptions and attitudes, and post-consumer material markets.
3 RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

Chapter 2 critically reviewed the body of knowledge on waste recycling. This chapter states and explains the objectives of the research and the guiding hypothesis. The chapter states the primary and specific research questions to be answered by the research. The field research process and the gradual development of the research strategy are also explained. The analytical framework of the research and data analysis strategy is described in the concluding sections of the chapter.

The chapter is organised into research objective, justification of context, guiding hypothesis, research questions, research design, exploratory methodology, lessons learnt from the exploratory methodology, data collection techniques and, analytical framework and data analysis.

3.2 Research objective

Solid waste recycling is one of the preferred options of sustainable waste management. In some developed countries, municipal organised recycling schemes have been adopted as a means to enhance recycling. Despite the embracement of municipal organised recycling by some municipalities and NGOs in developing countries, there are reservations over its appropriateness as a waste management strategy in such countries. The reservations usually outlined cuts across institutional, technical and socio-economic issues. However, the literature review shows that such reservations are not based on any objective examination of the practical constraints on the ground.
The objectives of this research are:

• To identify and develop an understanding of constraints of organised recycling in cities in developing countries with similar characteristics to Gaborone.

• To facilitate decision-making processes by developing workable guidelines for recycling for such cities based on practical constraints on the ground.

In this context, workable refers to being practical by taking into consideration the local constraints.

3.3 Justification of context

The study is carried out in Gaborone mainly because of some practical and logistical reasons. First there is interest in organised recycling as expressed by national policy and waste legislation. This policy and legal interest led to the local NGO, Somarelalang Tikologo, piloting a source separation scheme in collaboration with the local authority with the objective of embarking on fully-fledged project if the pilot was successful. Secondly, the author is a resident of Gaborone and familiar with the city, the local language and the associated waste management system. In addition, financing for the author’s program of study is from the Government of Botswana, and it makes sense to give back to the people who finance your work.

3.4 Guiding hypothesis

The thesis is directed by the guiding hypothesis that:

Despite the projection of organised recycling as an effective means to enhance waste recycling, its practicality as a waste management strategy in developing countries is constrained by the realities on the ground.
3.5 Research questions

This research sets out to answer the primary research questions:

What are the practical \textit{constraints} of developing organised recycling schemes in cities in developing countries with similar characteristics to Gaborone.

In this context, \textit{constraints} are issues and factors that can limit the establishment and success of organised recycling schemes.

Specifically, the research sets out to answer the questions listed in Table 3.1 below, which are the building blocks of the primary research question.

<table>
<thead>
<tr>
<th>Research question</th>
<th>Objective</th>
<th>Why?</th>
</tr>
</thead>
<tbody>
<tr>
<td>What constraints could the proportion of municipal solid waste generated in Gaborone that is potentially recyclable impose on organised recycling?</td>
<td>To estimate the recyclable content of municipal solid waste in Gaborone, that is, the \textit{supply} for post-consumer materials</td>
<td>The recyclable content of the waste stream can limit the potential supply of recyclables and impact on the potential diversion rate from disposal</td>
</tr>
<tr>
<td>What are the perceptions and attitudes of key stakeholders of households, municipal officials and NGOs to organised recycling schemes? How are these perceptions and attitudes likely to constrain organised recycling?</td>
<td>To assess knowledge, support and willingness to participate in organised recycling by \textit{key stakeholders} of households, municipal officials, and NGOs</td>
<td>Organised recycling can be undermined by lack of support from the responsible authorities, households, and other stakeholders</td>
</tr>
<tr>
<td>What is the nature and capacity of post-consumer material markets to absorb materials that can potentially be recovered by organised recycling schemes?</td>
<td>To establish the nature and capacity of post-consumer material markets to absorb recyclables that could be recovered organised recycling schemes, that is the \textit{demand} side.</td>
<td>Lack of market capacity for post-consumer materials can lead to ultimate disposal of recovered waste fractions hence undermining material recovery</td>
</tr>
</tbody>
</table>

3.6 Research design

Research design is essentially a ‘blueprint’ of research, dealing with at least four problems: what questions to study, what data are relevant, what data to collect, and how
to analyse the results (Yin 1994). The main purpose of the research design is to help to
avoid the situation in which the evidence does not address the initial research questions.
The components of the research design include (Yin 1994):

- **A study’s question(s):** What are the practical constraints of developing organised
recycling schemes in cities in developing countries with similar characteristics to
Gaborone?

- **Its propositions, if any:** The practicality of organised recycling as a waste
management strategy that effectively enhances recycling in developing countries is
constrained by the realities on the ground.

- **Its unit(s) of analysis:** This component is related to the fundamental problem of
defining what the ‘case’ is. In this study, the ‘case’ is constraints to organised
recycling in cities in developing countries.

- **The logic joining data to the propositions:** The method by which data are linked to
the hypothesis. A comparison of variables that lead to the success of organised
recycling schemes in other contexts with those reflected by the collected data in the
current study area is used as the basis for linking the data to the hypothesis.

- **The criteria for interpreting the findings:** Refers to the analytical framework by
which the data collected will be managed. In this study, parameters that are likely to
undermine organised recycling were measured using different variables. For example,
support for organised recycling by municipal officials was measured through their
attitudes towards organised recycling schemes.

This study is about cities in developing countries with similar characteristics to Gaborone
that might be considering organised recycling as a waste management strategy. The study
area was chosen conveniently, which means the results do not permit statistical
generalisations typical of survey designs (Sedlack and Stanley 1992; Robson 1993).
However, this does not preclude some kind of generalisation beyond the specific setting
studied. The study provides insight into constraints of organised recycling in cities in
developing countries with similar characteristics to Gaborone and sets out guidelines for recycling that take these constraints into consideration.

The research strategy that was used is governed by three conditions (Yin 1994). These conditions are:

- The type of research question posed
- The extent of control an investigator has over actual behavioural events
- The degree of focus on the contemporary as opposed to historical events

Table 3.2 shows relevant situations for which different research strategies apply. Clearly the questions asked in this study are 'What questions' in the form of a 'how much' or 'how many' line of enquiry. Identifying such outcomes favours surveys and archival strategies more than others do (Yin 1994). The subject matter of organised recycling strategy is a contemporary issue, which eliminates archival analysis, and there is no control over behavioural events, which further favours surveys. In addition, there are limited past studies and/or data on the constraints of organised recycling in developing countries' urban centres.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Form of Research Question</th>
<th>Requires Control Over Behavioural Events?</th>
<th>Focuses on Contemporary Events?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment</td>
<td>How, why</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Survey</td>
<td>Who, what, where, how much, how many</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Archival analysis (e.g. economic study)</td>
<td>Who, what, where, how many, how much</td>
<td>No</td>
<td>Yes/no</td>
</tr>
<tr>
<td>History</td>
<td>How, why</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Case study</td>
<td>How, why</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Source: Yin (1994)
3.6.1 Maximizing validity and reliability

Primarily, research design is supposed to represent a logical set of statements. The quality of any research design can be judged according to four logical tests (Rudestam and Newton 1992; Yin 1994) as detailed below. In this study, to maximize reliability and validity, the following strategies were employed during design of data collection instruments and during data collection as described under each respective logical test:

- **Construct validity**: establishing correct operational measures for the concepts being studied. There is no easy single way of measuring construct validity, and the methodological complexities of determining construct validity can lead to an unhealthy concentration on this aspect of carrying out an enquiry (Rudestam and Newton 1992; Robson 1993). Any one way of measuring or gathering data is likely to have its shortcomings, which suggests the use of multiple methods (Robson 1993). Multiple data collection techniques that are complementary to each other were used to enhance the reliability and validity of the data. For example, for post-consumer material markets survey, observation were used to verify post-consumer materials that are actually handled and the approximate scale of operation to triangulate self-completed market survey forms. In addition, secondary data from other studies were used to complement primary data.

- **Reliability**: concerns the replication of the study under similar circumstances with the same results. Reliability can be threatened by participant error or bias; and observer error or bias (Sedlack and Stanley 1992; Robson 1993). To minimize the reliability threats several strategies were used in this study including:
  - Pre-testing and peer reviewing of the questionnaires to minimise ambiguities and enhance clarity
  - Triangulation was used to minimise participant bias or error. For example house rental as a proxy measure for household income was triangulated by requesting households to state their monthly income
Verbatim transcripts as opposed to interviewer note taking were used during key-informant interviews. This was done to minimize interviewer bias that might be inherent in recording.

- **Internal validity:** refers to the validity of a causal inference, whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships (Sedlack and Stanley 1992). This could be achieved by the use of comparison groups who were exposed to different treatment (Robson 1993). For example, in household questionnaire surveys different sets of households were used, the first group never participated in a household source separation scheme while the second group participated in a pilot source separation scheme. In addition key-informant interviews were used to generate operational definitions used in survey instruments to make them more comprehensible.

- **External validity:** refers to establishing the domain to which a study's findings can be generalised. There are two general strategies for discounting threats to external validity, which are direct demonstration and making a case. A case is made for this study that the characteristics pertaining to quantity and quality of recyclable content of the waste stream, perceptions and attitudes of stakeholders and post-consumer material markets are not only peculiar to Gaborone but instead a common phenomena in many other developing countries' urban centres.

A further discussion of the application of these strategies that were intended to maximise validity and reliability are discussed under each data collection technique as detailed in section 3.8.

### 3.7 Exploratory methodology

The research started as an exploratory process carried out by way of fieldwork in Gaborone from August 2001 to December 2001. The exploratory research was conducted because the research problem was not clearly defined from the onset and its real scope
was unclear. However, the preliminary direction was to assess the impacts of source separation on environmental pollution parameters at disposal sites from a Life Cycle Analysis approach. The Lifecycle Inventory model of solid waste (IWM-2)\(^3\) was identified as the possible analytical tool and therefore influenced some of the earlier decisions such as the waste classification scheme.

Rapid appraisal methods such as desktop surveys, direct observation, key-informant interviews, and mini-survey for commercial enterprises were used during the exploratory process. Rapid appraisal methods fall on a continuum between very informal methods such as casual conversations or short site visits, and highly formal methods, such as censuses, surveys, or experiments (USAID 1996). Rapid appraisal methods are quick, low-cost and flexible enough to allow exploring relevant new ideas and issues that might have not been anticipated in planning the study. Despite these advantages, information generated through rapid appraisal methods may have limited reliability and validity because of informal sampling techniques, individual biases and difficulties in analysing the data collected. They also lack quantitative data from which generalisation could be made (USAID 1996).

### 3.7.1 Desktop surveys

Desktop surveys were used to identify local literature on waste management, particularly pertaining to legislation and waste management strategy. Five key documents were identified as of particular significance to this study, and their contents are discussed in detail in chapter 4. The five documents are:

1. The Waste Management Act, 1998 (GoB 1998b)
2. Botswana’s Strategy for Waste Management (GoB 1998a)

\(^3\) A model of integrated solid waste management used for waste management scenario optimisation and comparisons (see McDougall et al. 2001).
3. Study of the Recycling of Metal Wastes (GoB 1996)

4. Waste Management: Paper, Glass, Packaging Waste (GoB 1998c)


The key finding from the desktop survey is that the Waste Management Act gives the local authority the responsibility to organise recycling. However, at the time of the fieldwork, there were no fully-fledged organised recycling schemes, despite an earlier pilot scheme by an Environmental NGO, Somarelang Tikologo in collaboration with the Gaborone City Council.

3.7.2 Direct observations

Direct observations were used to gain insight into waste management in Gaborone. In particular, observation were used to:

- Identify major waste generators
- Establish the nature of waste generated
- Establish the nature of waste disposed
- Establish the working condition of the local landfill
- Establish the presence of any recycling activities

Observations were carried out at 9 major commercial outlets (5 big supermarkets, two hotels and two restaurants), at the local landfill and by taking tours around the city. Still camera pictures were taken as documentary evidence where possible. Table 3.3 summarises the major waste generators and the waste components they generate. Still camera pictures taken during the survey showed the waste components in the waste bins and the prevalent primary storage at commercial enterprises, which consisted of 240 litres
bins and 5 m$^3$ skips. The contents of the primary storage facilities were mainly food waste from hotels and restaurants, and packaging waste for supermarkets.

Table 3.3: Major waste generators

<table>
<thead>
<tr>
<th>Major generators</th>
<th>Observed fractions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial enterprises</td>
<td>Packaging waste, food waste and garden waste institutions</td>
</tr>
<tr>
<td>• Supermarkets, wholesalers, hotels, restaurants, institutions</td>
<td></td>
</tr>
<tr>
<td>Households</td>
<td>Food waste and packaging waste</td>
</tr>
<tr>
<td>Construction industry*</td>
<td>Construction rubble and top soil from new construction sites and upgrading of road and storm water infrastructure</td>
</tr>
</tbody>
</table>

*Even though some of it is disposed at the local landfill, it is not the responsibility of the municipal authority to collect it, but that of the contractors

The author also visited the local landfill on the 9 July 2001 to observe the nature of waste that is being disposed of. It was observed that the waste disposed of consisted mainly of construction rubble, household and commercial waste, and garden waste. Construction rubble was mainly from new construction sites and road and storm water upgrading in the city. Discussions with the landfill manager revealed that most delivered garden waste was from institutions such as the University and the Defence Force Barracks. The other garden waste came from bush clearing in the city. The discussions also indicated that the main waste generators are households and commercial enterprises. The component determination of the landfill-weighing programme is very approximate, with the driver of each truck passing through the weighbridge being asked the nature of waste they are carrying even though most of the time the waste is mixed.

It was also observed that the landfill was burning and most of the waste was not landfilled properly. The landfill manager revealed that most of the machinery has broken down and is awaiting maintenance, and the remaining ones are not able to cope with the landfill-operating schedule. This has led to some of the waste just being dumped without compaction and appropriate daily cover.
There was limited waste picking at the landfill. Most of the waste pickers were picking food items for personal consumption. Others were picking scrap metal either to sell to scrap metal collectors or for personal use. Ten labourers working at the landfill were hired by one of the collectors and processors to pick cardboard.

3.7.3 Key-informant interviews

Key-informant interviews were conducted with the Chief Technical Officer (Waste Management) of Gaborone City Council and two managers of waste recovery companies, Collect-A-Can (a steel can recovery company) and Pyramid Holdings (a paper recovery company) using checklists.

The objectives of the key-informant interview with the Gaborone City Council representative were to:
- To establish rapport with city council authorities and ask for their cooperation in carrying out the study as they are the authority responsible for waste management.
- To establish waste collection procedure and schedules.
- To establish waste collection and disposal costs.
- To establish perceptions and attitudes towards recycling.

The interview was carried out using a checklist below.

Recipients of waste collection service
Method of collection
Collection frequency
Quantities of waste collected and disposed
Problems with collection and disposal
Collection costs
Disposal costs
Waste management costs as a proportion of municipal budget
Perceived benefits of recycling as a waste management strategy
Envisaged benefits and constraints of source separation
Financial source for waste management
Progress in carrying out their responsibilities as apportioned by the Waste Management Act

The findings of the key-informant interview are reported in Chapter 4 and Chapter 6.

The objective of the key-informant interviews with representatives of waste recovery companies was to establish the motive for engaging in waste recovery; and the successes and limitations of their efforts. The interviews were carried out using the checklist below:

Motivations for recycling
Quantity of waste recovered
Methods used for recovery
Materials recovered
Market location for their recyclables
Incentives from the official authority

The findings of these interviews are reported in Chapter 7.

3.7.4 Mini-surveys

Mini-surveys involve interviews with a few individuals, usually selected using non-probability sampling techniques (USAID 1996). Mini-surveys were conducted with managers of 9 commercial enterprises, which comprised 5 big supermarkets, 2 hotels and 2 restaurants during the month of August 2001. The objective of the survey was to gather
baseline data on waste management activities of commercial enterprises. The surveys were carried out using the checklist below:

Waste quantities generated
Nature of waste generated
Frequency of collection service
Authority responsible for collection and disposal
Existence of recycling efforts on their part
The associated costs of their waste collection and disposal services

Most of the respondents were not sure of the quantity of waste they generate, but could only estimate it in terms of the number of bins filled in a day. Table 3.4 shows the approximate results of waste generated from commercial enterprises. The main components of waste generated were packaging and food waste.

Table 3.4: Approximate quantities of waste generated from some commercial enterprises

<table>
<thead>
<tr>
<th>Name of commercial enterprise</th>
<th>Approximate quantity of waste daily</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corner Super Market</td>
<td>• 3 to 4 x 240 litre bins of mixed waste daily</td>
</tr>
<tr>
<td></td>
<td>• 9 m³ truck load of cardboard daily</td>
</tr>
<tr>
<td>FoodMart Super Market</td>
<td>• 6 x 240 litre bins of mixed waste daily</td>
</tr>
<tr>
<td></td>
<td>• 1 x 5 m³ skips of mixed waste daily</td>
</tr>
<tr>
<td>Spar Supermarket (Kgale view)</td>
<td>• 2 x 5 m³ skips of mixed waste daily</td>
</tr>
<tr>
<td>Spar Supermarket (Game)</td>
<td>• 4x 240 litre bins of mixed waste daily</td>
</tr>
<tr>
<td>Shoprite Supermarket</td>
<td>• 2x 5 m³ skips of mixed waste daily</td>
</tr>
<tr>
<td>Grandpalm Hotel</td>
<td>• 8 x 240 litre bins of mixed waste daily</td>
</tr>
<tr>
<td>Gaborone Hotel</td>
<td>• 6x 240 litre bins of mixed waste daily</td>
</tr>
<tr>
<td>Moghul restaurant</td>
<td>• 3x 240 litre bins of mixed waste daily</td>
</tr>
<tr>
<td>Maharaja restaurant</td>
<td>• 4x 240 litre bins of mixed waste daily</td>
</tr>
</tbody>
</table>

All the respondents paid property tax to the City Council, which is supposed to cover waste collection and disposal costs. Due to the reported inefficiency of the City Council's
collection services most commercial enterprises collected and disposed of their own solid waste, while others engage private collectors.

No commercial enterprises have any recycling programme in place, but they were all willing to co-operate with any recycling initiatives. For instance, Pyramid Holdings and Botswana Tissue approached some supermarkets to source separate paper for collection and they agreed to do so. However, because of the reported inefficiency of these companies' collection service, source separated materials are often collected for disposal at the landfill with the rest of the waste.

The preliminary findings of the exploratory process revealed that there has not been any systematic waste characterisation of the local waste stream. The available data on waste quantity and composition were mainly from the landfill-weighing programme. The landfill-weighing programme data did not reflect the different waste generating groups (see Chapter 4). Data from the landfill-weighing programme were also not in a format that was suitable for use in IWM-2 model. This necessitated a comprehensive waste characterisation for household and commercial waste. The waste composition and characterisation study was carried out during the months of August to November 2001. The detailed methodology for the characterisation study is discussed in section 3.9.1 and the results of the characterisation are discussed in Chapter 5. The data generated by the characterisation study was subsequently used in trial runs in the IWM-2 model.

3.8 Lessons from exploratory methodology

The exploratory methodology collected both quantitative and qualitative data. Quantitative data was mainly gathered through the household and commercial waste characterisation sampling surveys and desktop surveys. Qualitative data was mainly collected through key-informant interviews, mini-surveys, direct observations and
desktop surveys. Table 3.5 summarises the nature of data gathered through the exploratory methodology.

### Table 3.5: Nature of data gathered during the first phase data collection

<table>
<thead>
<tr>
<th>Data collection strategy</th>
<th>Sources of data</th>
<th>Nature of data</th>
</tr>
</thead>
</table>
| Waste characterisation sampling survey | • 47 households (893 samples over 21 days)  
• Commercial waste landfill sampling | Quantitative (Waste quantities and composition) |
| Key-informant interviews | • Chief Technical Officer (waste management)-Gaborone City Council  
• Manager- Collect-A-Can  
• Manager- Pyramid Holdings | Qualitative and quantitative data |
| Direct observation | • 5 supermarkets  
• 2 hotels  
• 2 restaurants  
• Landfill  
• City wide tour | Pictorial, qualitative |
| Mini-surveys | • 5 supermarket managers  
• 2 hotel managers  
• 2 restaurant managers | Quantitative and qualitative data |
| Desktop surveys | • Grey and published literature on waste management in Gaborone/Botswana | Qualitative and quantitative data |

A number of lessons were learnt from the first phase data collection. Primarily, it was learnt that:

- Recycling is espoused by the National Waste Management Strategy and has been legislated for through the Waste Management Act
- The local authorities as waste management authorities have been given the responsibility by the Waste Management Act to enhance recycling including the drawing up of waste recycling plans. This mandate by the act is envisaged to lead to the establishment of source separation schemes to optimise recovery of recyclables.
- At the time of the fieldwork, there were no organised source separation schemes in operation and none were planned, so a guidance on what materials to source separate
and why, as a preliminary direction of the research, appeared to be of no immediate use.

- It was also realised that despite the non-existence of organised source separation for recycling schemes, there was some interest in establishing them, as witnessed by a joint pilot source separation scheme by a local NGO (Somarelang Tikologo) and the Gaborone City Council.

- There has previously been no systematic determination of waste composition data to enable better waste management planning. The results of the waste characterisation conducted by this study showed putrescible waste as the largest component of both the household and commercial waste streams at 67.93 percent and 53.61 percent respectively.

- Trial runs with the Life Cycle Inventory model as the preliminary analytical framework indicated that among others, it had internal shortcomings that restricted its potential use to associate different environmental pollution parameters with waste fractions. The internal shortcomings were due to the assumptions that:
  1. All organic pollution parameters of BOD/COD in leachate come from putrescible organic, paper and textile fractions.
  2. All other leachate components arise equally from all MSW fractions since it is not possible to identify their sources with any degree of certainty.

Despite organised recycling being supported by the waste management legislative framework, at the time of the fieldwork, there were no organised recycling schemes. However, there was interest in organised recycling as evidenced by the joint pilot source separation scheme between Somarelang Tikologo and Gaborone City Council. Even though the pilot scheme was evaluated as a success, a fully-fledged source separation scheme had not been implemented. With these issues in mind, the study focused on investigating the likely constraints for organised recycling in cities in developing countries with similar characteristics to Gaborone. The investigation was conducted around the key elements of organised recycling schemes i.e. quantity and quality of
recyclable content of the local waste stream, stakeholders' perception and attitudes and markets for post-consumer materials. The study evolved into a more refined case study research with the City of Gaborone as the case under examination.

3.9 Data collection techniques

This research is a case study that utilises multiple survey methods dictated by the nature of research questions posed. The nature of this particular case study is instrumental in that it is examined to give insight into an issue (Punch 1998). The main issues under examination are constraints to organised recycling in cities in developing countries with similar characteristics to Gaborone. The objective of each survey technique, its justification, the details of sampling strategies, and the design and administration of each survey instrument are discussed under each relevant survey section as detailed below. Second phase data collection was carried out by way of fieldwork in Gaborone during the months of July and August 2002.

3.9.1 Waste quantity and composition sampling surveys

Household waste generation survey

The preliminary use of the waste composition data was to assess the impact of source separation on pollution parameters of waste disposal. However, as a result of lessons learnt from first phase methodology as detailed in section 3.7, the focus of the research evolved into establishing the constraints of organised recycling in cities in developing countries with similar characteristics to Gaborone. In pursuance of the new research focus, the purpose of the household waste survey was to answer in part the specific research question of:
What constraints could the proportion of municipal solid waste generated in Gaborone that is potentially recyclable impose on organised recycling?

Household waste sampling was carried out at the source of generation as opposed to disposal sites primarily because:

- There was lack of information on waste quantity and composition as generated.
- The potential effect of the socio-economic status of households on MSW quantities and composition can be much better reflected when sampling takes place at household level rather than at the disposal site where there could be mixed waste from various income groups and other generators.
- Not all waste generated at source in Gaborone reaches the disposal site, generally because of a poor collection service, especially in low-income areas (GoB 1998a).
- Open burning at household level, and open space disposal and 'throwing away' of waste are prevalent in the study area (Kgathi and Bolaane 2001)

Various components of sampling procedures and fieldwork are presented below:

Sampling procedure

To obtain reliable results from the survey, it was necessary to determine the minimum number of samples that should be analysed to get results of reasonable accuracy. Barber (1988) and Weiss (1989) suggest that for a specified confidence interval, an estimate of the sample size (n) required can be made using the central limit theorem (equation 1 below), provided the standard deviation (σ) is known.

\[ n = \left( \frac{z_\alpha}{\frac{\sigma}{E}} \right)^2 \]  

(1)
Where $n$ is the sample size

$\sigma$ is the standard deviation of population = standard deviation of preliminary sample

$\frac{z_{\alpha}}{2}$ is the value of the standard normal table such that the area to the right of $\frac{z_{\alpha}}{2}$ is $\frac{\alpha}{2}$

$E$ is the sampling error.

The central limit theorem assumes the sample means are normally distributed. Furthermore, it is assumed that the sample means are approximately normally distributed as long as the sample size $(n)$ is greater than or equal to 30 (Weiss, 1989). But since the standard deviation of the population is unknown, a preliminary survey was considered necessary to determine it.

**Design of the sampling frame for household waste sampling**

Since the socio-economic status of households affect the quantity and components of waste generated (UNCHS, 1994; Abu Qdais et al. 1997), a stratified random sampling procedure was adopted. Stratified random sampling involves dividing the population under the study into homogeneous subgroups and then taking a simple random sample in each subgroup, where each subject in the subgroup has an equal chance of being selected.

The stratification into the socio-economic categories of low, medium and high income was based on whether the household lives in Self-Help Housing Agency (SHHA) area, Botswana Housing Corporation (BHC) low, medium or high cost houses and other privately developed houses. An initial assumption was made that low-income households live in SHHA areas, medium income households live in BHC low-cost houses and high-income households live in BHC medium and high cost houses and privately developed ones. The same stratification model was used during the pilot source separation scheme (Somarelang Tikologo 2001). The assumption on housing for different income groups was later checked by responses to questions in Survey Table 2 in Appendix A. The
answers gave information on the family size, property rent and range of family income. The categorisation by income as used in Survey Table 2 is shown in Table 3.6.

The socio-economic data of the participating households is shown in Table 3.7. Table 3.7 shows the average waste generation rate, number of people per household, the assumed income level and the declared income level as per the categorisation in Table 3.6. Generally, because of the prevailing housing policy that promotes home ownership, most people own their houses, especially in SHHA areas. This has undermined the use of the rental rate as a verification measure for household income. However, on the basis of the socio-economic data in Table 3.7, the assumed and declared incomes are not that different with, 70 percent, 64 percent and 54 percent match for low, middle and high-income respectively. The initial assumption that low-income households live in SHHA areas, medium-income households live in BHC low-cost houses and the high income live in BHC medium and high income houses and the privately developed ones has reasonably been confirmed by the data on income ranges, despite a few overlaps.

Table 3.6: Categorisation by Household Income for 1993/94 and 2001

<table>
<thead>
<tr>
<th>Income group</th>
<th>1993/94 income and expenditure survey (P/month)*</th>
<th>2001 income categorisation adjusted by annual rate of inflation (P/month)**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-income</td>
<td>Less than 750</td>
<td>Less than 1350</td>
</tr>
<tr>
<td>Medium-income</td>
<td>Between 750 and 4000</td>
<td>Between 1350 and 7000</td>
</tr>
<tr>
<td>High-income</td>
<td>More than 4000</td>
<td>More than 7000</td>
</tr>
</tbody>
</table>

** Computed by the author by compounding the annual inflation rate from 1994 to 2001
* P stands for Pula the Botswana currency with international notation of BWP (1USD = 7BWP in 2001)

Data on the types and number of different residential properties in each assumed income category are not well organised or well kept by the Central Statistics Office (CSO). However, approximate information obtained from various sources indicates that the number of housing units in each assumed income category is as detailed in Table 3.8. Table 3.8 shows that the majority of households live in SHHA with 43 percent of housing units in these areas. In an effort to produce representative results in the survey, the
number of housing units in each income category was made proportional to their approximate number in the city as a whole.

Table 3.7: Socio-economic data of households participating in the main survey

<table>
<thead>
<tr>
<th>House No</th>
<th>Waste generation rate (kg/p/day)</th>
<th>Number of people</th>
<th>Assumed income level *</th>
<th>Declared income level**</th>
<th>House No</th>
<th>Waste generation rate (kg/p/day)</th>
<th>Number of people</th>
<th>Assumed income level</th>
<th>Declared income level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.347</td>
<td>6</td>
<td>L</td>
<td>L</td>
<td>25</td>
<td>0.347</td>
<td>5</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>2</td>
<td>0.237</td>
<td>6</td>
<td>L</td>
<td>L</td>
<td>26</td>
<td>0.315</td>
<td>3</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>3</td>
<td>0.496</td>
<td>3</td>
<td>L</td>
<td>M</td>
<td>27</td>
<td>0.300</td>
<td>4</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>4</td>
<td>0.578</td>
<td>4</td>
<td>L</td>
<td>L</td>
<td>28</td>
<td>0.424</td>
<td>5</td>
<td>M</td>
<td>H</td>
</tr>
<tr>
<td>5</td>
<td>0.245</td>
<td>5</td>
<td>L</td>
<td>L</td>
<td>29</td>
<td>0.223</td>
<td>5</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>6</td>
<td>0.541</td>
<td>2</td>
<td>L</td>
<td>M</td>
<td>30</td>
<td>0.310</td>
<td>3</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>7</td>
<td>0.078</td>
<td>7</td>
<td>L</td>
<td>L</td>
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<td>8</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>8</td>
<td>0.456</td>
<td>2</td>
<td>L</td>
<td>L</td>
<td>32</td>
<td>0.772</td>
<td>2</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>9</td>
<td>0.479</td>
<td>3</td>
<td>L</td>
<td>L</td>
<td>33</td>
<td>0.139</td>
<td>5</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>10</td>
<td>0.236</td>
<td>5</td>
<td>L</td>
<td>M</td>
<td>34</td>
<td>0.332</td>
<td>3</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>11</td>
<td>0.103</td>
<td>12</td>
<td>L</td>
<td>L</td>
<td>35</td>
<td>0.190</td>
<td>9</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>12</td>
<td>0.085</td>
<td>10</td>
<td>L</td>
<td>M</td>
<td>36</td>
<td>0.126</td>
<td>8</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>13</td>
<td>0.508</td>
<td>3</td>
<td>L</td>
<td>L</td>
<td>37</td>
<td>0.215</td>
<td>4</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>14</td>
<td>0.395</td>
<td>3</td>
<td>L</td>
<td>L</td>
<td>38</td>
<td>0.363</td>
<td>7</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>15</td>
<td>0.787</td>
<td>2</td>
<td>L</td>
<td>L</td>
<td>39</td>
<td>0.277</td>
<td>5</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>16</td>
<td>0.469</td>
<td>3</td>
<td>L</td>
<td>M</td>
<td>40</td>
<td>0.315</td>
<td>8</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>17</td>
<td>0.408</td>
<td>8</td>
<td>L</td>
<td>L</td>
<td>41</td>
<td>0.214</td>
<td>6</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>18</td>
<td>0.222</td>
<td>6</td>
<td>L</td>
<td>L</td>
<td>42</td>
<td>0.122</td>
<td>5</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>19</td>
<td>0.276</td>
<td>8</td>
<td>L</td>
<td>M</td>
<td>43</td>
<td>0.237</td>
<td>4</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>20</td>
<td>0.086</td>
<td>5</td>
<td>L</td>
<td>L</td>
<td>44</td>
<td>0.680</td>
<td>6</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>21</td>
<td>0.317</td>
<td>6</td>
<td>M</td>
<td>L</td>
<td>45</td>
<td>0.240</td>
<td>3</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>22</td>
<td>0.370</td>
<td>5</td>
<td>M</td>
<td>L</td>
<td>46</td>
<td>0.332</td>
<td>5</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>23</td>
<td>0.373</td>
<td>3</td>
<td>M</td>
<td>M</td>
<td>47</td>
<td>0.184</td>
<td>8</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>24</td>
<td>0.511</td>
<td>4</td>
<td>M</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: L = low-income; M = medium-income; H = High-income

*Refers to income category assumed on the basis of households either living in SHHA, BHC low, medium and high cost areas

**Refers to declared income on the basis of the categorisation in Table 3.6, obtained by Survey Table 2
### Table 3.8: Number of Housing Units in Each Income Category

<table>
<thead>
<tr>
<th>Income category</th>
<th>Number of housing units</th>
<th>Percentage of total housing units</th>
<th>Number of sampled housing units as a proportion number of units in each income category*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-income (SHHA)</td>
<td>11303</td>
<td>43</td>
<td>20</td>
</tr>
<tr>
<td>Medium-income</td>
<td>7913</td>
<td>30</td>
<td>14</td>
</tr>
<tr>
<td>High-income</td>
<td>7343</td>
<td>27</td>
<td>13</td>
</tr>
<tr>
<td>TOTAL</td>
<td>26559</td>
<td>100</td>
<td>47</td>
</tr>
</tbody>
</table>

*Entries were computed by multiplying each corresponding entry in column 3 by 47 and dividing by 100

Source: ¹Mpoloka (2001); ²Vista (2001)

All SHHA areas, BHC low, medium and high-cost houses and privately developed houses were demarcated from the map of Gaborone West Phase I and II (see Map 1 in the Appendix B). To stand an equal chance of being selected, each house in the assumed income category was assigned a unique number, which was used to randomly select the required sample size from the sampling frame. It had however emerged during the reconnaissance survey that, in the SHHA areas, in one plot, there was usually more than one household. On selecting the participating household, the number of households per compound was first established. Each household was then given a unique number between 1 and 6, and a dice was then tossed to choose one participating household.

**Preliminary sampling survey**

Before carrying out the preliminary survey, six research assistants were recruited. Three of the research assistants had just completed a degree in Urban and Regional Planning and the other three were going into their final year of the same degree programme. All the research assistants had taken an introductory course in solid waste management as part of their degree programme. The assistants were trained for a day on the requirements of both the household and commercial waste sampling surveys. The training focused on the objectives of the survey, approaching potential participants, responding to queries from sceptical participants, identifying the different components, and drawing samples.
from waste collection vehicles at the landfill. The trained research assistants worked on
the preliminary, main and commercial waste sampling surveys.

The preliminary sampling survey took place during the month of July 2001. The main
objective of the survey was to determine the standard deviation to be used in the central
limit theorem to estimate the number of samples required for the main survey. The
samples were obtained from low, medium and high-income households in proportion to
their percentages in the sampling frame. Each participating household was given a plastic
bag in which to deposit their waste from the beginning to the end of each day. Households
were initially issued with two plastic bags, one for use on the first day and
the other for use the next day in case research assistants arrived late after the elapse of the
first day. This would minimise the possibility of placing the waste for the following day
in same bag as that for the previous day. Each morning a team of research assistants
visited the selected houses to weigh and record the waste generated (see Survey Table 1
in Appendix A), and then issue them with a plastic bag for the next day. The process
continued for a period of a week during which 336 samples were obtained from 48
households.

The results of the preliminary sampling survey are shown in Table 3.9. Table 3.9 shows
the total waste generated from each household, number of persons per household and the
average waste generation rate per person per day for the 48 selected households. The
waste generation rate ranged from 0.065 kg/capita per day to 0.736 kg/capita per day, with
the number of persons per household ranging from 1 to 12 and an average of 5
persons/household. The waste generation rate and the number of persons per household
are not necessarily related. The preliminary survey yielded an average waste generation
rate of 0.272 kg per capita per day. The calculated standard deviation from 336 samples
of waste generated was 0.143.
Table 3.9: Results of the preliminary sampling survey

<table>
<thead>
<tr>
<th>Household number</th>
<th>Total waste generated from household (kg/week)</th>
<th>Number of persons per household</th>
<th>Average generation rate (kg/capita/day)</th>
<th>Household number</th>
<th>Total waste generated from household (kg/week)</th>
<th>Number of persons per household</th>
<th>Average Generation rate (kg/capita/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13.92</td>
<td>4</td>
<td>0.497</td>
<td>25</td>
<td>1.37</td>
<td>1</td>
<td>0.196</td>
</tr>
<tr>
<td>2</td>
<td>2.72</td>
<td>6</td>
<td>0.065</td>
<td>26</td>
<td>4.89</td>
<td>3</td>
<td>0.233</td>
</tr>
<tr>
<td>3</td>
<td>6.20</td>
<td>3</td>
<td>0.295</td>
<td>27</td>
<td>6.90</td>
<td>3</td>
<td>0.329</td>
</tr>
<tr>
<td>4</td>
<td>33.45</td>
<td>12</td>
<td>0.398</td>
<td>28</td>
<td>10.22</td>
<td>4</td>
<td>0.365</td>
</tr>
<tr>
<td>5</td>
<td>10.50</td>
<td>2</td>
<td>0.736</td>
<td>29</td>
<td>7.48</td>
<td>2</td>
<td>0.534</td>
</tr>
<tr>
<td>6</td>
<td>7.22</td>
<td>4</td>
<td>0.258</td>
<td>30</td>
<td>7.28</td>
<td>3</td>
<td>0.347</td>
</tr>
<tr>
<td>7</td>
<td>5.39</td>
<td>10</td>
<td>0.077</td>
<td>31</td>
<td>4.64</td>
<td>5</td>
<td>0.133</td>
</tr>
<tr>
<td>8</td>
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<td>7</td>
<td>0.056</td>
<td>32</td>
<td>5.20</td>
<td>5</td>
<td>0.149</td>
</tr>
<tr>
<td>9</td>
<td>7.22</td>
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<td>0.344</td>
<td>33</td>
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<td>5</td>
<td>0.071</td>
</tr>
<tr>
<td>10</td>
<td>7.24</td>
<td>2</td>
<td>0.517</td>
<td>34</td>
<td>7.23</td>
<td>2</td>
<td>0.516</td>
</tr>
<tr>
<td>11</td>
<td>4.35</td>
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<td>35</td>
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<td>0.255</td>
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<td>5</td>
<td>0.233</td>
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<td>0.298</td>
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<td>15</td>
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<td>39</td>
<td>7.75</td>
<td>4</td>
<td>0.277</td>
</tr>
<tr>
<td>16</td>
<td>8.51</td>
<td>5</td>
<td>0.243</td>
<td>40</td>
<td>14.51</td>
<td>6</td>
<td>0.345</td>
</tr>
<tr>
<td>17</td>
<td>3.15</td>
<td>5</td>
<td>0.090</td>
<td>41</td>
<td>5.96</td>
<td>4</td>
<td>0.213</td>
</tr>
<tr>
<td>18</td>
<td>7.91</td>
<td>8</td>
<td>0.141</td>
<td>42</td>
<td>9.02</td>
<td>5</td>
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</tr>
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<td>0.168</td>
<td>43</td>
<td>9.70</td>
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</tr>
<tr>
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<td>1.86</td>
<td>3</td>
<td>0.081</td>
<td>44</td>
<td>3.91</td>
<td>4</td>
<td>0.140</td>
</tr>
<tr>
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<td>0.246</td>
<td>45</td>
<td>18.81</td>
<td>7</td>
<td>0.384</td>
</tr>
<tr>
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<td>3</td>
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<td>11.20</td>
<td>6</td>
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<td>5</td>
<td>0.148</td>
<td>48</td>
<td>12.61</td>
<td>9</td>
<td>0.200</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Average</td>
<td></td>
<td>0.272</td>
</tr>
</tbody>
</table>

Main household sampling survey

The required sample size was based on the results of the preliminary survey. For a 95 percent and a 1 percent standard error, the optimum size, n, was determined by equation (1):

\[ n = \left( \frac{1.96 \times 0.143}{0.01} \right) = 786 \text{samples} \]
The main survey started after the determination of the required number of samples (786), which meant collecting samples from 37 households over 21 days during the months of August and September 2001. It was however decided to increase the number of households by 25 percent to 47 to cater for those that might not co-operate or for the prevalence of absenteeism that was experienced during the preliminary survey. This resulted in the sample size of 987 (i.e. collecting samples from 47 households over 21 days). The increased sample size was also expected to overcome the limitations of sample weight. Sample weights varied between 0 and 7.437 kg/household/day. But because of general absenteeism of some households during some days of the sampling period and at times just forgetting to place the waste in the provided waste bags, elimination of extreme samples, the final number of samples obtained was 893. Similar to the preliminary survey, each of the participating household was issued with two plastic bags (one black and one white/yellow). They were then requested to deposit their daily wet waste in the black plastic bag and dry waste in the white/yellow one.

Due to the usually high temperatures (averaging between 30°C and 35°C) that make it difficult to work with decomposing putrescible waste, the waste samples were collected daily from households and taken to the Gaborone landfill for sorting and weighing. Two samples were collected from each household, one sample being of wet waste and the other being of dry waste. Each sample bag was first opened to verify that the contents were deposited as directed. The wet waste was weighed and the weight recorded under food and garden waste (see Survey Table 2). The dry waste was deposited on a dry surface and sorted into a seven component classification scheme of food and garden waste, paper, glass, metals, plastics, textile and other (fines, leather, wood etc.). Garden waste was weighed and added to the weight of food waste. The adopted classification scheme is used for the Life Cycle Inventory Model (see McDougall et al., 2001) of solid waste. The classification scheme was adopted because the Life Cycle Inventory model was initially going to be used to process the data to predict the environmental burdens of source separation for recycling and presented a clear classification.
During sorting, each component was placed in a separate container for weighing. The difference between the gross weight and the tare weight represented the weight of the waste fraction and was recorded in the appropriate column in Survey Table 2. The waste was sorted into 7 components of food and garden waste, paper, metal (ferrous and nonferrous), glass, plastic (film and hard), textiles and other. Ferrous and nonferrous metals were distinguished by using a magnet.

The results and analysis of household waste characterisation are reported and discussed in Chapter 5.

Commercial waste weighing programme

The objective of the commercial weighing programme was to answer in part the specific research question of:

What constraints could the proportion of municipal solid waste generated in Gaborone that is potentially recyclable impose on organised recycling?

It was revealed by commercial enterprises managers during a reconnaissance survey that commercial waste is collected and delivered to the landfill daily (see Chapter 4 for an overview of waste management in Gaborone). The landfill manager also confirmed this. This enabled the carrying out of a week-long daily weighing programme at the landfill to establish the quantity of commercial waste that is generated. Sampling at the landfill was made easier by that, because of the reported inefficient collection of commercial waste by the local authority, some commercial sectors both collect and dispose of their waste or hire private collectors. This has resulted in some waste arriving at the landfill as pure commercial waste. In addition, the local authority also collects some commercial waste.
separately at the end of the trading period. The weighing programme was carried out during the month of August as detailed below:

- As vehicles carrying commercial waste arrived at the disposal site, a research assistant stationed at the weighbridge recorded their gross weight as well as their tare weight once they had disposed of their load
- The difference between the two weights was calculated to represent the net weight of the waste
- To confirm that they only carried commercial waste some of them were followed around their collection trips.
- In addition, most vehicles were skip carriers collecting skips from commercial areas and the drivers were particularly asked from where they had collected the skip.

Commercial waste characterisation programme

There are some well-established sampling procedures for municipal solid waste sampling at disposal sites. Among these are truckload sampling and spot sampling (Corbitt 1998). Truckload sampling involves randomly selecting a loaded collection truck each day from one of the designated areas for waste sorting and characterisation. Spot sampling involves randomly withdrawing many small-weight increments of waste from the mass of waste material collected daily. But these procedures can be costly and time consuming. The recommended sample sizes during spot sampling at disposal sites ranges from 90 to 135 kg for mixed municipal waste (Corbitt 1998). There is little evidence of systematic sampling and analysis of commercial waste, although this tends to be more homogeneous than household waste and varies with respect to commercial activity (White et al. 1995; Corbitt 1998).

In this study, because of the similarity of commercial activities, mainly dominated by supermarkets, restaurants and hotels, and due to limited resources a modified spot sampling procedure was used. The modification was in withdrawing weights of samples
less than the recommended 90-135kg for the mixed waste stream. Because of the general homogeneity of commercial waste, a sample of 3 m$^3$ was withdrawn from 5 randomly selected vehicles carrying commercial waste. Before the sample was withdrawn, the waste was mixed thoroughly with a shovel. The procedure was repeated for a period of 7 consecutive days (from Monday to Sunday). The total number of samples obtained was 35 with a total volume of 105m$^3$. The withdrawn samples were passed through a 20mm sieve mesh to remove the fines (Pescod 1991). The samples were then deposited on a clean surface for sorting. In the sorting process, each waste fraction was placed in its appropriate container. On completion of the sorting, each container and its contents were weighed. Gross and tare weights were recorded in Survey Table 2. The difference between the two weights is the net weight of the individual components.

Experience and Practical constraints of sampling procedures

Sampling household waste and commercial waste had practical constraints that could have affected the results of the waste generation survey. Household waste sampling was done at the source of generation while that of commercial waste was done at the landfill.

For household waste, the household was used as the basic unit for sampling for the preliminary and main household sampling surveys. The following are some of the lessons learnt and practical constraints from the household sampling survey.

- The initial assumption was that a single household would occupy each plot. This implied that the use of plot numbers from the street map of the study area was deemed adequate to design the sampling frame with each one of them representing a single household. It was however realised during the reconnaissance survey that most plots, particularly in the designated low-income areas (SHHA) have more than one family residing in them, either sharing a single housing unit or in separate units built on one plot. The definition of household was modified to represent the situation on the ground. A household was redefined as people living in a housing unit or part of a housing unit sharing the same food preparation arrangements. One of the findings of
the research is that it is important to validate the units of assessments. For example, a household; some areas of Gaborone could not be defined as people living in the same plot because more than one family may occupy one plot.

- As per common knowledge all SHHA areas are considered as low-income. This is linked with size of the plot. However this indicator presents a problem. Several plots designated in the SHHA areas have high-cost structures built in them and vice versa. This makes it difficult to design sampling frames stratified by income. It also means that the assumed stratification has to be cross-checked by some variable that can reflect household income. Based on the prevailing government policies, societal culture and preferences, such variables are often difficult to choose. For example, ownership of a television set in Gaborone is symbolic of urban dwelling, implying that most households, even those with no access to electricity, have it. It was assumed in this study that housing rental would reflect the income level of households. However, it emerged that because of the prevailing government policy that promotes home ownership, most houses are owned rather than rented. This rendered the use of housing rental ineffective. The direct household monthly income was therefore used to crosscheck the assumed household income.

- Sampling at source is dependent on the willingness of the household to participate. In this study households were requested to place their waste in plastic bags by dividing them into two separate components for the main survey and in one plastic bag for the preliminary survey. It emerged that participants in such a process want immediate and tangible benefits for their efforts. In addition, such a process arouses suspicions in them. Most of the participants wanted rewards for participating in the survey. Despite an explanation that the survey was particularly intended for academic purposes, most participants especially in the low-income households were suspicious that the results of the survey would lead to them being required to pay for their waste management services. They also indicated that they were not comfortable with individuals having access to their waste content for fear of taboos such as witchcraft or for being laughed at. The presence of the head of the household, especially in the low-income areas,
was a significant factor in determining whether or not they participated in the survey. If the head of the household was absent at the time of establishing contact, then the available householder was not able to make a commitment to participate. This indicates some of the limitations of the sampling at the source of generation.

- It is worth mentioning some practical problems faced during the actual sampling. Some households placed the bags in their usual waste bins and were collected by the local authority before the surveyors had access to them. Some households locked their gates while the bags were inside which made it impossible to have access to them. This was predominantly so in the high-income areas where the plots are security walled. In some high-income areas, guard dogs also made it impossible to collect the waste in the absence of householders. Some bags were left outside and torn by the dogs. During weekends, some participating householders went to the cattle posts and other social engagements such as weddings outside Gaborone. However, the degree of absenteeism of householders was minimised by carrying out the sampling during school holidays. This ensured that during the week there was at least somebody at home.

- When householders were required to separate their waste into wet and dry during the main survey, they found it to be inconvenient and time consuming. Even though most of them managed to do so after persuasion, there were a few who often mixed their waste. This had implications on their real willingness to participate in source separation. After a few days of sampling there was some improvement in the will and effort of separating the waste. Taking the opportunity of a special collection, households also placed into the bag the waste that had long been in the house such as old clothes, newspapers and others because it was convenient to do so. Households in the low-income areas were happy with the main survey when their waste was collected daily for sorting. This could be explained by the poor collection service in their areas.
For commercial waste, sampling at the landfill meant that some paper and cardboard collected by paper recovery companies had already been removed from the waste stream. Even though the results do not indicate the waste generated at source, they indicate the quantity and components of waste still available for possible recovery at the time of disposal. In addition, most commercial waste that is collected by the local authority is collected late in the afternoon when most commercial activities cease. This meant that it was difficult to sample commercial waste delivered to the landfill by the local authority late in the evening. The majority of the sampled waste stream sampled was delivered by the commercial sector itself or subcontracted to private collectors. An attempt to triangulate the results of the sampling survey by asking commercial enterprises the quantity of waste they generate proved difficult since they do not keep such records and can only estimate it by the number of bins filled in a day. Similar to householders in low-income areas, managers of commercial enterprises were also suspicious of the motive of estimating the quantity of waste they generate, which in some instances resulted in limited cooperation. In two instances, the author was required to produce an identification that linked him to an academic institution instead of the media.

3.9.2 Questionnaire-based household surveys

Household surveys were conducted using questionnaires with two separate groups of households to establish their perceptions and attitudes regarding organised recycling schemes. Perception could mean observation and sensitivity but, as used in this context, it refers to awareness of recycling and local recycling initiatives. While attitude can refer to approach and feelings, in this context it refers to the thoughts that could influence one to participate or not to participate in recycling. Participation can refer to contribution, but in this context, it refers to taking part in activities that contribute towards recycling, such as separating household waste and returning the separated materials to collectors such as buy back centres and deposit refund schemes. The main objective of household surveys was to answer in part the specific research question of:
What are the perceptions and attitudes of key stakeholders of households, municipal officials and NGOs to organised recycling schemes? How are these perceptions and attitudes likely to constrain organised recycling?

Questionnaire-based survey techniques involve the collection of primary data about subjects, usually by selecting a representative sample of the population or universe under study, through the use of the questionnaire (Ryerson 2002). In addition to surveys, other data collection techniques were considered for possible use, particularly focus group discussions. However, questionnaire-based surveys were chosen over focus group discussions because surveys (Robson 1993; Ryerson 2002; Sedlack and Stanley 1992):

- Provide a relatively simple and straightforward approach to the study of attitudinal, motivational, behavioural and perspective aspects;
- Allow for standardisation and uniformity both in the question asked and in the method of approaching subjects
- May be adapted to collect information that can be generalised from almost any human population

In contrast, in focus group discussions:

- Focus groups explore a collective phenomena, not individual ones, and attempts to infer the latter from focus group data are likely to be unfounded.
- It is difficult to have standardisation and discussions can often be derailed by individuals with dominant views if the moderator is not very experienced.
- The results could not be generalised, as they cannot be regarded as representative of the wider population.

In addition, focus groups are usually made up of people with common characteristics. These must be in relation to what is being studied, and consist of demographic
characteristics as well as a certain knowledge base or familiarity with a given topic. However, there was uncertainty of a knowledge base of the subject in the study area.

Household surveys were carried out through questionnaire-based surveys. Interviewer administered questionnaires were preferred as an appropriate data collection technique for household interviews primarily because (Ryerson 2002; Robson 1993):

• The technical nature of some of the questions gave the interviewer the opportunity to clarify them.
• The interviewer also has the opportunity to probe answers by asking the respondent to clarify a specific response.
• It was learnt during the first phase methodology of household-based waste characterisation that households needed a lot of encouragement to participate when they do not receive immediate benefits. The presence of the interviewer was expected to encourage participation
• Conducting interviews from door to door was expected to increase response rate.

Questionnaire-based surveys are however susceptible to interviewer error or bias and respondent error or bias, which can have an effect on validity and reliability. Below is a discussion of the main items on validity and reliability as well as the processes that were undertaken to minimise interviewer and respondent errors.

• Sample selection bias: Samples were selected randomly for each household to stand an equal chance of being selected
• Non-response error: Enumerators were trained and encouraged to be pleasant and establish rapport with the respondents and where possible to explain to them in detail the objectives of the study to minimise non-response error
• Item non-response error: Interviewer administered questionnaires minimized non-response error. Enumerators ensured that no item was skipped unless the
respondent did not want to respond to the question for one specific reason or another. An analysis of missing values indicated low levels of item non-response even for items that were thought to be sensitive such as household income. In this case a less than 8 percent non-response was recorded.

- **Response error**: Enumerators were given a detailed orientation on the each question and response items.

### Sampling unit and sampling frames

Households were chosen as targets for surveys mainly because they are the common unit of production as well as consumption. The household unit in the study area is very coherent based on social ties and economic dependencies. To improve the internal validity of the household surveys (see section 3.6.1), instead of assuming that all households have attitudes about source separation regardless of their prior contact with it, two sampling frames were used.

1. **The first sampling frame** was that of households who had not participated in the pilot source separation programme, who are referred here as ‘general households’. The objectives of this survey were to:
   - Assess households’ awareness of recycling
   - Assess the impact of awareness on practising recycling
   - Assess households’ willingness to participate in future source separation schemes

2. **The second sampling frame** was that of households who participated in a pilot source separation project that was carried out by Somarelang Tikologo in collaboration with Gaborone City Council, who are referred here as ‘specific households’. The pilot scheme, which took place from November 1999 to July 2000, had 39 households participating. Households who participated in the pilot scheme were identified using contact information obtained from Somarelang Tikologo, which included house
numbers and names of contact persons within the household. By virtue of participating in the pilot source separation scheme, these households are likely to have some knowledge about source separation of household waste and presumably have formed an opinion about it. The objectives of this survey were to:

- Assess the impact of awareness on practising recycling
- Assess households' willingness to participate in future source separation schemes
- Assess households' attitudes towards source separation schemes based on their experience with the pilot project

The Questionnaires

It is normally advisable to use a measuring instrument whose validity and reliability have already been established (Rudestam and Newton 1992). As discussed in Chapter 2, similar empirical studies to assess knowledge, attitudes and practice have been carried out in different areas and settings. Various research instruments from previous studies particularly those by Choon and Poon (1994) and Choon and Poon (1999) were modified and adapted to develop the questionnaires used in this study.

The questionnaire length, and hence the time taken to complete it, can be greatest in face-to-face interviews. Several researchers recommend a procedure for development of a questionnaire that takes this into consideration (Punch 1998, Robson 1993; Sedlack and Stanley 1992). This procedure was closely followed in development of the questionnaires.

Key informant interviews with the Chief Health Officer (Waste Management) of Gaborone City Council and a representative of Somarelang Tikologo (an environmental NGO) provided operational definitions of some study variables. The first drafts of the questionnaires were peer reviewed by colleagues at the University of Botswana. The suggestions of the peers were incorporated into the second draft prior to piloting to
minimise ambiguities. The questionnaire administered to 'general households' was piloted with 20 households in the area with similar characteristics to the main survey. During piloting, enumerators were asked to note any problems, difficulties, and ambiguities encountered. Following pre-testing, the following amendments were made to the questionnaire to address the problems noted.

- Section D on the draft questionnaire referring to personal data of the respondents was moved to be Section A. This was motivated by the local norms that the respondents wanted an exchange of greetings and other personal information before they could be interviewed.
- Examples of material fractions as given in question (17) of the questionnaire have been amended to reflect local usage of words.

The questionnaire administered to 'specific households' was not piloted because the number for participating households was relatively small.

To further improve the reliability of the questionnaires that were used as data-gathering instruments the following guidelines, as stipulated by Robson (1993) and Sedlack and Stanley (1992), were closely followed in designing them.

- Questions were made as specific as possible
- Questions were in closed format
- The local language, Setswana, gets very complicated in an attempt to translate it into recycling terminology. A decision was made not to directly translate the questionnaires into Setswana. Instead, enumerators were inducted in a comprehensive translation of the questionnaires into the local language with the object of establishing uniformity on asking questions and eliciting answers.

*Questionnaire 1 (Survey Instrument 1 in the Appendix C):* This questionnaire was administered to 'specific households'. The questionnaire is divided into five sections:
Section A: Personal information to be correlated with the variables in the other sections.
Section B: The objective of this section is to explore general issues in household waste management.
Section C: This section assesses the awareness (knowledge) of recycling by households and how the awareness translates into practising recycling.
Section D: The section assesses households' attitudes to source separation. Respondents were asked to express their opinion in relation to the pilot source separation scheme in which they had previously participated, on a scale of; strongly disagree (SDA), disagree (DA), don’t know (DK) and strongly agree (SA).
Section E: This section assesses the willingness of household to participate in future source separation schemes.

Questionnaire 2 (Survey Instrument 2 in the Appendix C): This questionnaire was administered to 'general households'. The questionnaire is divided into four sections:

Section A: Personal information to be correlated with the variables in the other sections.
Section B: The objective of this section is to explore general issues in household waste management.
Section C: This section assesses the awareness (knowledge) of recycling by households and how the awareness translates into practising recycling.
Section D: This section assesses the willingness of household to participate in future source separation schemes.
Sampling and administration

Stratified random sampling was used as a means for conducting the survey for 'general households'. A stratified random sample is obtained by forming classes in a population and then selecting a simple random sample from each class (Burt and Barber 1996). The basis for stratification was household income. As seen during the household waste quantity and composition survey, the type of housing approximately represents the household income category. Low-income households live in self-help housing areas (SHHA), medium-income households live in BHC low-cost houses and high-income households live in BHC medium and high cost houses, and privately developed houses. To minimise travel and travel costs, plot numbers on the map of Gaborone West Phase I and II were used to design the sampling frame for 'general households' (see Map 1 in Appendix B). Participating households were chosen randomly from the designed sampling frame. Gaborone West Phase I and II were chosen because they have all the predominant housing types.

The size of the sample for 'general households' was determined by using the formula (1) applicable to estimating proportions (Burt and Barber 1996).

\[ n = \left( \frac{z_{\alpha/2} \sqrt{p(1-p)}}{E} \right)^2 \]  

where \( n \) is the sample size
\( z_{\alpha/2} \) is the value of the standard normal distribution with an upper-tail probability of \( \alpha/2 \)
\( p \) is the proportion of success
\( E \) (short for error) is the level of precision desired

A maximum error of 5% with a confidence of 90% was set as the desired reliability. Since nothing is known about the population, \( p \) was assumed to be 0.5 to determine the upper bound limit of the population (Burt and Barber 1996). The required sample size is
The calculated sample size was increased by 5% to 284, allowing for some missing cases that might occur due to technical or other errors during the survey. The sample size was distributed on the basis of the proportion of each housing unit type in the study area as shown in Table 3.10

<table>
<thead>
<tr>
<th>Income category</th>
<th>Total number of housing units</th>
<th>Proportion of total housing units (%)</th>
<th>Number of sampled households (Column 3x284/100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-income (SHHA)</td>
<td>11303</td>
<td>43</td>
<td>122</td>
</tr>
<tr>
<td>Medium-income</td>
<td>7913</td>
<td>30</td>
<td>85</td>
</tr>
<tr>
<td>High-income</td>
<td>7343</td>
<td>27</td>
<td>77</td>
</tr>
<tr>
<td>Total</td>
<td>26559</td>
<td>100</td>
<td>284</td>
</tr>
</tbody>
</table>

Source: ¹Mpoloka (2001); ²Vista (2001)

Four enumerators administered questionnaires to a single member of the household who was willing to be interviewed. Because of the cohesiveness of the household unit, the views of the interviewee were deemed to adequately represent the views of the household.

The pilot source separation project took place from November 1999 to July 2000 and interviews were conducted during the months of July and August 2002 (Somarelang Tikologo 2001). An attempt was made to interview all 39 of 'specific households'. This was not possible because of the long time lapse between the pilot project and the conducting of interviews with most of them having relocated to new areas. Among the 39 households who participated in pilot scheme, only 20 were identified. Of the 20 identified households, 3 did not want to be interviewed. They were unhappy that despite having agreed to source separate their materials, no one came to collect them.

The findings and analysis of data on household surveys are presented in Chapter 6.
3.9.3 Key-informant interviews

Semi-structured interviews were conducted with key-informants in the Environment Health and Sanitation Department (EHSD) of Gaborone City Council; Department of Sanitation and Waste Management; and Somareleng Tikologo. Key informants are people who by virtue of their placement have first-hand knowledge about a topic of interest (USAID 1996). Key informant interviews are useful where there is a need to understand motivation, behaviour and perspectives of programme planners and managers (USAID 1996). Semi-structured interviews are conversations where the interviewer has worked out a set of questions in advance, but is free to modify their order based upon the perceptions of what seems most appropriate in the context of the conversation (Robson 1993). The objective of semi-structured interviews with key informants was to answer in part the specific research question:

What are the perceptions and attitudes of key stakeholders of households, municipal officials and NGOs to organised recycling? How are these perceptions and attitudes likely to constrain organised recycling?

Semi-structured interviews with key informants were carried out using a checklist. The use of a checklist as opposed to a questionnaire was to avoid respondents having to ask for the questionnaire and completing it during the interviewer's absence, which can limit the possibility of follow-up questions. Checklists also allow the interviewer to modify the order of questioning based upon perceptions of what seems most appropriate in the context of the conversation. They also allow the interviewer to change the wording of questions to make them clearer, give explanations, leave out particular questions which seem inappropriate to a particular interviewee or include additional ones (Robson, 1993).
Respondents to the interview were chosen conveniently on the basis of their involvement in waste management but at senior level in their departments. Prior to the commencement of the interview, interviewees were informed about:

- Purpose of interview and research objectives
- Estimated length of interview
- Use of tape recorder to establish consent if necessary
- Confidentiality

All interviews were recorded to capture verbatim transcripts. Key-informant interviews were conducted on average over a period of 45-60 minutes. Interviews were transcribed into text the same day they were conducted. None of the respondents required anonymity. Full transcripts of the interviews are contained in the Appendix D.

Municipal authority key informant interview checklist

Gaborone City Council is the local authority responsible for municipal waste collection and safe disposal. They are required by the Waste Management Act to formulate waste management and recycling plans for approval by the Department of Sanitation and Waste Management (DSWM). At local authority level, key informant interviews were carried out with two officials involved with planning and execution of waste management activities within the Environmental Health Department of Gaborone City Council on the 23rd and 29th of July 2002. The officers interviewed were (see structure of Environmental Health Department of Gaborone City Council in chapter 4):

- Senior Environmental Health Officer
- Senior Technical Officer (waste management)

The checklist and objectives of key informants interviews with municipal authority representative(s) are shown on Table 3.11.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Checklist</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Departmental role</td>
<td>o Availability of recycling plan and/or progress in making it</td>
<td>o To establish awareness and execution of the departmental role as established by the Act which might impact on formulation of recycling plans</td>
</tr>
<tr>
<td>Motivations and future plans</td>
<td>o Reasons for piloting the source separation scheme</td>
<td>o To establish motivations for collaboration in piloting a source separation scheme</td>
</tr>
<tr>
<td>Attitude towards recycling</td>
<td>o Lessons learnt from the pilot that can</td>
<td>o To establish attitudes of municipal officials towards municipally sponsored waste recycling</td>
</tr>
<tr>
<td>Incentives</td>
<td>o Policies promoting recycling e.g. preferential procurement of goods with recycled content subsidies and taxes</td>
<td>o To establish the existence of regulatory and economic instruments to support recycling at local level</td>
</tr>
<tr>
<td>Manpower and institutional support</td>
<td>o Number of officer(s) designated to oversee recycling</td>
<td>o To establish institutional support for recycling</td>
</tr>
<tr>
<td>Private sector collaboration</td>
<td>o Previous activities involving private sector</td>
<td>o To establish the existence and prospects of cooperation with private sector in recycling</td>
</tr>
</tbody>
</table>

NGO key informant interview checklist

Somarelang Tikologo is a local environmental NGO with interest in waste management. It piloted a source separation scheme in 39 households in Gaborone from November 1999 to July 2000. The checklist and objectives of the key informant interview with NGO representative are shown on Table 3.12. The key informant interview was conducted with the Chief Executive of Somarelang Tikologo on the 18th July 2002.
### Table 3.12: Checklist for interview with representative of NGO

<table>
<thead>
<tr>
<th>Variable</th>
<th>Checklist</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivations</td>
<td>• Reasons for piloting the scheme</td>
<td>• To establish the objective of piloting the scheme</td>
</tr>
<tr>
<td>Materials fractions</td>
<td>• Materials targeted</td>
<td>• To establish the reasons behind targeting the specified materials</td>
</tr>
<tr>
<td>Pilot and stratification</td>
<td>• Basis for choosing the participants • Publicity • Distribution of the sampled households</td>
<td>• To establish the practical knowledge on source separation by the NGO officials</td>
</tr>
<tr>
<td>Constraints</td>
<td>• Financial • Technical • Logistical • Participation rate</td>
<td>• To establish the nature of constraints encountered during piloting likely to affect future programmes</td>
</tr>
<tr>
<td>Lessons learnt</td>
<td>• Feasibility of organised recycling schemes • Do findings support initial motivations • Was the pilot successful?</td>
<td>• To establish the nature of lessons learnt that could support or constrain organised recycling schemes</td>
</tr>
<tr>
<td>Institutional support</td>
<td>• Areas of cooperation between private and public sector</td>
<td>• To establish the nature of support and linkages forged between official agencies, private sector and NGOs</td>
</tr>
<tr>
<td>Future plans</td>
<td>• Expansion of pilot scheme • Plans for a fully-fledged scheme • Time frame</td>
<td>• To establish any intentions to pilot other schemes in the future or implement a fully fledged source separation scheme</td>
</tr>
</tbody>
</table>

**Department of Sanitation and Waste Management key-informant interview checklist**

The Department of Sanitation and Waste Management (DSWM) is the custodian of the Waste Management Act. They also approve waste management and recycling plans formulated by the municipal authorities. An interview was conducted with a Senior Waste Management Officer in the Department of Sanitation and Waste Management (DSWM) on 25th July 2002. The checklist and objectives of the key informant interview with a representative of the Department of Sanitation and Waste Management are shown on Table 3.13.
Table 3.13: Checklist for interview with representative of DSWM

<table>
<thead>
<tr>
<th>Variable</th>
<th>Checklist</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivations</td>
<td>Motivations for requiring recycling plans in the Act</td>
<td>• To establish the motivations of including recycling plans as part of waste management plans</td>
</tr>
<tr>
<td>Targets</td>
<td>Targeted diversion rates and time frames</td>
<td>• To establish the existence of any recycling targets</td>
</tr>
<tr>
<td>Act enforcement</td>
<td>Disincentives</td>
<td>• To establish the nature of disincentives administered to local authorities for non-compliance with the Act</td>
</tr>
<tr>
<td>Support instruments</td>
<td>Economic incentives</td>
<td>• In addition to the regulatory instrument, the Act, to establish economic incentives to support recycling</td>
</tr>
</tbody>
</table>

The findings and analysis of all key informant interviews are discussed in chapter 6.

3.9.4 Post-consumer materials market survey

Availability of markets for recyclables is critical for the success of community recycling programmes. A market is a customer (or a group of customers) who is willing and able to accept the product or commodity that is being offered (LDEQ 1999). There are two types of recyclable markets; intermediate and end-user markets. Intermediate markets include collectors and processors while end-users manufacture products directly from the recovered material (Sutherland 2001). The objective of the market survey was to elicit baseline data on the existing state of recycling in Gaborone with the following parameters as indicators;

- Number of recyclers – refers to the number of companies/organisations that collect and process and/or make finished products from secondary materials
- Materials recycled – refers to types of post-consumer materials collected and processed or made into finished products
Number of recyclers by material fraction – refers to the number of companies/organisations that collect, process and/or make finished products from certain specific post-consumer material fractions

Quantity of material recycled – refers to the quantity of materials collected, processed and/or made into finished products

Available capacity – refers to the potential of recyclers to collect, process and/or make finished products from additional post-consumer materials over and above the existing level of operation

Sources of materials and nature of collection networks

Nature of official support for post-consumer material markets creation and sustenance.

Post-consumer material prices

The overall objective of the local post-consumer material market survey was to answer the specific questions:

**What markets are available for recyclables and what capacity do they have to absorb materials from organised recycling schemes?**

A market survey for post-consumer materials was carried out in Gaborone in July 2002. The market survey involved identifying intermediate and end-user markets and administering self-completed questionnaires to representatives of intermediate and end-user markets. To identify intermediate and end-user markets, the following procedures were undertaken:

- Search of the telephone book under ‘recycling’ or similar listings. This was not helpful because there was no recycling or similar listing on the index of the telephone book.
- Contacted the local NGO, ‘Somarelang Tikologo’ which piloted a source separation for recycling study in Gaborone between 1999 and 2000. This proved very helpful
because the NGO keeps a directory of most recyclers. It also operates a ‘bring-site’ for most consumer materials, which are then collected by the recyclers from its premises.

- Contacted the local authority (Gaborone City Council), which together with Somarelang Tikologo piloted the source separation for recycling study in Gaborone. The local authority only knew the recyclers that collaborated with them during the pilot scheme.
- Talked to paper pickers at the landfill. Almost all paper pickers who pick predominantly cardboard have been engaged by a paper recycIer to recover paper as it is being disposed.

Self-completed market survey form

Managers of the identified recycling establishments were first contacted by phone to make an appointment with them to deliver a market survey questionnaire for their completion (see Survey Instrument 3 in the Appendix E). The questionnaire was then hand-delivered to the contact persons. The respondents were given two days to complete the questionnaire. On arrival for collection of the questionnaire some of the respondents who had not completed the questionnaire were given an extra two days to do so. After the questionnaires were collected, they were checked for the level of detail provided. Most questions referring to quantity and prices of materials were sparsely completed, or either completed as confidential. A telephone follow-up was made to all the respondents to try to improve on the data captured by the questionnaire.

The pre-determined structure of the questionnaire has been preferred because the expected quantitative responses outweigh qualitative ones. Self-completion of the questionnaire was deemed to allow the respondent to look for numerical information such as cost figures that might not have been readily available if the questionnaire was administered by the interviewer. Quite often such information might have to be retrieved
from the company's records. Below is the checklist that was used in the design of the questionnaire. The developed questionnaire mainly took the format of the market survey form in Sutherland (2001).

- Year of establishment
- Objective of establishment
- Types of materials
- Sources of materials
- Reliability of supply
- Quality criteria
- Collection costs
- Prices paid to suppliers
- Average quantities of materials obtained daily
- Average quantity of materials processed daily
- Available capacity for processing/manufacturing
- Delivery costs of processed materials
- End-users of processed materials and their geographical location
- Types of finished products
- Quantity of finished products produced annually
- Quantity of finished products sold annually
- Existence/possibilities of contracts with suppliers and end-users
- Purchasers of finished products and their geographical location
- Selling prices to consumers of finished products
- Any support from official agencies and type of support
- Expected support from government agencies
- Possibilities of expanding processing/manufacturing capacity
- Costs of expanding capacity
The data reported by the recyclers through market survey were triangulated by physical
observations. In particular the available collection capacity and the effectiveness of the
collection network were triangulated by observations at commercials areas, which were
the main sources of the materials, and at recycling centres. Observations focused on the
parameters that were easy to measure:

- Availability and utilisation of collection vehicles – this would indicate the ability of
  the recycler to collect more material than they currently do.
- Presence of materials with established markets at disposal sites, at commercial areas
  or as litter – this would indicate the effectiveness of the existing post-consumer
  material collection network

Regional post-consumer material market survey

The local-market survey revealed that the main driver of recycling activities in Gaborone
is regional end-user demand with 8 out of 10 recyclers collecting and processing
materials for export to South Africa. In recognition of these, an e-mail questionnaire was
sent out to post-consumer end-users in South Africa that were identified as importing
materials from Gaborone. The regional end-users were identified through the local
market survey. The e-mail addresses of the end-users were obtained from the Institute of
Waste Management of Southern Africa. The main end-users identified and the materials
they sourced from Gaborone are listed in Table 7.6. The objectives of the e-mail
questionnaire were to:

- Establish the existing reprocessing capacity
- Establish the existing spare reprocessing capacity
- Establish quantity of materials imported from Gaborone
- Prices paid for materials sourced in South Africa
- Possible constraints of importing materials from Gaborone.
Table 3.14: Contacted regional end-users

<table>
<thead>
<tr>
<th>End-users identified</th>
<th>Materials reprocessed</th>
<th>Contacts</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collect-A-Can, S.A (Nampak)¹</td>
<td>Metal cans</td>
<td>R.C. Christie</td>
<td><a href="mailto:ChristieRC@Nampak.co.za">ChristieRC@Nampak.co.za</a></td>
</tr>
<tr>
<td>Mondi²</td>
<td>Paper</td>
<td>Peter Cannon</td>
<td>Peter <a href="mailto:Cannon@Mondi.co.za">Cannon@Mondi.co.za</a></td>
</tr>
<tr>
<td>Sappi</td>
<td>Paper</td>
<td>Sales office</td>
<td><a href="mailto:Salesoffice@sappi.co.za">Salesoffice@sappi.co.za</a></td>
</tr>
<tr>
<td>Glass-Recycling²</td>
<td>Glass</td>
<td>Dick Poultney</td>
<td><a href="mailto:Dickp@glassrecycling.co.za">Dickp@glassrecycling.co.za</a></td>
</tr>
</tbody>
</table>

The results and analysis of the post-consumer market survey are discussed in chapter 7.

3.9.5 Internet search

The main objective of the Internet search was to identify and retrieve secondary data that were used to complement primary data sources. The internet search identified international, regional and local data sources. At local level, the Botswana government’s Central Statistics Officer’s website was visited regularly to triangulate some of the data obtained by survey methods. At regional level, the website of the South African Institute of Waste Management was a useful data source. Some key stakeholders identified through visits to this website were contacted by e-mail to elicit specific information where possible. Findings from the Internet search are found in most of the chapters.

3.10 Analytical framework and data analysis

The analytical framework was gradually developed during preliminary data analysis. Different indicators were used as measures to understand prospects of organised recycling in developing countries. For example, household support for organised recycling as an indicator was measured through participation in recycling, willingness to participate in future source separation schemes. A more detailed look at the indicators revealed that they broadly fall under two categories of: *opportunities* and *constraints*. The opportunities for organised recycling are in terms of legislative and institutional support, willingness of household to participate etc. There is a variation of perceptions and
attitudes of key stakeholders. Some perceptions and attitudes support organised while others do not. Such variables are appropriately placed in both categories of opportunities and constraints. Some of the constraints are lack of developed markets for certain materials fractions, inefficient collection of materials with established markets etc.

Most of the data obtained were both qualitative and quantitative. Qualitative data were primarily obtained through semi-structured interviews with key informants, observations and the market survey. Key informant interviews were tape recorded to obtain verbatim transcripts. Field notes were recorded during observations. Field notes and some transcripts of interviews were coded into key categories of investigation. A code was placed next to every word or group of words that mentioned the key categories of investigation. The thesis is rich with qualitative data.

Quantitative data were obtained from waste quantities and composition surveys; market surveys and household surveys. Data from waste quantity and composition surveys, market surveys were analysed using Microsoft Excel 2000 spreadsheet. After household survey questionnaires were completed, they were codified and analysed using Statistical Package for Social Sciences (SPSS) version 11. Since most variables are nominal, the Pearson Chi-square statistic \( \chi^2 \) was used to measure the relationships between variables with a value of less than 0.05 considered significant.

A more detailed analysis is discussed in the following chapters.

### 3.11 Summary

This chapter laid out the hypothesis, objectives and key research questions that guided the work. The research started as exploratory process utilising rapid appraisal methods, which evolved into a case study. In an attempt to understand the issues at stake from a variety of perspectives, multiple survey techniques were used within the overall
methodological design. Quantitative and qualitative methods were combined and a cross-section of stakeholders was interviewed. A significant effort was paid to systems and procedures that could improve validity of data and reliability of findings such as triangulation. The collected data were analysed and interpreted around the guiding hypothesis stated in section 3.4.

Two methods did not meet original expectations and/or were difficult to employ. Stratified random sampling of households resulted in wider dispersion of selected households, which made it difficult to locate them for interviews and/or waste sampling. This resulted in delays and increased travel costs. In addition, the market survey resulted in limited quantitative data, particularly relating to financial matters. However, this was improved by triangulation.
4 AN OVERVIEW OF SOLID WASTE MANAGEMENT IN GABORONE

4.1 Introduction

Chapter 3 described the steps that were undertaken to address the objective, hypothesis and research questions. This chapter gives an overview of waste management in Gaborone. The overview establishes a context against which the results in chapters 5, 6 and 7 should be viewed. In particular, the chapter provides baseline data gathered by the exploratory methodology of desktop surveys, observations, key informant interviews and mini-surveys, as outlined in chapter 3. The overview focuses on examining, but not exclusively, the legislative and institutional framework of waste management in Gaborone, and comparing it with the practice in other areas with a view of establishing the following parameters:

- Legislative support for waste data acquisition in an appropriate format for planning recycling
- Institutional arrangements and responsibilities to support planning and execution of recycling schemes
- Incentives for participation in recycling by local authorities and other stakeholders
- Funding for solid waste management services

The overview mainly focuses on legislative and institutional frameworks because failure of municipal solid waste management services in developing countries has often been attributed to weak and outdated institutional patterns as well as ineffective legislation (Jindal et al. 1997; van Beukering et al. 1999). The legislative framework sets out the desired results that waste management services should achieve, establish enforceable standards as well as assigning responsibilities to the official institutions and other stakeholders. In addition, the institutional framework identifies institutions involved in waste management, their responsibilities and linkages. The linkages of institutions involved are critical for the establishment of potential partnerships between stakeholders.
The chapter gives an overview of waste management in Gaborone around the guiding hypothesis that:

**Despite the projection of organised recycling as an effective means to enhance waste recycling, its practicality as a waste management strategy in developing countries is constrained by realities on the ground.**

This chapter identifies legislative and institutional issues that can possibly be a constraint to development of organised recycling around the key fundamental blocks of quantity and quality of recyclables in the waste stream, stakeholder perception and attitudes, and post consumer material markets. It is organised into: legislative framework; institutional framework; NGOs and CBOs; waste quantities and composition; storage, collection, recycling and disposal; financing and cost for MSWM services; waste management strategy and a summary of the key points.

### 4.2 Legislative framework

Post-colonial Botswana enacted some laws aimed at protecting the country's natural environment as well as ensuring acceptable health conditions. Among others, these included the Public Health Act of 1981 (GoB 1981), the Atmospheric Pollution Act of 1979 (GoB 1979a) and the Factories Act of 1979 (GoB 1979b). The Acts dwell on defining measures that should be undertaken to realise public health objectives. None of these Acts recognise solid waste management as a public health issue.

Prompted by the requirements of Agenda 21, an international programme of action towards sustainable and environmentally sound development, the most comprehensive waste management legislation, the Waste Management Act (WMA) of 1998, came into being. The Act provides for the establishment of the Department of Sanitation and Waste
Management in the Ministry of Local Government to oversee and regulate sanitation and waste management. The objective of the Act is:

"To make provision for the planning, facilitation and implementation of advanced systems for regulating the management of controlled waste\(^4\) in order to prevent harm to human, animal and plant life; to minimise pollution of the environment, to conserve natural resources------" (GoB 1998b: p A85)

The Act embodies regulatory measures, which are aimed at managing controlled waste to minimise impact on human, animal and plant life. Primarily, the Act:

- Requires local authorities to prepare waste recycling plans as part of their local waste management plans. The information to be included in the plan includes:
  - Type and quantity of materials that could be recycled;
  - Implications of the recycling plan for waste management;
  - Technical, organisational, and financial initiatives the local authority will provide to encourage recycling; estimated costs or savings attributable to recycling;
  - The possibility of returning waste materials to the manufacturer in order to control pollution, conserve resources and prevent harm to human, animal and plant life.

- Sets out the institutional framework, with local authorities designated as collection and disposal authorities of all the controlled waste in their area of jurisdiction.

- Empowers a local authority to provide receptacles for primary storage of commercial and industrial waste at an agreed fee with the person requiring them.

- Empowers a local authority to collect and dispose all waste at an agreed fee other than household waste.

\(^4\) Controlled waste defined in the Act, refers to household; commercial; industrial; clinical or hazardous waste
• Requires the local authority to deliver all the waste it collects to a licensed waste management facility\(^5\), with the exception of any household waste, which the local authority may decide to retain for recycling.

• Sets out penalties for non-compliance with some aspects of the Act. For example, operating a waste management facility without a license carries a fine not exceeding P8000 or imprisonment not exceeding seven years.

Even though the Act looks comprehensive, unlike legislation in Jordan and Hennipen County, it does not put emphasis on acquisition of waste data to enable waste management planning. For example, in Jordan, the Environmental Protection Law No. 12 of 1995 requires the Ministry of Municipalities to prepare daily and periodic indexes pertaining to landfill’s works, including quantity of waste, quality, source and the quantity of sorted substances (GCEP 1996). In addition Hennepin County Ordinance 13 of 1986 requires each municipality to collect and report data on an annual basis all information relating to waste generation, collection and disposal (Hennepin County 1986). It is not clear if the requirements of these pieces of legislation are often fulfilled, but they indicate an understanding that waste management planning requires up to date waste quantity and composition data. Even though Gaborone currently monitors solid waste quantity at the landfill, failure to give it legislative support may undermine continued acquisition of up to date data. For example, despite the existence of the landfill-weighing programme, there is limited time series data on waste quantity and composition. Apart from that, landfill data format in Gaborone does not support detailed composition and can limit the knowledge of the potentially recyclable content of the waste stream that can enable planning organised recycling schemes.

In addition to the absence of legislative requirements for monitoring of waste quantity and composition, there are no incentives or disincentives for municipalities to comply

\(^5\) Refers to a waste disposal site licensed for the purpose of controlled waste management.
with the Waste Management Act through the formulation and implementation of waste recycling plans. This is in contrast to other areas that have similar legislation. For example in Hennepin County, the County Board may implement a source separation programme within the boundaries of the municipality that fails to comply with the requirements of the law and such a programme shall be forced upon all persons residing in it (Hennepin County 1986). In England, the National Waste Minimisation and Recycling Fund has been made available to help local authorities set up recycling and waste initiatives across England (Defra 2002). To utilise the fund, municipalities bid for funding from the Department of Environment, Transport and the Regions for their recycling initiatives. The lack of incentives and/or disincentives for municipalities can limit their participation in developing and implementing organised recycling schemes.

The Act gives local authorities the responsibility to provide receptacles for primary storage of commercial and industrial waste at an agreed fee with the person requiring them. Provision of receptacles at a fee could be a disincentive for source separation of commercial and industrial waste since this sectors might consider acquisition of multiple receptacles costly.

In addition, the Act gives the local authority the responsibility to collect and dispose all waste at an agreed fee other than household waste. The concept of agreed fee could mean that the fee does not have necessarily to reflect the marginal cost⁶ of collection and disposal. Failure of the collection and disposal fee to reflect the marginal cost of such activities could be a disincentive for reduction of waste generated through source separation. Apart from that, since the enactment of the Act in 1998, by 2002 there were still no direct user fees for collection and disposal of commercial and industrial waste. This could indicate lack of implementation capacity by the local authority. Lack of implementation capacity by local authorities could limit the development of organised recycling schemes.

⁶ Marginal cost indicates how much total cost changes for a given change in quantity of output.
4.3 Institutional framework

The main institutions responsible for regulation and management of solid waste are:

- Ministry of Local Government
- Department of Sanitation and Waste Management (DSWM)
- Department of Local Government and Development (DLGD)
- Department of Local Government Service Management (DLGSM)
- Environmental Health and Sanitation Department (EHSD) of Gaborone City Council (GCC)

The linkages of the above institutions are shown in Figure 4.1 and their respective functions are described below.

Figure 4.1: Linkages of local authority with National institutional structure
Source: GoB (2002)
The national authority responsible for regulating and giving policy direction on solid waste management is the Department of Sanitation and Waste Management (DSWM). The DSWM ensures compliance with the Waste Management Act by local authorities and formulates policies on waste management for implementation at local level. The Department of Local Government and Development (DLGD) is responsible for local government policy directions as well as recommending financial disbursements to the local authority from the national government. The Department of Local Government Service Management (DLGSM) is responsible for the recruitment and training of manpower for local authorities.

At local authority level, the Gaborone City Council (GCC), through its Department of Environmental Health and Sanitation (EHSD), is responsible for the collection and disposal of waste from residential areas, institutions, industries and commercial area. The organisational structure of the City Council’s Environmental Health and Sanitation Department is shown in Figure 4.2. Figure 4.2 shows that in addition to the City Clerk, who is the overall Chief Executive of the City Council, there are eight municipal officials involved in planning and operational activities in solid waste management. Some of the responsibilities of the personnel shown in Figure 2 are briefly summarised in Table 4.1.
The responsibilities of the personnel shown in Figure 4.2 and Table 4.1 are interlinked with key personnel supporting each other in different roles. No particular officers have been specifically assigned for the development of the waste management plan as the responsibility of the local authority. There are also no officers specifically assigned to oversee recycling. This is in contrast to the practice in the UK where the trend in municipalities is to appoint recycling officers as part of their structures in waste management. For example, London Borough of Sutton and Bath, and North East
Somerset have a recycling manager and a recycling officer respectively (Roberts and Glynn 2003). The absence of organisational reform of the EHSD in recognition of the new responsibilities as apportioned by the Act means that lack of officers specifically assigned to oversee recycling can constrain development and implementation of recycling plans. This is mainly because no one in the EHSD structure is specifically bound by duty to carry out the recycling initiatives. In supporting this line of thinking, Tharum (1989) argues that the main advantage in creating a single point of prime responsibility for any waste management initiative is to be able to hold someone responsible for inaction or failure, as well as to instil a strong sense of duty to perform and accomplish one’s tasks within the institution.

However, the positive aspect of the institutional structure is that at a national level, the departments responsible for the provision of personnel, finances and, policy direction to local authorities are under the same ministry. This does not support this thesis but provides an opportunity for cooperation in the three areas to support waste management activities by local authorities. In addition, the waste management activities such as collection, disposal, planning and administration are under the same municipal department, the Environmental Health and Sanitation Department of the Gaborone City Council. In supporting this institutional arrangement, Jindal et al. (1997) argues that failure of waste management services in developing countries in Asia is usually due to fragmented management and institutional structure, with solid waste management activities being managed by more than one municipal department.
Table 4.1: Roles and responsibilities of municipal personnel

<table>
<thead>
<tr>
<th>Municipal personnel</th>
<th>Role/Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Principal Environmental Health Officer</td>
<td>Head of the Environmental Health and Sanitation Department, responsible for its day to day operations</td>
</tr>
<tr>
<td>2. Senior Environmental Health Officer</td>
<td>Responsible for planning and operations of waste management and other public health issues</td>
</tr>
<tr>
<td>3. Chief Technical Officer (waste management)</td>
<td>Plans and supervises waste collection and disposal activities at city wide level</td>
</tr>
<tr>
<td>4. Principal Technical Officer (waste management)</td>
<td>Plans and supervises waste collection and disposal activities at city wide level</td>
</tr>
<tr>
<td>5. Senior Technical Officer (west, south, north)</td>
<td>Supervises waste collection and other activities related to waste management in their assigned areas</td>
</tr>
<tr>
<td>6. Senior Technical Officer (landfill)</td>
<td>Plans and supervises landfill operations</td>
</tr>
<tr>
<td>7. Senior Health Assistant</td>
<td>Carry out public health education campaigns</td>
</tr>
<tr>
<td>8. Senior Administration Assistant</td>
<td>Keeps records of waste disposed at landfill</td>
</tr>
<tr>
<td>9. Drivers</td>
<td>Drive waste collection vehicles</td>
</tr>
<tr>
<td>10. Plant Operators</td>
<td>Operate landfill machinery such as compactors</td>
</tr>
<tr>
<td>11. Chargehands</td>
<td>Do a variety of miniature jobs mainly as messengers</td>
</tr>
<tr>
<td>12. Landfill Labourers</td>
<td>Pick up litter that spreads around the landfill</td>
</tr>
<tr>
<td>13. Refuse crews</td>
<td>Pick up litter in and around the city for proper disposal</td>
</tr>
</tbody>
</table>

Source: GCC (2001)

4.4 NGOs and CBOs

In addition to the activities of the local authority, there is an NGO, Somarelang Tikologo (Environmental Watch Botswana), which is active in environmental education including some aspects of waste management such as anti-litter campaigns and recycling. It also piloted a source separation study in 1999/2000 in Gaborone, together with the Gaborone City Council Environmental Health Department. Recently the First Lady in Botswana launched a project aimed at keeping Botswana clean called Keep Botswana Clean Up Beautiful Project (Matsoga 2000). The activities of NGOs and particularly those working in waste management are a new development in Gaborone. This has led to limited NGOs and CBOs activities in recycling. Experience in Pakistan, Brazil, Argentina, The Philippines show that NGOs and CBOs could be pioneers and leaders in supporting and organising recycling in developing countries (Lardinois and Furedy 1999). The limited
support for recycling from NGOs and CBOs may constrain the development of organised recycling schemes.

4.5 Conclusion

The following conclusions can be drawn from the assessment of the legislative and institutional frameworks.

- The Waste Management Act does not place emphasis on monitoring and acquisition of municipal waste quantity and composition data. Failure of the legislation to support acquisition of up to date waste data could limit waste management planning, including recycling.

- The legislation does not make provision for incentives/ disincentives for local authorities to comply with its requirements. This could limit local authorities participation in developing and implementing organised recycling schemes.

- There is lack of organisational reform of the EHSD of the Gaborone City Council in recognition of the new responsibilities apportioned by the Act. Lack of reform to include personnel specifically assigned to oversee recycling could limit the development and implementation of recycling plans.

- There is limited NGO and CBO activities in Gaborone. Limited NGO and CBO activities could limit initiation and support for recycling initiatives.

4.6 Waste quantities and composition

This section reports the findings of desktop surveys, mini-surveys and observation at the local landfill during the exploratory methodology. The section covers a broad range of issues; including waste quantity and composition of the basis of the landfill-weighing programme, the waste classification system, and the method of establishing the different fractions in the waste stream.
Solid waste data was not collected regularly in Gaborone until 1993. This means that data on quantities and composition of municipal solid waste is limited. An attempt to estimate the quantity and composition of municipal solid waste in Gaborone was carried out by Dohrmann et al. in 1991. The study estimated that there was a total of 84 tonnes per day of commercial, household and light industrial waste generated, of which 60 tonnes per day was disposed of at a gazetted\(^7\) disposal place, 14 tonnes per day was disposed of on site and 10 tonnes per day was recycled through private sector initiatives. The reported recycling rate of 16 percent in 1991 was substantially high by international standards. For example, municipalities of Subaraya, Indonesia and Metro Manila with organised recycling schemes reported recycling rates of 10.75 percent in 1999 and 14 percent in 2002 respectively (UNCRD 1999; Salaverria 2002). The high recycling rate can limit the potential of the local authority to divert substantial quantities of recyclables from disposal over and above the existing recycling rate. This could be a disincentive for the municipality to embark on organised recycling schemes.

The opening of a sanitary landfill in Gaborone in 1993 resulted in the establishment of a daily solid waste-weighing programme. The results of the landfill-weighing programme from 1998 to 2000 are shown in Table 4.2. The annual total waste disposed of at the landfill was 829,146,673,468 and 87,050 tonnes in 1998, 1999 and 2000 respectively (GCC 2000). Even though the landfill-weighing programme started in 1993, there are no proper records for the period prior to 1998. The absence of adequate time series data makes it difficult to establish if a trend exists on the quantity and composition of waste disposed of. This could make it difficult for the local authority to plan organised recycling schemes.

Table 4.2 also shows the typical composition of municipal solid waste from 1998 to 2000 from the landfill-weighing programme. Refuse constitutes the largest component of the waste.

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\(^7\) Designated and recognised as the official disposal site by the local government, the designation may have no scientific basis.
waste stream comprising 39, 42 and 54 percent of the total in 1998, 1999 and 2000, respectively. Refuse here refers to the waste that is collected by the local authority and or private sector from households and commercial enterprises. Naturally, this refuse is made up of all the major fractions of the municipal waste stream that are often the target for organised recycling schemes. Even though it is difficult to establish the trend of the quantity of waste disposed on the basis of absolute values, it is clear from Table 4.2 that the refuse fraction has been increasing as a proportion of the total waste disposed. The proportion of refuse increased by about 9 percent from 1998 to 1999, and by 29 percent from 1999 to 2000. The increase of the refuse fraction can potentially increase the quantity of materials to be targeted for recycling. However, because of the classification system used in Table 4.2, it is not easy to establish what proportion of the refuse is potentially recyclable. Inability to establish the proportion of refuse that is potentially recyclable could undermine the planning of organised recycling schemes.

The classification system used for reporting the landfill-weighing programme data in Gaborone is comprised of a mixture of classification by source of generation and material fractions. This classification system does not support detailed waste composition that might be required for planning purposes. A more detailed classification that adopts a micro-approach\(^8\) may enable assessment of various recycling and material recovery strategies (Waite 1995; Cerrato 2001).

Apart from the possible constraints of the current classification system adopted by the landfill-weighing programme, there has never been a waste characterisation study for the purpose of establishing the quantity and composition of waste generated at source in Gaborone. However, such waste characterisation studies are not cheap (Corbitt 1998; Pescod 1991). With already limited municipal budgets, lack of expertise and equipment, municipal authorities in developing countries are not likely to cope with the demands of

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\(^8\) The micro-approach details the different fractions of the waste stream, for example paper can be further divided into: newsprint, corrugated, books, magazines, office paper
waste characterisation studies (UNCHS 1994). Experience in UK and USA shows that such data has been obtained through national projects, financed by national government to establish an understanding of the waste generation rate and associated components to enable waste management planning (Atkinson and New 1993; Franklin Associates 1997). It is important that a detailed project to determine the quantity and composition of municipal waste stream should be undertaken by the national government to relieve local authorities of the financial burden of carrying out such studies. The absence of such data may limit the understanding of the quantity and quality of materials at the source of generation that are potential recyclable. This could lead to planners of organised recycling schemes setting unrealistic recycling targets.

Table 4.2: Annual waste disposed of at the Gaborone landfill 1998-2000

<table>
<thead>
<tr>
<th>Waste component</th>
<th>Annual waste disposed of (tonnes)</th>
<th>Annual percentage of the components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refuse</td>
<td>33908</td>
<td>28222</td>
</tr>
<tr>
<td>Garden refuse</td>
<td>17936</td>
<td>12515</td>
</tr>
<tr>
<td>Paunch</td>
<td>1948</td>
<td>2505</td>
</tr>
<tr>
<td>Rubble</td>
<td>30637</td>
<td>16352</td>
</tr>
<tr>
<td>Scrap</td>
<td>182</td>
<td>289</td>
</tr>
<tr>
<td>Yeast</td>
<td>345</td>
<td>4073</td>
</tr>
<tr>
<td>Steel</td>
<td>180</td>
<td>60</td>
</tr>
<tr>
<td>Tyres</td>
<td>398</td>
<td>358</td>
</tr>
<tr>
<td>Ash</td>
<td>1123</td>
<td>1943</td>
</tr>
<tr>
<td>Glass</td>
<td>94</td>
<td>33</td>
</tr>
<tr>
<td>Planks</td>
<td>135</td>
<td>77</td>
</tr>
<tr>
<td>Canned meat</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Saw dust</td>
<td>94</td>
<td>107</td>
</tr>
<tr>
<td>Canned food</td>
<td>60</td>
<td>20</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>82914</strong></td>
<td><strong>66734</strong></td>
</tr>
</tbody>
</table>

Source: GCC (2000)

The following conclusions can be drawn from the assessment of the existing waste quantity and composition data in Gaborone.

- Data from a 1991 study indicated that 16 percent of municipal solid waste is recycled, which represents a relatively high recycling rate by international standards. The high
recycling rate can limit the potential of the local authority to divert substantial quantities of recyclables from disposal over and above the existing recycling rate.

- The classification system used for reporting landfill-weighing programme data does not support detailed composition that might be required for planning organised recycling schemes.
- There is no data that indicates the quantity and composition of municipal solid waste from the source of generation. The absence of such data may limit the understanding of the quantity and quality of materials at the source of generation that are potential recyclables.

4.7 Waste collection, recycling and disposal

This section discusses the potential impacts of collection and disposal on recycling in Gaborone. The direct relationship between these three components of waste management appears obvious. The effectiveness of the existing collection system may reflect on the ability of the local authority to collect source separated materials. Apart from that, one of the objectives of setting up extensive recycling programmes is to reduce amount of waste to be disposed, prompted by lack of landfill space (Schertenleib and Meyer 1992).

4.7.1 Collection

There are two basic types of waste collection services in Gaborone: door-to-door collection in most residential areas; drop-off collection systems in areas where skips have been provided such as some low-income and commercial areas. In 2002, the local authority had 20 compactor trucks, three tipper trucks, one flat truck, two tractors and 2 skips carriers all acquired for waste collection (Lienbenberg and Stander 2002). However, on average, only 10 of these vehicles are operational due to frequent breakdowns and excessive delays in carrying out repairs (Lienbenberg and Stander 2002).
In addition to normal waste collection, the city council employed more than 250 litter pickers to pick litter in the open spaces and road reserves (Sithole 2001).

The collection frequency varies from daily for commercial establishments that produce large quantities of food waste, to twice a week for other premises (GCC 1996). It is not an uncommon scene to see skips in open spaces and commercial areas overflowing with waste. The author observed some skips in open areas overflowing with waste for over a month as shown in Plate 4.1. The continued existence of some overflowing skips that remained uncollected is attributed to shortage of skip carriers. In 2002, the local authority had 290 skips with volume of 5.5m³ against two skip carriers (Lienbenberg and Stander 2002). However, only 85 skips were used because of shortage of skip carriers.

Continuous breakdown of collection vehicles with excessive delays in carrying out repairs could impact on the ability of the local authority to collect the recyclables. Apart from that, overflowing of skips in open areas could indicate the local authority is already struggling to effectively collect the waste generated due to limited collection equipment. This could also impact on the ability of the local authority carry out the additional responsibility of collecting source-separated materials.

4.7.2 Recycling

There are some resource recovery initiatives by the private sector mainly motivated by the desire to earn income through collecting and selling the recyclables. The materials that are usually recovered for reuse and recycling are steel beverage cans, glass bottles and paper. All three material fractions are recovered through different systems.

Glass bottles for beer and soft drinks bottles that are bottled in Botswana are recovered through a deposit refund scheme operated by the main bottling company, Segwana,
(PTY) LTD. The scheme reported a recovery rate of 90 percent of returnable bottles nationally. This is a relatively high recovery rate. The high recovery rate achieved by the scheme could be a disincentive for the local authority to organise recycling schemes that target this fraction of the waste stream. A more detailed discussion of this scheme is in Chapter 7.

The recycling of steel beverage cans in Gaborone is carried out through a buy back scheme operated by Collect-A-Can, Botswana. The company was set up and is fully financed by the South African Canning and Steel Industry as part of producer responsibility initiatives. The company pays cash for beverage cans that are delivered to the Gaborone Depot from sources such as pubs, households and others. Collect-A-Can reported that there were about five individuals who regularly collected some of the cans that are dispersed as litter from different parts of the city and the landfill and deliver them to the company’s depot in Gaborone for a fee. In 2002, the company reported to be collecting 320 tonnes of steel beverage metal cans per month nationally. This was reported to represent 65 percent diversion rate of steel beverage cans from disposal. The 65 percent diversion rate is relatively high. The high recovery rate achieved by the scheme could be a disincentive for the local authority to organise recycling schemes that target this fraction of the waste stream. The buy back scheme is discussed in more detail in Chapter 7.

There are various paper recovery initiatives. The most visible ones are by Pyramid Holdings and Botswana Tissue that collect paper and cardboard from commercial enterprises. These companies have made arrangements with some commercial enterprises to set aside paper and cardboard for collection, apart from that coated in plastic. The recovered paper is exported to paper mills in Zimbabwe and South Africa. However, some of the commercial enterprises have reported that the companies are not effective in collecting the source-separated materials, resulting in their disposal because of lack of
storage space. Lack of storage space and ineffective collection of the materials could undermine continued source separation.

In addition to the above initiatives, Somarelang Tikologo, an environmental NGO, and Gaborone City Council jointly piloted a household waste source separation study in Gaborone (Somarelang Tikologo 2001). Gabororone City Council provided the waste bins that were used to store the recyclables as well as the field officer who guided the participants on separation. A summary of the pilot project is described in Box 4.1. A more detailed discussion of the objectives of piloting the scheme as outlined by each stakeholder is given in Chapter 6.

From the description of the pilot project in Box 4.1, the following issues emerge:

- Of the 45 households who were willing to participate in the pilot project, six of them did not participate. This shows that expression of willingness to participate does not necessarily translate into actual participation. Failure to translate willingness to participate into actual participation could undermine the development of organised recycling schemes.

- Generally household need continuous education and assistance in getting the separation of the required materials correct. Limited manpower could undermine the ability of local authorities to render such assistance hence undermining the success of organised recycling schemes.

- On the basis of the pilot source separation project, it appears there is limited technical knowledge by both the local authority and the NGO on organising recycling schemes. For example, on piloting the project, the 45 selected participants were distributed over several areas of the city. This eventually presented logistical problems. The lack of expertise can constrain the development of organised recycling.

- Organised recycling is an expensive undertaking, which is unlikely to be self-sustaining, nonetheless the NGO want the local authority to implement it. This could
put the local authority in financial difficulties, hence constraining organised recycling.

A more detailed inventory of recycling activities was carried out by the market survey and is reported in Chapter 7.

4.7.3 Disposal

Most of the collected municipal solid waste is disposed of at the Gaborone landfill, which was opened in 1993 and located about 5km from the city centre (see Map 1 in Appendix B). The landfill site measures 630m by 340m and is equipped with a weighbridge. The site is fenced and has four leachate quality monitoring boreholes. In 2002, the landfill equipment consisted of two compactors, one tanker truck, one bulldozer, one front-end loader and one tipper truck (Liebenberg and Stander 2002). Due to persist breakage in equipment used for landfilling, some parts of the landfill are almost operated like a dumpsite with no daily cover of waste. Plate 4.2 shows the operating state of the current landfill with uncovered waste and fires. Waste that is not collected is either disposed illegally in open space and open drains, or dispersed as litter.

Continuous breakage of equipment resulting in uncovered waste and landfill fires could indicate the inability of the local authority to operate the landfill properly because of shortage of resources. An additional responsibility on the local authority such as recycling could further limit their ability to carry out effective disposal by placing more demands on their waste management resources. Limited waste management resources could constraint the involvement of the local authority on recycling.
In November 1999 Somarelang Tikologo (an environmental NGO) in collaboration with Gaborone City Council, piloted a household waste source separation project. Recycling companies also assisted by collecting the separated materials. The project was initiated in support of the government's desire to support recycling as captured by the Waste Management Strategy and the Waste Management Act of 1998. The main objectives of the pilot source separation project study were to raise environmental awareness through practical projects and to estimate the quantity of the recyclable content of the household waste stream. The project operated for nine months and involved 45 households selected randomly from areas spread across the city that were identified as being, low, medium and high income. Only 45 households were selected for the pilot project because it was seen as manageable in number. The selected households were asked to participate by Somarelang Tikologo writing them a letter. Of the selected households who agreed to participate, six did not separate their waste. Each household was provided with three bins and asked to separate their waste into glass, cans and paper. The residual waste was deposited into ordinary household bins. Initially the participants did not get the separation right, but with assistance from field officers, they eventually got the separation right. The separated materials were collected by recycling companies and sold. The main problem encountered during piloting was that houses were located in different areas, which made it difficult to locate at times, and increased the costs of collection for recycling companies. The project concluded that, households in urban Botswana have the capacity and willingness to source separate household waste with appropriate assistance. It also concluded that there was successful environmental education and environmental awareness amongst participating stakeholders. Despite the fact that the financial costs of the pilot source separation project were higher than the financial benefits, the study recommended that local authorities should include household waste source separation and recycling in their waste management plans.
Plate 4.1: Overflowing skip in open space

Plate 4.2: Poor operation with uncovered waste and waste burning at Gaborone landfill
4.7.4 Conclusion

The following conclusions can be drawn from the assessment of the existing waste collection, recycling and disposal systems in Gaborone.

- There is shortage of collection and landfill operation equipment as a result of limited financial resources, breakdowns and poor maintenance schedule. This has impacted on the ability of the local authority to effectively collect and dispose solid waste. Collection of recyclables could place further resource strain on the local authority.
- There is limited technical knowledge on organising recycling schemes by both the local authority officials and NGO officials. Limited technical knowledge could undermine the development of effective organised recycling schemes.
- Lessons learnt from the pilot source separation project indicated that organised recycling schemes are an expensive undertaking, which is unlikely to be self-sustaining. Organisation of organised recycling schemes could place financial strain on the local authority.
4.8 Financing and cost recovery for solid waste services

The local authority finances most of the urban infrastructure services including municipal solid waste services through financial grants from the Central Government. The funds are disbursed through the Department of Local Government and Development in the Ministry of Local Government (see Figure 4.1). In addition to public funds, the local authority also generates income from property taxes and service levy. Figure 4.3 below summarises typical cash flows into and out of the local authority related to the financing of the competing urban services, including waste management.

![Diagram of cash flow in and out of municipal authority for urban services]

Figure 4.3: Typical Cash flow in and out of municipal authority for urban services
Property taxes are paid by urban dwellers that own property in areas other than site and service areas. The tax is paid for services that are provided by the local authority such as refuse collection and disposal, street lighting, roads, sewage system, fire brigade and primary education (GCC 1997). Public places, such as hospitals and schools, are exempted from the tax. The tax is paid in relation to the value of the property, as shown in Table 4.3, with more expensive properties attracting a higher tax rate. Undeveloped properties attract a high percentage of property value as tax to encourage development. The property tax is in essence a hidden incentive in as far as waste collection and disposal is concerned. Most people do not even know that waste management is covered by the tax (Kgathi and Bolaane 2001).

Table 4.3: Relationship between category of plot and properties tax

<table>
<thead>
<tr>
<th>Category of plot</th>
<th>Annual property tax as percentage of property value (1996-97)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential developed</td>
<td>1.1</td>
</tr>
<tr>
<td>Residential-undeveloped</td>
<td>4.3</td>
</tr>
<tr>
<td>Commercial and industrial-developed</td>
<td>1.3</td>
</tr>
<tr>
<td>Commercial and industrial-undeveloped</td>
<td>5.2</td>
</tr>
</tbody>
</table>

Source: GCC (1997)

An alternative to property tax in site and service areas is the service levy. The service levy is a tax that covers similar services, like those covered by property tax. However, the levy is not related to the value of property. It is usually a flat rate with a very small component of it targeted for solid waste collection and disposal. Table 4.4 shows the level of the service levy in Gaborone for 1978, 1980, 1983 and 1992 and the proportion of the solid waste component in the levy. The solid waste component in the levy seems to be arbitrarily set, for example, in 1978, 1980, 1983 and 1992, it constituted 12.0, 12.4, 3.1 and 2.2 percent respectively. This implies that as the service levy is increased, the proportion for waste management is decreasing, undermining the importance of solid waste management.

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9 These are low-income areas where only basic services such as waste collection, water and street-lighting are provided.
waste management in the set of infrastructure services covered by the levy. The decreasing proportion of the solid waste component could decrease financial resources for waste management. Decreased financial resources for waste management could limit the potential of the local authority to engage in organised recycling schemes.

Table 4.4: Annual service levy and solid waste component

<table>
<thead>
<tr>
<th>Year</th>
<th>Service levy (P*)</th>
<th>Proportion of Solid waste component in the service levy (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978</td>
<td>1.00</td>
<td>12.0</td>
</tr>
<tr>
<td>1980</td>
<td>5.00</td>
<td>12.4</td>
</tr>
<tr>
<td>1983</td>
<td>8.00</td>
<td>3.1</td>
</tr>
<tr>
<td>1992</td>
<td>12.00</td>
<td>2.2</td>
</tr>
</tbody>
</table>

*p is Botswana currency known as Pula with international notation BWP
Source: Kgathi and Bolaane (2001)

Apart from property tax and service levy, there are no other direct incentives for waste generators to reduce the quantity of waste disposed of. Absence of such incentives could limit households' participation in waste minimisation measures such as source separation for recycling.

The annual operational budget for waste management has remained relatively constant over three financial years at P6 902 523; P6 318 670 and P6 793 020 respectively for financial years 2000/01; 2001/02 and 2002/03 (GCC 2003). The budget has relatively remained constant despite the increased local authority responsibility of formulating waste management and recycling plans, and implementing them. Stagnation of waste management budget could limit the ability of the local authority to carry out responsibilities such as organising recycling.

There are no incentives by the national government for local authorities to engage in organised recycling schemes. Developments in other countries like the UK show national governments not only require local authorities to engage in recycling activities, but they also offer financial incentives that are directly intended to finance them. For example,
recycling credits in the UK are used to promote organised recycling (DoE 1990a). In addition, the Waste Minimisation and Recycling Fund in England provides direct financial incentives to municipalities for embarking on organised recycling schemes (Defra 2002). Lack of financial incentives could limit the ability of local authorities to organise recycling schemes.

The following conclusions can be drawn from the assessment of the financial and cost measures for waste management in Gaborone.

- There are no direct user charges for solid waste management. This could be a disincentive for waste generators to participate in waste minimisation measures such as source separation.
- There are no financial incentives from the national government for local authorities to engage in organised recycling scheme. This could limit their ability to implement such schemes.
- The proportion of solid waste component in the service levy had been decreasing, which could reduce the local authority’s waste management financial resources. In addition, the local authority’s waste management operational budget has relatively remained constant over three financial years despite an addition of responsibilities. Limited financial resources can limit the ability of the local authority to engage in organised recycling schemes.

4.9 National Waste Management Strategy

The Botswana Waste Management Strategy (BWMS) came into being in 1998. The strategy adopts the Waste Management Hierarchy as the main guiding principle. The main objective of the strategy is put forward as to protect human health, the environment and conserve natural resources. Among the core components of the strategy are:

- Creation of the Department of Sanitation and Waste Management
• Enactment of appropriate legislation
• Recycling selected waste streams
• Public awareness campaigns

The strategy recognises the need for reliable data for planning solid waste management services. It requires local authorities to collect local waste data to be used in drawing local waste management plans. The irony of this is that the strategy itself is not based on comprehensive national waste data in contrast to similar strategies such as Waste Strategy 2000 for England and Wales, which was based on comprehensive waste quantity and composition data (DETR 2000). For example, at the time of the strategy only the Gaborone landfill had a landfill-weighing programme, while most areas were serviced by dumpsites with no means of estimating the quantity of waste disposed. There were no waste characterisation and sampling studies that were carried out prior to the development of the strategy. Some of the data used in the strategy is misleading. For example, the waste generation per capita for each local authority in 1996 was based on population statistics of 1991. Lack of data or use of inappropriate data could undermine effective planning and execution of organised recycling schemes.

Despite the recognition of the need for accurate data for purposes of planning waste management by the strategy, the Waste Management Act, 1998 does not explicitly require local authorities monitor, collect and store local waste data. This discrepancy between the BWMS and WMA is problematic because they are supposed to lead in the same direction. Inconsistencies within official documents that are intended to support recycling can undermine its implementation. For example, the strategy proposes regulation of the deposit refund scheme for returnable beverage bottles through the WMA, but there is no such regulation in the Act.

The strategy undertakes to encourage recycling through procurement policies that favour goods with recycled content, and promotion of source separation. The resultant effect of
these undertakings is two strategies: on recycling metal wastes; and recycling paper, glass and packaging waste. The strategy on recycling metal waste of 1996 proposed setting up recycling centres in the major towns and cities of Gaborone, Francistown, Selebi-Phikwe and Lobatse by local authorities with the help of national government and private sector (GoB 1996). By 2002, none of the recycling centres had been established. The strategy for recycling paper, glass and metal waste of 1998 proposed setting up of pilot recycling centres in Maun, Fracistown and Gaborone by local authorities, national authorities, private sector and NGO (GoB 1998c). By 2002, none of the proposed pilot projects had been undertaken. Failure to set up recycling centres and implement pilot projects could indicate lack of implementation capacity by the local authority. Lack of implementation capacity could impact on the ability of local authorities to organise recycling schemes.

The following conclusions can be drawn from the assessment of the Botswana National Waste management Strategy:

- There are inconsistencies within official documents that are intended to support recycling. These inconsistencies could undermine the support and development of organised recycling schemes.

- The waste management strategy was based on limited and sometime misleading waste generation data. The use of limited data could undermine planning recycling activities.

- There is limited or lack of implementation capacity at local and national level. Lack of implementation capacity can undermine implementation of organised recycling schemes.
4.10 Summary

This chapter discusses a number of constraints to organised recycling. The identified constraints are related to the prevailing waste management system. Among the constraints is that there is limited waste quantity and composition data, and where such data is available, it is not in an appropriate classification schemes to enable adequate planning for recycling. There is also limited or lack of implementation capacity of waste management plans by both local and national authorities. The major constraint is that there are no direct incentives for both generators and local authority to engage in organised recycling schemes. In addition, the local authority has limited financial, equipment and financial resources for waste management and is already struggling with collection and disposal.

There is also limited NGO and CBO activity in waste management to support recycling activities. This is compounded by limited technical knowledge on organising recycling schemes by key stakeholders of local authority and NGO officials. In addition, the reported recycling rate in 1991 at 16 percent was already high by international standards, which could be a disincentive for the municipality to get involved. Furthermore, there is lack of institutional reform of the municipal waste management department in recognition of the new responsibilities apportioned by the Act such as recycling.
5 RECYCLABLE CONTENT OF THE WASTE STREAM

5.1 Introduction

Chapter 4 gave an overview of waste management in Gaborone focusing on institutional and legislative frameworks. This chapter presents and analyses the main research findings from the survey of the quantity and composition of household and commercial waste by the methodology described in section 3.8.1 in chapter 3. In particular, the main intention of this chapter is to provide evidence to support the research question:

What constraints could the proportion of municipal solid waste generated in Gaborone that is potentially recyclable impose on organised recycling?

The results and analysis are presented around the guiding hypothesis that:

Despite the projection of organised recycling as an effective means to enhance waste recycling, its practicality as a waste management strategy in developing countries is constrained by the realities on the ground.

The chapter is organised into waste quantity and generation rates, waste composition; and a summary of the main points.

5.2 Waste quantity and generation rates

The literature shows that the waste quantity and generation rate vary from one city to another and between countries (Diaz et al. 1993; UNCHS 1994; UNEP 2000). Generally, the waste generation rate in developing countries is lower than in developed countries. Lower waste generation rates could impact on the requirements of disposal facilities. The higher the waste generation rate, the higher the demand for disposal facilities. In addition, the waste generation rate could impact on the generation of the different materials that could potentially be recovered by organised recycling schemes as shown in Table 5.4.
The main generators of solid waste in Gaborone are households and commerce. The landfill-weighing programme shows that refuse which refers to household and commercial wastes, constitute the largest proportion of the waste stream at 54.4 percent (GCC 2000). Due to limited industrial activity, industrial waste is limited. Industrial activity, which is dominated by manufacturing of clothing and fabrication of metal products excluding machinery, represents 1.1 percent of the economic activities (CSO 2002). This section discusses the quantity and generation rate for both households and commercial waste in Gaborone.

5.2.1 Household waste

Household waste quantity and composition data were obtained by a household waste sampling survey at the source of generation. The survey obtained 893 samples from 47 households over 21 days during the months of July and August 2001. Each sample was weighed and recorded.

From the analysis of survey data, it was found that the average waste generated by different socio-economic categories in Gaborone as described in section 3.9.1 is as detailed below:

1) Low income \(0.35\)kg/capita/day
2) Medium income \(0.35\)kg/capita/day
3) High income \(0.27\)kg/capita/day

The results show that the average waste generation rates from low- and medium-income groups are the same. This could be because the lifestyles of these two income groups are not significantly different. However, waste generation rates by high-income groups were lower than those by low-income groups. This is not in agreement with common
understanding that the waste quantities generated are directly proportional to household income levels (Abu Qdais et al. 1997; Diaz et al. 1993). The reason for such a pattern mainly lies in the lifestyle and the type of food consumed. While high-income generate significant proportions of packaging waste, the low-income generate wet food waste, typified by soft porridge, which is a popular staple diet, particularly by low-income households. Wet waste generally weigh more than the predominantly dry packaging waste, that is common in high-income.

Since the weighted average presents an unbiased estimate of the mean by minimising the sampling error (Weiss 1989), the resultant weighted average of waste generation rate for all income groups in Gaborone was calculated as:

$$\frac{(0.352 \times 43\%) + (0.352 \times 30\%) + (0.269 \times 27\%)}{100\%} = 0.330 \text{Kg/capita/day}$$

On the basis of the city’s population of 186,000 (CSO 2001) and the weighted household waste generation rate of 0.330 kg/capita/day the total waste generated was calculated as 22404 tonnes/year, which is equivalent to a household generation rate of 61 tonnes/day.

5.2.2 Commercial waste

Commercial waste quantity and composition was obtained by sampling at the landfill during the month of September 2001. Sampling at the landfill was made easier by that, because of the reported inefficient collection of commercial waste by the local authority, some commercial sectors both collect and dispose of their waste or hire private collectors. This has resulted in some waste arriving at the landfill as pure commercial waste. In addition, the local authority also collects some commercial waste separately at the end of trading period. The commercial waste weighing-programme was carried out over a continuous seven-day period, which resulted in a total of 90.9 tonnes of commercial
waste weighed. A total of 129 waste carriers were weighed with weights ranging between 20kg and 5460kg. The large variation between weights was due to that some commercial waste was delivered to the landfill from single commercial enterprises, while those delivered by the local authority at the end of the trading period was often collected from several commercial enterprises. On the basis of the weighing programme results, it was estimated that the quantity of commercial waste generated was 4740 tonnes/year, which is equivalent to 13 tonnes/day.

5.2.3 Reliability and implications of waste quantity results

To check the reliability of the household and commercial waste surveys, the results of this study were compared with similar studies in Gaborone. In addition, the waste quantity data were compared with the results from the landfill-weighing programme. Table 5.1 compares the results of the household and commercial waste survey with a study carried out by Liebenberg and Stander (2002). The Liebenberg and Stander study showed that the household waste generation rate was 0.40kg/capita/day, which is 21 percent higher than the results of this study. The difference could be attributed to the different household occupancy rate used to compute the per capita waste generation rate. The Liebenberg and Stander study used a time and motion study to sample and weigh household waste in primary storage containers following collection trucks on their routine door-to-door collection service. The waste generation rate per capita was based on an assumed occupancy of 4.8 persons/plot. However, this study established that in low-income areas there are usually more than one household in one plot using the same primary storage container at the entrance to the plot. The average number of people per household was estimated to be 4.8 persons/household (CSO 2002). In reality, using the assumed occupancy of 4.8 persons/plot as opposed to 4.8 persons/household will tend to overestimate the per capita waste generation. However, it appears if the same household occupancy rate was used, the per capita waste generation rate could be of similar magnitude.
Table 5.1: Comparison of waste generation rate of this study and that by Liebenberg and Stander

<table>
<thead>
<tr>
<th>Sources of waste</th>
<th>This study (kg/capita/day)</th>
<th>Liebenberg and Stander (2002)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household waste generation rate</td>
<td>0.33</td>
<td>0.40</td>
</tr>
<tr>
<td>Commercial waste generation rate</td>
<td>0.07</td>
<td>*</td>
</tr>
<tr>
<td>Total (kg/capita/day)</td>
<td>0.40</td>
<td>0.48**</td>
</tr>
</tbody>
</table>

*The study did not estimate commercial waste generation rate separately

**Based on landfill data, Liebenberg and Stander estimated the refuse generation rate (household and commercial waste) excluding industrial, heavy garden waste and special wastes of this magnitude

Source: Liebenberg and Stander (2002)

It is difficult to directly compare the quantity of waste from household and commercial waste surveys of this study with that from the landfill-weighing programme. This is mainly because of the classification scheme adopted for recording the waste quantities by the landfill-weighing programme does not clearly distinguish between household and commercial waste. The classification scheme used at the landfill broadly describes waste from households, commerce, institutions and light industrial as refuse, whilst this study mainly focused on household and commercial waste as separate waste streams. However, apart from the landfill-weighing programme data, no other data sources are available to enable such a comparison. This study estimated that the combined of household and commercial waste generated in Gaborone was 27144 tonnes/year, which is equivalent to 0.40 kg/capita/day. But because of low industrial activity (see section 5.2) this represents the highest proportion of the waste that has to be handled by the local authority.

Limited results of the landfill-weighing programme are presented in Table 4.2 in chapter 4.

A comparison the waste generation rates for Gaborone and other areas is made difficult by that there is limited published data that specifically relate to household and commercial waste. Most studies reported the results of the combined municipal waste stream as measured from disposal sites (Blight et al. 1999, Martin et al. 1995). A few
studies were identified that enabled a comparison of household generation rates in Gaborone and other cities as shown in Table 5.2. However, because of the difference in time frames during which the data were obtained, the comparison only serves to highlight the scale of waste generation in different areas. In addition, because of limited resources, this study carried out a cross-sectional survey during winter, the data indicated does not take into account seasonal variability. It is possible that there might be some difference in the generation rate during the harvest season, which is usually around February, March, April. Apart from that, because of cultural limitations such as fear of taboos (e.g. witchcraft) some households might have been reluctant to place some of their waste in the allocated plastic bags. This could have impacted on the accuracy of the results. The data in Table 5.2 clearly confirms that the household waste generation rate varies from one city to another, with cities/municipalities in developed countries exhibiting relatively high generation rates. This variation could reflect the relative demand of treatment and disposal facilities between these areas. Cities/municipalities with high generation rates could experience a relatively higher demand for treatment and disposal facilities.

Table 5.2: Comparison of waste generation rate across different areas

<table>
<thead>
<tr>
<th>Area</th>
<th>Household waste generation rate (kg/capita/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dublin (Ireland)1</td>
<td>1.28</td>
</tr>
<tr>
<td>Geneva (Switzerland)2</td>
<td>1.34</td>
</tr>
<tr>
<td>Abu Dhabi (United Arab Emirates)3</td>
<td>1.76</td>
</tr>
<tr>
<td>Hong Kong4</td>
<td>1.06</td>
</tr>
<tr>
<td>Beirut (Lebanon)5</td>
<td>0.75</td>
</tr>
<tr>
<td>Ojinaga (Mexico)6</td>
<td>0.60</td>
</tr>
<tr>
<td>Petaling Jaya (Malaysia)7</td>
<td>0.36</td>
</tr>
<tr>
<td>Gaborone (Botswana)</td>
<td>0.33</td>
</tr>
</tbody>
</table>

Sources: 1Dennison et al. (1992); 2Leroy et al. (1992) 3Abu Qdais et al. (1997); 4Ayoub et al. (1996); 6BECC (2000); 7Malek et al. (1996)

The findings in chapter 6 reveals that the key stakeholders of municipal officials, NGO(s) and national authorities support organised recycling because it is seen as having the potential to reduce the quantity of waste disposed. This means that the main objective of municipal involvement in organised recycling would be to reduce the quantity of waste to
be disposed. The relatively lower waste generation rate in some cities in developing countries like Gaborone as shown in Table 5.2 could be a disincentive for municipalities to engage in waste diversion measures such as recycling as a means of reducing the quantity of waste disposed. For example;

- Lower waste generation rates could mean less pressure on disposal facilities. Limited pressure on disposal facilities could lead to the main preoccupation of such municipalities being basic operations of efficient collection and disposal (UNEP 2000; GARNET 2000).

- Lower generation rates could mean few landfill developments. This may not highlight the environmental problems of waste disposal necessary to trigger public debate in waste management issues such ‘NIMBY’ that often lead to public pressure on local authorities to set up recycling schemes (McDougall et al. 2001; The Economist 1991; van Beukering 1999).

- Municipalities not experiencing shortage of land for disposal may not be inclined to embark on waste diversion measures. For example, GoB (1999) found that recycling in Botswana was hampered by relatively cheap disposal costs as a result free to land for waste disposal.

- Lower waste generation rates could mean disincentives offered by the municipality that are intended to reduce the quantity of waste disposed such as direct user charges will have little impact in reducing the quantity of waste that is already low.

5.3 Waste composition

Waste composition is an important factor in planning waste management activities, including recycling. The determination of waste composition was carried out for both household and commercial waste. The objective of composition determination was to understand the proportion of the waste stream that can potentially be recycled. This section discusses the composition and potential recyclable content of both household and commercial waste in Gaborone.
5.3.1 Household waste

The 893 samples obtained from households were collected daily from households and taken to the Gaborone landfill for sorting and weighing. The classification scheme used was adopted from the Life Cycle Inventory model (McDougall et al. 2001), which comprised of food and garden waste, paper, glass, metals, plastics, textiles and other. The classification scheme was adopted because it presents a clear classification.

Figure 5.1 shows the average composition of household waste in Gaborone, and the break-down of the components into the different socio-economic groups. As shown in Figure 5.1, putrescible waste at 67.9 percent of the total waste generated constituted the largest portion of household waste, which is as expected in a developing country (Femandez 1996; Palmer Development Group 1996; Diaz et al. 1993). It can also be observed from the Figure 5.1 that packaging waste (paper and plastics) increased with increase in income level. This was generally expected since medium and high-income households are more likely to buy a variety of ready-made foodstuff in packages than the low income ones who quite often prepare very basic meals from their houses (UNCHS 1994; McDougall 2000).

Table 5.3 compares household waste composition in Gaborone and other areas in developed and developing countries. It is clear from Table 5.3 that composition of waste varies from one area to another. However, the inorganic fractions of paper, glass, plastic, metal and textile that are often the target for organised recycling schemes are relatively lower in developing countries.
Figure 5.1: Household waste composition by income groups

Table 5.3: Comparison of waste composition between areas with different level of development

<table>
<thead>
<tr>
<th>Waste component</th>
<th>Gaborone</th>
<th>Beirut, Lebanon¹</th>
<th>Bandung, Indonesia²</th>
<th>Dublin³</th>
<th>Geneva⁴</th>
<th>Abu Dhabi⁵</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper</td>
<td>12.5</td>
<td>13.7</td>
<td>10</td>
<td>18.7</td>
<td>21.5</td>
<td>6</td>
</tr>
<tr>
<td>Glass</td>
<td>6.2</td>
<td>5.2</td>
<td>0.4</td>
<td>5.4</td>
<td>13.0</td>
<td>9</td>
</tr>
<tr>
<td>Plastics</td>
<td>6.4</td>
<td>11.1</td>
<td>9</td>
<td>16.1</td>
<td>7.5</td>
<td>12</td>
</tr>
<tr>
<td>Metals</td>
<td>4.5</td>
<td>2.7</td>
<td>1</td>
<td>2.9</td>
<td>3.8</td>
<td>8</td>
</tr>
<tr>
<td>Textile</td>
<td>1.3</td>
<td>3.3</td>
<td>1</td>
<td>2.6</td>
<td>7.2</td>
<td>-</td>
</tr>
<tr>
<td><strong>Sub-total inorganic waste</strong></td>
<td><strong>30.9</strong></td>
<td><strong>36</strong></td>
<td><strong>21.4</strong></td>
<td><strong>35.7</strong></td>
<td><strong>53.0</strong></td>
<td><strong>35</strong></td>
</tr>
<tr>
<td>Putrescible</td>
<td>67.9</td>
<td>61.7</td>
<td>73</td>
<td>34.2</td>
<td>35.2</td>
<td>49</td>
</tr>
<tr>
<td>Other</td>
<td>1.2</td>
<td>2.3</td>
<td>6</td>
<td>20.1</td>
<td>11.8</td>
<td>16</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100.0</td>
<td>100</td>
<td>100</td>
<td>100.0</td>
<td>100.0</td>
<td>100</td>
</tr>
</tbody>
</table>

*This is mainly ash/dust

Sources: ¹Ayoub et al. (1996); ²Listyawan (1997) ³Dennison et al. (1992); ⁴Leroy et al. (1992); ⁵Abu Qdais et al. (1997)
As assessment of generation rates by material component as reflected in Table 5.4 shows that the highest weighted average generation rate was of putrescibles at 0.22kg/capita/day with the low-income households generating more at 0.25kg/capita/day. A combined weighted average generation rate for the traditional recyclables of paper, glass, plastic, metal and textile was 0.10kg/capita/day. On a daily basis, the largest quantity of the waste component generated was putrescible at 40.2 tonnes/day and paper at 8.0 tonne/day represents the second largest component generated. A combined daily generation for the traditional recyclables was 20.1 tonnes/day.

<table>
<thead>
<tr>
<th>Waste component</th>
<th>Waste generation rate (kg/capita/day) by household income</th>
<th>Waste generation rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Putrescibles</td>
<td>0.25</td>
<td>0.20</td>
</tr>
<tr>
<td>Paper</td>
<td>0.04</td>
<td>0.05</td>
</tr>
<tr>
<td>Glass</td>
<td>0.01</td>
<td>0.04</td>
</tr>
<tr>
<td>Film plastic</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Hard plastic</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Metal</td>
<td>0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>Textile</td>
<td>0.00</td>
<td>0.01</td>
</tr>
<tr>
<td>Other</td>
<td>0.01</td>
<td>0.00</td>
</tr>
<tr>
<td>Total</td>
<td>0.35</td>
<td>0.35</td>
</tr>
</tbody>
</table>

The reliability of household waste composition data from this study was checked by comparing of generation rates of certain materials with those obtained through the pilot source separation project as shown in Table 5.5. It is clear from Table 5.5 that the results of the waste characterisation programme are similar in waste quantities to that of the pilot source separation pilot project, but the average generation rate for metals from the pilot project only refers to beverage steel cans. Paper constituted the highest generation rate with glass the second highest generation rate and metals the lowest.
Table 5.5: Comparison of material generation rates between this study and the pilot project

<table>
<thead>
<tr>
<th>Material fraction</th>
<th>Average generation rate (kg/capita/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>This study</td>
</tr>
<tr>
<td>Paper</td>
<td>0.04</td>
</tr>
<tr>
<td>Metals</td>
<td>0.01</td>
</tr>
<tr>
<td>Glass</td>
<td>0.02</td>
</tr>
</tbody>
</table>

*Refers specifically to beverage steel cans; **Refers to all glass other than returnable beverage bottles

Source: ¹Somarelang Tikologo (2001)

5.3.2 Commercial waste

A total of 35 samples of commercial waste were obtained at the landfill over seven consecutive days for sorting. The 35 samples, composition and weight are shown in Table 1 in appendix A. The sample weight varied between 2.495 and 27.645 kg. It is clear from the table that some of the materials occurred as ‘pure’ recyclables that could potentially be intercepted for recycling before disposal. The total volume of the sorted material was approximately 105 m³. The results of the sorting programme for commercial waste are shown in Table 5.6. The largest constituent of commercial waste was putrescible waste at 53.8 percent. Paper constituted the second highest component at 23.5 percent. The combined composition of the traditional recyclables of paper, glass, plastic, metal and textile was 45.9 percent.
When taking into consideration that the estimated commercial waste generation rate is 13 tonnes/day (4740 tonnes/year), the daily generation rate of each material component is as shown in Table 5.6. The highest generation rate was that of putrescibles at 7 tonnes/day. Paper had the second highest generation rate at 3.1 tonnes per day. The combined generation rate of the traditional recyclables was 6.0 tonnes/day.

It must, however, be noted that there were some paper recovery activities that took place at some commercial areas. These activities were highlighted in Chapter 4 and are discussed in detail in Chapter 7. This means that sampling at the landfill does not strictly indicate the quantity of paper generated at source, since it does not account for the paper recovered by these activities. The figures discussed in Figure 5.2 and Table 5.6 reflect the
proportion of paper destined for disposal, not necessarily generated at source. This can limit the understanding of how much paper is generated at commercial sources prior to recovery.

Table 5.6: Commercial waste generation rate by components

<table>
<thead>
<tr>
<th>Waste component</th>
<th>Average generation rate (tonnes/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Putrescibles</td>
<td>7.0</td>
</tr>
<tr>
<td>Paper</td>
<td>3.1</td>
</tr>
<tr>
<td>Glass</td>
<td>0.7</td>
</tr>
<tr>
<td>Film plastic</td>
<td>1.1</td>
</tr>
<tr>
<td>Hard plastic</td>
<td>0.3</td>
</tr>
<tr>
<td>Metal</td>
<td>0.7</td>
</tr>
<tr>
<td>Textile</td>
<td>0.0</td>
</tr>
<tr>
<td>Other</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13.0</strong></td>
</tr>
</tbody>
</table>

5.3.3 Implications of results on waste composition

Data in Tables 5.3 and 5.6 show that organised recycling schemes that target the inorganic waste could achieve relatively lower diversion rates from disposal in developing countries. Data emerging from other areas in developing countries have shown that municipally organised recycling schemes targeting inorganic waste have achieved minimal diversion rates from disposal (Noor 1996; UNCRD 1999). For example, a source separation scheme operated by Petaling Jaya Municipal Council in Malaysia reported a waste diversion rate of 1.5 percent of the total municipal waste stream (Noor 1996). In addition, an organised recycling scheme in Surabaya, Indonesia operated by the municipality is reported to be diverting 23.13 percent of the total waste stream of both wet and dry waste, but 10.8 percent when only the inorganic waste are taken into consideration (UNCRD 1999).

Lower diversion rates through targeting inorganic waste could be a disincentive for municipalities that embarked on organised recycling schemes with maximising diversion from disposal as the main objective. For example, a recycling venture in the Durban Metropolitan known as ‘Greensavers’ was stopped at the end of 1994 as Durban Solid
Waste found that the waste stream was only being reduced by 1 to 2 percent and the operating company, Mondi was finding the venture not economically viable (Palmer Development Group 1996). In addition, some Material Recovery Facilities (MRFs) installed in Metropolitan Manila have been severely criticised by the chairman of Manila Metropolitan Development Authority (MMDA). The criticism emanated from the fact that the facilities were intended to reduce the quantity of waste disposed by 60 percent but only achieved a reduction rate of 14 percent and are reportedly idle (Salaverria 2002). This has been attributed to the fact that recycling was already done at household level and limited recyclable waste reached MRFs. This had led the MMDA to explore other cheaper alternatives to MRFs to take care of Metro Manila’s waste.

In addition to the lower generation rate of inorganic waste, the proportion of waste that can potentially recycled and diverted from disposal could further be limited by:

- Degree of contamination
- Public participation
- Post-consumer material markets

Limited work has been done on the impact of contamination on the quantity of waste available for recycling. In the UK, a model based on work done at Warren Spring Laboratory estimates the proportion of dry household waste available for recycling taking contamination into consideration (Atkinson and New 1993). The model is based on practical results of source separation schemes in the UK. But because of the variation of waste composition from one area to another, the proportion of ‘clean waste’ available for recycling is likely to vary accordingly. In addition, the model is likely to overestimate the quantity of materials available for recycling in developing countries as a result of difference in quality of materials in the household waste stream. For example, during household waste sampling in Gaborone, households were requested to separate their waste into wet and dry fractions. It was observed that the quality of the dry waste fractions particularly paper and plastic was poor. The paper and plastic often occurred in
small pieces, and was smeared with food waste despite being separated at source. Even though the model cannot be directly applied to estimate the proportion of 'clean waste' in Gaborone, it is used here to give indicative results.

The recyclable content of household waste in Gaborone estimated on the basis of the UK model is presented in Table 5.7. Table 5.7 shows that the total inorganic waste that can potentially be recycled in household waste is 20.5 percent of the total waste stream; with paper being the largest constituent at 7.5 percent.

Table 5.7: Estimated generation rate of clean inorganic content of household waste

<table>
<thead>
<tr>
<th>Waste component</th>
<th>Percentage by weight (A)</th>
<th>Clean material as percentage of (A) (B) 1 %</th>
<th>Clean material as percentage of total waste (A)x(B)/100%</th>
<th>Clean waste generation rate (tonnes/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper</td>
<td>12.48</td>
<td>60</td>
<td>7.49</td>
<td>4.6</td>
</tr>
<tr>
<td>Glass</td>
<td>6.21</td>
<td>60</td>
<td>3.73</td>
<td>2.3</td>
</tr>
<tr>
<td>Film plastic</td>
<td>3.26</td>
<td>70</td>
<td>2.28</td>
<td>1.4</td>
</tr>
<tr>
<td>Hard plastic</td>
<td>3.10</td>
<td>90</td>
<td>2.79</td>
<td>1.7</td>
</tr>
<tr>
<td>Ferrous metal</td>
<td>4.38</td>
<td>80</td>
<td>3.50</td>
<td>2.2</td>
</tr>
<tr>
<td>Aluminium</td>
<td>0.10</td>
<td>70</td>
<td>0.07</td>
<td>0.0</td>
</tr>
<tr>
<td>Textile</td>
<td>1.28</td>
<td>50</td>
<td>0.64</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>Inorganic waste sub-total</strong></td>
<td><strong>30.81</strong></td>
<td><strong>67</strong></td>
<td><strong>20.5</strong></td>
<td><strong>12.6</strong></td>
</tr>
<tr>
<td>Putrescibles and other</td>
<td>69.19</td>
<td>79.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.00</strong></td>
<td><strong>100.00</strong></td>
<td></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

Sources: "Waite (1995) and DoE (1991)

Limited work has been done to estimate the recyclable content of commercial waste (DoE 1991). The Life Cycle Inventory model assumes that on the basis of limited contamination, 100 percent of the dry fraction of commercial waste is potentially recyclable with an allowance of 8 percent lost at MRFs (McDougall et al. 2001). This assumption is problematic because some commercial waste from retailers, restaurants and shops has similar characteristics to household waste. This is reflected by waste composition in Gaborone where the large proportion (53.8 percent) of commercial waste was found to be putrescible. Even though it is probably a conservative estimation, it is reasonable to assume that because of the domination of commercial sector by restaurants,
shops and hotels, the same model for estimation of the recyclable content of household waste could be applied to commercial waste in Gaborone. The results obtained are just indicative that not all the waste generated is potentially recyclable.

Using the model for estimating the recyclable content of household waste, the estimated recyclable content of commercial waste is shown in Table 5.8. Table 5.8 shows that the total inorganic waste that can potential be diverted for recycling from commercial waste was 30.1 percent with paper at 14.1 percent representing the highest potential diversion rate.

<table>
<thead>
<tr>
<th>Waste component</th>
<th>Percentage by weight (A)</th>
<th>Clean material as percentage of total (B)</th>
<th>Clean material as percentage of total waste (AxB)</th>
<th>Clean waste generation rate (tonnes/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper</td>
<td>23.5</td>
<td>60</td>
<td>14.1</td>
<td>1.8</td>
</tr>
<tr>
<td>Glass</td>
<td>5.7</td>
<td>60</td>
<td>3.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Film plastic</td>
<td>8.8</td>
<td>70</td>
<td>6.2</td>
<td>0.8</td>
</tr>
<tr>
<td>Hard plastic</td>
<td>2.5</td>
<td>90</td>
<td>2.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Ferrous metal</td>
<td>5.2</td>
<td>80</td>
<td>4.2</td>
<td>0.5</td>
</tr>
<tr>
<td>Aluminium</td>
<td>0.0</td>
<td>70</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Textile</td>
<td>0.1</td>
<td>50</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Inorganic waste sub-total</td>
<td>45.8</td>
<td>67</td>
<td>30.1</td>
<td>3.8</td>
</tr>
<tr>
<td>Putrescibles and other</td>
<td>54.2</td>
<td></td>
<td>69.9</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100.00</td>
<td></td>
<td>100.00</td>
<td></td>
</tr>
</tbody>
</table>

Sources: Waite (1995) and DoE (1991)

An analysis of the results in Table 5.7 and Table 5.8, show that of the 74 tonnes/day dry fraction of both household and commercial waste, 16 tonnes/day (21 percent) is potential recyclable. In this case, the proportion of the waste stream that can be diverted from disposal could significantly be altered by contamination.

The UK model used above assumes household participation rate in source separation of 100 percent. But most studies show that average participation rates of 50 to 75 percent is realistic for voluntary schemes in developed countries (Atkinson and New 1993;
Dennison et al 1992; Nealon 1995; Hammerton 1992). But public participation in voluntary projects could be the limiting factor in attempting to divert substantial amounts of waste from disposal in developing countries. First, to divert substantial amounts of waste from disposal in developing countries the main target should be putrescibles. But studies have shown that participants in source separation schemes are more willing to separate materials that are easy to separate such as metal cans, glass bottles and glass bottles (Chung and Poon 1994; Noor 1996; Chung and Poon 1996). A requirement for households to separate organic waste could result in lower participation rates. Secondly, the results of household surveys in chapter 6 show that households would be more inclined to participate in source separation schemes if they are offered incentives to do so.

The quantity of waste that could be diverted from disposal would also depend on the availability of markets for the targeted materials fractions. The findings in chapter 7 show that a significant proportion of the total waste stream does not have developed markets.

5.4 Summary

One of the main issues often cited by the proponents of organised recycling is its ability to reduce the quantity of waste destined for disposal. This chapter discusses a number of constraints to organised recycling. These constraints range from waste quantity and composition to factors that may affect diversion rates such as contamination, public participation and post-consumer material markets. The results of the waste quantity and composition survey show that the waste generation rate in Gaborone is relatively low. This means that the demand for waste disposal facilities might not be as high as those in countries that are experiencing higher waste generation rates. In addition, the inorganic waste fraction that is often a target of organised recycling schemes constitutes a relatively smaller proportion of the total waste stream compared to putrescible waste. This means
that targeting inorganic waste would represent a relatively smaller diversion rate from disposal.

Even though targeting putrescible waste would represent a higher diversion rate, indications are that participants in source separation schemes are more willing to separate materials that are easy to separate such as metal cans, glass bottles and glass bottles. A requirement for households to separate organic waste could result in lower participation rates. In addition, households are more inclined to participate in source separation schemes that offer incentives such as selling the materials they separate. Lack of incentives for separating certain materials could limit participation and further reduce the proportion of waste that could be diverted from disposal. In addition, lack markets for certain materials fraction could limit the quantity of waste that can be diverted from disposal. Lower potential diversion rates could be a disincentive for municipalities that intended to organise recycling schemes with the objective of reducing the quantity of waste to be disposed.
6 STAKEHOLDERS' PERCEPTIONS AND ATTITUDES

6.1 Introduction

Chapter 5 discussed waste quantity and composition and how they could impact on the recyclable content of the waste stream, highlighting the possible constraints to organising recycling. This chapter discusses key stakeholders’ perceptions and attitudes to organised recycling. Perception could mean observation and sensitivity but, as used in this context, it refers to awareness of recycling and local recycling initiatives. While attitude can refer to approach and feelings, in this context it refers to the thoughts that could influence one to participate or not to participate in recycling. Participation can refer to contribution, but in this context, it refers to taking part in activities that contribute towards recycling, such as separating household waste and returning the separated materials to collectors such as buy back centres and deposit refund schemes. The key stakeholders identified through the literature review as critical to planning and execution of organised recycling schemes are:

- Households: organised recycling schemes rely on households’ participation in separating waste materials according to the suggested material fractions for collection;
- Municipal officials: the responsibility to set up organised recycling schemes is often delegated to municipal authorities, municipal officials have a critical role in fulfilling the requirements of national legislation;
- Non-Governmental Organisations (NGO): NGOs play a role in raising public awareness on recycling. Some of the public awareness campaigns are carried through involvement in practical source separation schemes.

The key stakeholders identified above are also valid in Gaborone. For example, the Waste Management Act of 1998 (GoB 1998b) assigns planning and organisation of recycling to municipalities. In addition, Somarelang Tikologo, an environmental NGO, is actively involved in public anti-litter campaigns and raising awareness on waste recycling. In 1999 the NGO piloted a source separation programme in collaboration with
the local authority, and the participants in the project were households. Households are expected to participate in possible future source separation projects (Somarelang Tikologo 2001).

In addition to the key stakeholders mentioned above, there are other important stakeholders in recycling that are not covered in detail such as:

- Private sector recycling enterprises – create a market for recyclables that could potentially be recovered through organised recycling schemes
- Commercial sector – producers and generators of waste that could be a target of organised recycling schemes

In particular, this chapter sets out to provide evidence to answer the research question:

What are the perceptions and attitudes of key stakeholders of households, municipal officials and NGOs to organised recycling schemes? How are these perceptions and attitudes likely to constrain organised recycling?

The results and analysis are presented around the guiding hypothesis that says:

Despite the projection of organised recycling as an effective means to enhance waste recycling, its practicality as a waste management strategy in developing countries is constrained by the realities on the ground.

This chapter is organised into perceptions and attitudes of households, municipal officials, NGOs, other stakeholders, other significant findings and a summary of the key points.
6.2 Households' perceptions and attitudes

Public participation is considered the touchstone for the success of source separation schemes. Opponents of organised recycling schemes in developing countries are of the view that they may lack wider public support (UNCHS 1994; UNEP 2000; Noor 1996). Public support for source separation is often related to factors such as awareness of recycling, participation and willingness to participate in recycling, public attitudes to recycling, availability and convenience of the recycling system and motivational aspects (UNCHS 1994; Noor 1996). Investigation and understanding of these parameters could enable formulation of recycling strategies that have wider public support.

Household surveys were conducted using questionnaires with two separate groups of households to establish their perceptions and attitudes regarding organised recycling schemes. The questionnaires that were used are contained in Appendix C.

The first household survey was conducted with 284 respondents from households chosen randomly from a sample stratified by household income, who are referred to here as 'general households'. The main objective of the 'general household' survey was to assess households' awareness of recycling, impact of awareness on practising recycling and their willingness to participate in future source separation schemes.

The second household survey targeted 39 households that participated in a nine-month pilot source separation scheme, who are referred to here as 'specific households'. The main objective of the 'specific household' survey was to assess the impact of awareness on practising recycling, willingness to participate in source separation and attitudes towards source separation schemes based on their experience with the pilot project. The pilot project by Somarelang Tikologo and Gaborone City Council, as detailed in Box 4.1 in chapter 4, took place from November 1999 and July 2000 and interviews were conducted during the months of July and August 2002. The long time lapse between the pilot project and the conducting of interviews with participants resulted in difficulty
identifying all the participants. Most of the participating households had relocated to different areas. Of the 39 households who participated in the pilot project, only 20 were identified. Of the 20 identified households, only 17 were interviewed. Three households did not want to be interviewed because they were unhappy that despite having agreed to source separate their materials, no one came to collect them. The unhappiness by households as a result of failure to collect the source-separated materials could limit their continued participation. This could undermine the sustainability of source separation schemes.

The data obtained from the two household surveys were analysed using SPSS version 11. The variables investigated were awareness of recycling and its impact on practising recycling, willingness to participate in recycling and households' attitudes. Since most variables are nominal, the Pearson Chi-square statistic ($\chi^2$) was used to measure the relationships between variables, with a value of less than 0.05 considered significant with 90 percent confidence for 'general households'.

6.2.1 Awareness and its impact on practise recycling

The questions in section C of the questionnaire were designed to establish awareness and the level of participation in recycling activities by both 'specific and general households'. Awareness refers to having information about an event or an activity. It can give an indication of how the information was acquired and how useful the information is from the households' perspective. In this study, awareness was established using two distinct questions (questions 8 and 13 in the questionnaire) in parallel being:

- Have you heard or read about recycling before?
- Segwana LTD currently has a scheme where you can return your beverage bottles to the store from which you bought them for a fee. Are you aware of the scheme?
The second question was chosen mainly because the deposit refund scheme was the most visible reuse/recycling activity in Gaborone, with most stores accepting empty beverage bottles from consumers to refund their deposit.

The survey found that 97.1 percent of the sampled general households had heard or read about recycling. This could be attributed to the fact that Somarelang Tikologo and Department Sanitation and Waste Management (DSWM) had been actively raising awareness on recycling through print media and the radio. Apart from that, since the Rio Declaration of 1992 environmental issues such as recycling have been part of the school curriculum. It was also found that 98.1 percent of the sampled general households were aware of the deposit refund scheme operated by Segwana LTD for beverage bottles. This could be attributed to the monetary incentives of returning the beverage bottles. These results showed that households were generally aware of recycling and some recycling initiatives. However, the following discussion shows that this awareness does not necessarily translate into practising recycling.

Practising recycling was established by asking ‘specific and general households’ who were aware of recycling and the deposit refund scheme three questions (questions 10, 11 and 14 in the questionnaire):

• Do you usually set aside materials from your waste for reuse and recycling?
• What materials do you usually set aside?
• Do you usually return your beverage bottles?

Of the 97.1 percent respondents from ‘general households’ who were aware of recycling, 47 percent set aside some materials for recycling while 53 percent did not. There were also 2.1 percent of households who have not heard about recycling but set aside some materials. There is a possibility that this group do not associate setting aside materials with recycling. Within those who set aside materials for recycling, the majority of them
(51 percent) set aside glass bottles because of the deposit paid for returning the bottles. A cross-tabulation of heard/read about recycling by setting aside materials for recycling, as shown in Table 6.1, showed that the relationship between awareness and practising of recycling was weak with a continuity correlation of 0.806 (computed for 2x2 table to compensate for overestimation of the Pearson Chi-square). The weak relationship between the two variables means that few people who have heard/read about recycling set aside materials for recycling. This could indicate that there are other factors in addition to awareness that contribute to practising recycling such as ‘visible’ recycling centres and incentives.

The sample for ‘specific households’ was too small to be of any statistical significance. However, of the 100 percent households who were aware of recycling, 58.3 percent set aside some materials for recycling. Within those who set aside materials for recycling, the majority of them (60 percent) set aside beverage glass bottles.

### Table 6.1: Cross-tabulation of heard/read about recycling by setting materials for recycling

<table>
<thead>
<tr>
<th>Heard/read about recycling</th>
<th>Setting aside materials for recycling</th>
<th>Row Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes (row %, column %)</td>
<td>No (row %, column %)</td>
</tr>
<tr>
<td>Yes</td>
<td>94 (47.0, 97.9)</td>
<td>106 (53.0, 96.4)</td>
</tr>
<tr>
<td>No</td>
<td>2 (33.3, 2.1)</td>
<td>4 (66.7, 3.6)</td>
</tr>
<tr>
<td>Column Total (%)</td>
<td>96 (46.6)</td>
<td>110 (53.4)</td>
</tr>
<tr>
<td>(\chi^2) Value</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.060</td>
<td>1</td>
</tr>
<tr>
<td>Continuity Correlation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The relatively low level of setting aside some materials for recycling compared to awareness could be explained by the general lack of ‘visible’ recycling centres. For example, 51 percent of ‘general households’ set aside glass bottles because they had ‘visible’ collection system provided by the deposit refund scheme through a network of beverage distributors such as stores. In addition, within the ‘specific households’ who set aside materials for recycling, 60 percent set aside glass bottles because of the available collection system provided by the deposit refund scheme for beverage bottles. Apart from the deposit refund scheme, the other recycling systems include:
• Buy back scheme for beverage steel cans, which operates from a single depot not centrally located in the city.

• The ‘bring’ site operated by Somarelang Tikologo, which has four material banks for glass, paper, metal cans and plastics. The site is located within the NGOs small fenced office premises, which are not centrally located. In addition, the ‘bring’ site was only accessible for use from 8 a.m. until and 5 p.m.

In addition to lack of ‘visible’ recycling centres the low level of setting some materials aside compared to awareness could be explained by lack of financial incentives. For example, 51 percent of ‘general households’ set aside glass bottles primarily because of the deposit paid back on returning them; similarly 60 percent of ‘specific households’ set aside glass bottles. Furthermore, of the 98.1 percent ‘general household’ respondents who were aware of the deposit refund scheme, 76.3 percent returned their bottles to obtain the deposit. This high level of participation could be a result of the monetary gain attached to returning the beverage bottles. In the absence of the monetary gain, the level of participation could be reduced. A cross-tabulation of the awareness of the deposit refund scheme and the returning of beverage bottles, as shown in Table 6.2, shows that there is a significant relationship between the two variables with a Continuity Correlation of 0.001 (computed for 2x2 table to compensate for overestimation of the Pearson Chi-square). The strong relationship means that most people who are aware of the deposit-refund schemes do return the bottles to be refunded the deposit.
Even though the sample for ‘specific households’ was too small to be of any statistical significance, it indicated that 29.4 percent and 35.3 percent of households ‘agreed’ and ‘strongly agreed’ respectively that if they would be more motivated to participate in source separation if it brought them money. This further indicated the importance of direct financial incentives in encouraging participation in recycling.

- The importance of ‘visible’ and accessible recycling centres as well as financial incentives to encourage participation in recycling is supported by some studies from Durban, Malaysia, Mexico and China as shown in chapter 2.

The majority of households who were willing to participate in future source separation projects wanted to separate materials that have known collection system as well as direct financial incentives. For example, it was found that 30 percent and 25 percent of the ‘general households’ were willing to separate glass bottles and metal cans respectively. In addition, 25 percent and 24 percent of specific households were willing to separate glass bottles and metal cans respectively. The results support the previous findings that generally people were willing to separate materials that had known markets and financial incentives, as well as easy to separate (Chung and Poon 1994; Chung and Poon 1999).

It can be concluded that even though households were generally aware of recycling, this awareness appears not to necessarily translate into practising recycling. This could indicate that there were other factors that hinder public participation in recycling, such as absence of ‘visible’ recycling centres or lack of incentives to do so. Failure to translate
awareness into practising recycling could limit the success of public awareness programmes intended to promote organised recycling. Apart from that, the general attitude of households was that they would be more inclined to practise recycling if they could benefit financially from separating and returning the materials. The interest of households to separate materials that attract a monetary value could limit source separation of the materials that do not produce financial rewards.

The key conclusions from awareness and its impact on practising recycling are:

- Household awareness of recycling appears not to necessarily translate into practising recycling. There are indication that there are other factors that could encourage participation in recycling such as incentives and availability of recycling systems
- The attitude of households was that they would be more inclined to separate materials that had financial incentives. The bias towards separating materials that had financial incentives could undermine the recovery of materials that do not.

6.3 Municipal officials' perceptions and attitudes

In most countries, the municipality is the designated waste management authority. This has resulted in national policy and legislation designating local authorities as the implementers of national recycling strategies, either by formulating local recycling strategies or setting up organised recycling schemes. Municipal officials' perceptions and attitudes as stakeholders in organised recycling are critical to fulfilling this role. This section discusses municipal officials' perceptions of and attitudes towards organised recycling.

Prior to the enactment of the Waste Management Act of 1998, the role of the local authority in Gaborone was to collect municipal solid waste for safe disposal. Recycling was carried out through private sector initiatives. The enactment of the Act added a new responsibility for the local authority. In addition to waste collection and disposal, the local authority is required to prepare waste recycling plans in which it spells out clearly
how it intends to carry out recycling. In addition, the Act gives the local authority the responsibility to make arrangements with any waste industry in the private sector to recycle waste. Despite the Act having been effective since 1998, the status quo still prevailed in 2002. The local authority has not made any changes pertaining to the new responsibilities but rather continues to collect and dispose of waste. In addition, recycling continues to be carried out through private sector initiatives.

Key informant interviews were carried out with two officials involved with the planning and execution of waste management activities within the Environmental Health Department of Gaborone City Council on the 23rd and 29th of July 2002. The interviews were conducted using a checklist contained in section 3.8.3 of chapter 3. The officers interviewed were (see structure of Environmental Health Department of Gaborone City Council in chapter 4):

- Senior Environmental Health Officer
- Senior Technical Officer (waste management)

The two interviews were tape recorded and transcribed on the day of the interview. Full transcripts of the interviews are contained in Appendix D.

The Chief Technical Officer (waste management) was interviewed during the exploratory part of the study using a similar but different checklist to the one used with the two officers above as contained in section 3.6.3 of chapter 3. The full transcript of the interview is also contained in Appendix D.

The interview transcripts were coded into key categories that reflected awareness of recycling (aw) and attitude towards organised recycling (at) where letters in brackets represented codes. A code was placed next to every word or group of words that mentioned the key categories of investigation. An order of importance was recorded on
the basis of the number of times an item was mentioned under each key category during the interviews.

A summary of the key categories as they emerged from the key informant interviews is summarised in Table 6.3 below. It emerges from Table 6.3 that municipal officials were generally aware of organised recycling and its potential benefits. The awareness of the potential benefits of organised recycling schemes was created by:

- Study tours by some municipal officials in Europe (in particular Sweden) where they saw fully-fledged source separation schemes in operation
- Experience gained through a pilot source separation programme in Gaborone

The main potential benefit of organised recycling schemes was seen to be the reduction of the quantity of waste to be disposed, which was referred to six times by the key informants. The second benefit of reduction of quantity of waste for collection prior to disposal was referred to three times by the key informants. The envisaged benefits, primarily those related to collection costs, were seen as only possible if private sector recyclers carry out collection of the recyclables. However, despite these potential benefits the attitude of the local authority officials was to maintain the status quo, where the local authority only collected and disposed of waste as a social responsibility and left recycling initiatives to the private sector. This attitude could further be reinforced by their experience with political interference in previous waste management reforms that involved private sector. For example, municipal officials made reference to a waste collection contract with a private company that was terminated by politicians even though the technical and economic evaluation showed that it was a successful undertaking. Maintenance of the status quo was further demonstrated by the keenness of the local authority officials to only play a facilitation role in recycling that would ensure maintenance of their primary role of collection and disposal of waste. The facilitation role of the local authority was seen in the context of two scenarios:
Table 6.3: Summary of key categories from key informant interviews

<table>
<thead>
<tr>
<th>Category</th>
<th>Nature</th>
<th>Benefits or dis-benefits</th>
<th>Frequency of reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perception</td>
<td>• Municipal officers’ views on recycling</td>
<td>- Potential to reduce quantity of waste disposed</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Potential to reduce quantity of waste collected</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Potential to create jobs for the low-income groups</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>• Maintain the status quo</td>
<td>- Shortage of manpower</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Shortage of transport</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Lack of funds</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Lack of markets for recyclables</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>• Should be a private initiative</td>
<td>- Local authority has a social responsibility to collect waste and dispose of waste, profit making is for the private sector</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Polluter pays principle, thorough commercial buy back centres</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>• Institutional</td>
<td>- No budget for recycling</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- No officers assigned for recycling</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- No current incentives for recycling</td>
<td>2</td>
</tr>
</tbody>
</table>

- Contracting out source separation schemes

The local authority has previous experience of contracting out waste management services to the private sector. They previously had a contract with a private company to collect waste from certain area(s) of the city. In this contracting out scenario, it is envisaged private sector recyclers would approach the city council with proposals to organise source separation schemes in certain area(s) of the city. The City Council could
then enter into a contract with the respective private enterprise to execute the programme. This arrangement is also provided for under Section 33 of the Waste Management Act.

- **Producer responsibility**

The City Council officials strongly felt that the commercial sector should take back the waste they generate by virtue of their distribution of goods to the final consumer. They envisaged a situation whereby there is a linkage between licensing commercial operations in the city and recovery of post-consumer materials. Commercial enterprises applying to operate within the jurisdiction of the City Council should present, along with their application for operation, a recycling plan. The recycling plan should contain a detailed process of how they intend to recover post-consumer materials, with appropriate incentives for households to return the materials. The respective commercial enterprises would then identify end-user markets for recovered materials. This proposal is couched within the polluter pays principle\(^\text{10}\), which is one the guiding principles of the Botswana National Waste Management Strategy.

Evaluation of the pilot source separation scheme and the lessons learnt thereof further reinforced the belief of local authority officials to maintain the status quo. Some of these lessons learnt were that:

- A fully-fledged source separation scheme would require more manpower, transport and financial resources than they currently have. The local authority officials were adamant that lack of these resources would make it difficult for the local authority to organise source separation schemes. Lack of manpower and transport resources cited by the local authority officials appeared to be true. For example, at the time of the interviews, there were six officials involved in planning and operational activities in solid waste management for the whole city, with two of them also involved in issues of environmental health other than waste management. There was no official specifically assigned to oversee recycling (see Figure 4.2). The waste management

\(^{10}\text{The costs of preventing or eliminating damage to the environment must be borne by the party responsible}\)
The operational budget has remained relatively constant in real terms over three financial years at P6 902 523; P6318 670 and P6 793 020 respectively for financial years 2000/01; 2001/02 and 2002/2003 (GCC 2003). The annual rate of inflation stood at 6.6 percent, 8.0 percent and 11.2 percent respectively (CSO 2000). This relatively high rate of inflation could have an impact on the real monetary budget. In addition, the Gaborone City Council waste collection fleet consisted of 20 compactor trucks with an average age of 7 years, of which, on average 10 were operational. This was due to frequent breakdowns and excessive delays in the repairs to the trucks (Liebenberg and Stander 2002).

- Source separation would not be able to be self-financing. The total costs of the pilot source separation scheme were estimated to be P9 259.30, while the total benefits were estimated to be P1601 (Somarelang Tikologo 2001). This represented a total loss by the scheme of 83 percent. The cost benefit analysis did not include hidden social costs and benefits. However, the inability of the source separation scheme to be self-financing indicated that it might require subsidisation by the local authority. The attitude of local authority officials was that offering incentives for recycling was equivalent to supporting private sector profit-making by public resources.

- When the source-separated recyclables were not collected in time and the bins got full and started overflowing, as happened at times during the piloting period, the participants got angry and stopped source separating their materials. This reinforced the local officials’ view that since they were already struggling with collection of waste, an attempt to collect recyclables could place them on a further collision course with participating households.

The views of municipal officials should be seen in light of the study by Ali (1997), which found that there is an inclination by municipal attitudes to support the status quo, which in itself is a major constraint to development of new initiatives such as organised recycling. Municipal officials felt that they were not in a position to initiate recycling
activities that involved the informal sector, but felt that such steps should be undertaken by NGOs.

Furedy (1993) reported that there was reluctance by municipalities to work in partnership with informal sector engaged in solid waste recycling. The authorities considered the activities of informal recyclers to interfere with their operations.

Municipal officials' attitudes to maintain the status quo appear to be a factor where public funds are limited. For example, Scheinberg (1999) reported that the attitude of public officials in Central and Eastern Europe to maintain the status was the main barrier to waste related reforms. The mindset of public officials was that nothing could be accomplished in modification of waste management behaviour because of lack of resources. This official attitude was demonstrated by poorly designed pilot projects that often conveyed negative information about source separation.

These municipal attitudes to preserve the status quo could be even more enhanced if municipalities were not able to recoup the money invested in organised recycling schemes, which could further strain their waste management budget (Gotoh 1989; Jindal et al. 1997). This was discovered in some parts of Sao Paulo and Rio de Janeiro where municipalities that collect materials had not been able to recover the collection costs (UNEP 2000). A similar experience in Metro Manila has led to the chairman of Metro Manila Development Authority to declare that municipal organised recycling as a waste management option is not viable (Salaverria 2002).

It can be concluded that the attitude of local authority officials is to maintain the status quo and leave waste recycling to private sector initiatives. The limited human, transport and financial resources as well as the realisation that organised recycling is unlikely to be self-financing further reinforced this attitude. Unless there is a change, the local authority is unlikely to promote the organisation of recycling schemes.
6.3.1 Local authority officials' practical experience on organised recycling

One of the lessons learnt by local authority officials from the pilot source separation scheme was that they had limited practical knowledge in organised recycling. A comparison of the pilot source separation scheme in Gaborone, with the pilot schemes in Dublin and Petaling Jaya as shown in Table 6.4 reinforces the limited practical knowledge in organising recycling as acknowledged by local authority officials.

Table 6.4: Comparison of pilot source separation scheme in Gaborone, Dublin and Petaling Jaya

<table>
<thead>
<tr>
<th>Variables</th>
<th>Gaborone</th>
<th>Dublin</th>
<th>Petaling Jaya</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Households</td>
<td>45</td>
<td>2100</td>
<td>5000</td>
</tr>
<tr>
<td>Distribution of households</td>
<td>Scattered across the city</td>
<td>Housing street blocks</td>
<td>Housing street blocks</td>
</tr>
<tr>
<td>Publicity</td>
<td>Letters written to selected households</td>
<td>Promotional and advisory leaflets for target households, television advertisements</td>
<td>Promotional and advisory literature for target households</td>
</tr>
</tbody>
</table>

First, the sample of 45 households for the pilot scheme in Gaborone was relatively small to enable a proper evaluation of the key parameters such as costs and quantity of potential recyclables, and the operational information yielded may not be easily generalised. Secondly, the participating households were scattered across the city. This presented logistical problems in collecting the materials with collectors not being able to locate some of the participating households. This led to recyclables not being collected and undermined continued participation by some households. One of the objectives of the pilot project was to raise environmental awareness. However, scattering the participating households across the city, limited the 'visibility' of the scheme that could have developed wider community interest. There was also no wider publicity of the schemes that could have aroused wider public interest. Because of the lack of information leaflets the fieldworkers had to spend more time explaining the separation process. The lack of
practical knowledge of source separated also applied to Somarelang Tikologo, since they jointly piloted the project with the local authority. This was supported by some findings by Noor (1996), Gotoh (1989), Jindal et al. (1997), Scheinberg (1999) and Furedy (1989) as discussed in the literature review.

It can be concluded that municipal officials in developing countries have limited knowledge and practical experience on organised recycling. Limited knowledge and practical experience could constrain development of organised recycling schemes by local authorities.

6.3.2 Main points from key informant interviews with municipal officials

The following main conclusions emerge from key informant interviews with municipal officials as possible constraints to organised recycling.

- The general local authority officials’ attitude was to maintain the status quo of collecting and disposing of waste as a social responsibility. Recycling was seen as private sector responsibility in accordance with the ‘polluter pay principle’ as well as for financial gain. Offering incentives for recycling was seen as supporting private sector profit-making by public resources.

- Organised recycling was seen as a waste management strategy that could not be undertaken by the local authority primarily because of manpower, transport and financial constraints. This was reinforced by the realisation that organised recycling was unlikely to be self-financing.

- Despite being aware of the potential benefits of recycling, local authority officials had limited knowledge and practical experience of organising recycling schemes.
6.4 NGOs' perceptions and attitudes

A key informant interview was conducted on the 18\textsuperscript{th} July 2002 with the Chief Executive Officer of Somarelang Tikologo. Somaraleng Tikologo was chosen because of its work in waste management issues relating to anti-litter campaigns, and in particular because they initiated and piloted a household source separation for recycling scheme in Gaborone. The interview was recorded and transcribed on the day it was conducted. A full transcript of the interview is contained in Appendix D.

The main objective of the interview was to establish the NGO official’s perceptions and attitudes on source separation. The interview was conducted using a checklist contained in section 3.8.3 of chapter 3.

6.4.1 Description of the pilot scheme

Somarelang Tikologo piloted the source separation scheme in 39 households in collaboration with Gaborone City Council, Pyramid Holdings, and Collect-A-Can (Botswana) from November 1999 to July 2000. A detailed description of the pilot source separation project is given in Box 4.1 in Chapter 4 and is summarised here. Initially, the scheme identified 45 households who agreed to participate. However, at the time of implementation, only 39 households source separated their waste. The participating households were chosen on the basis of assumed income stratification, to establish the variation of the targeted components with income. In an attempt to achieve the stratification by income, the participating households were distributed in a wider area across the city. The participating households were selected by writing them letters introducing Somarelang Tikologo and the project it wanted to undertake. The pilot source separation scheme targeted all forms and types of paper, glass and metal cans for source separation.
The pilot scheme recovered 1085 kg of paper, 637 kg of metal cans and 1006.6 kg of glass over the nine-month period. However, there was no conclusive relationship between income and the quantity of various components generated.

The NGO perceived source separation as a possible means of reducing the quantity of waste disposed, and reducing collection costs by reducing the quantity of waste to be collected by the local authority. This confirms the attitude of voluntary organisations such as NGOs that they support source separation because they see it as fulfilling the environmental objective of reducing the quantity of waste to be disposed (Furedy 1993; El Hawi et al. 2002). The additional objectives of the pilot schemes were to verify these perceptions by:

- Assessing if the City Council could save money in collection costs, assuming that the recyclables would be collected by recycling companies
- Establishing the quantity of waste that could be diverted by source separation

Apart from acknowledgement of their limited knowledge and experience in organising recycling schemes, one of the key lessons learnt by the NGO from the pilot scheme was that source separation is an expensive undertaking that is unlikely to be self-financing. Despite this key lesson, there was a concerted effort by the NGO to lobby the local authority to engage in a large-scale pilot source separation scheme, with the objective of expanding it to a fully-fledged scheme if the pilot was successful. The attitude of the NGO was that their role was mainly to mobilise the community and demonstrate sustainable waste management solutions for local authority and private sector implementation. The lobbying of the local authority by the NGO to organise recycling deviates from the conventional role of NGOs in recycling. Most of the documented cases involve NGOs initiating, supporting and sponsoring community recycling initiatives (Lardinois and Furedy 1999; Jindal et al. 1997; Fung 2000). One of the objectives of
these initiatives is often to help municipalities with limited resources to cope with collection and disposal through the reduction of waste at source.

It can be concluded that an opinion gap existed between the local authority officials and the NGO as to who should take the lead in recycling. The local authority officials wanted to preserve the status quo and leave recycling to the private sector, while the NGO wanted the local authority to be actively involved in organising recycling. This opinion gap could undermine cooperation between the local authority and the NGO in organising recycling schemes. The opinion gap between the NGO and the local authority is highlighted by the fact that the legal framework is not clear on the role of NGOs in recycling. The local authority has been given the authority to make arrangements for recycling with the private sector where possible. It is not clear from the legal framework if NGOs are considered part of the private sector. In addition, the pressure by the NGO for the local authority to engage in organise recycling could further strain the resources of the latter.

6.5 Other stakeholder informant interview

An interview was conducted with a Senior Waste Management Officer in the Department of Sanitation and Waste Management (DSWM) on 25th July 2002. The interview was recorded and transcribed on the same day. A full transcript of the interview is contained in Appendix D.

The DSWM is the authority responsible for ensuring adherence to the Waste Management Act that empowers local authorities to organise recycling. The objectives of the interview are outlined in section 3.8.3 of chapter 3 along with a checklist used in the interview. In addition, the interview was used to triangulate information obtained with interviews with other official authority key informants.
It emerged from the interview that the main objective of requiring recycling plans to be prepared by local authorities was to fulfil the requirements of the waste hierarchy, which has been adopted by the government as the guiding principle in waste management. Primarily the government believed that by promoting recycling:

- They would reduce the quantity of waste that was landfilled, thereby increasing the operating life of the landfill
- They would raise awareness that some waste materials are a resource
- They would promote environmental cleanliness

The DSWM envisaged a situation where local authorities would set up source separation schemes as failure to do so would represent non-compliance with the Act. However, there are no incentives/disincentives in the Act for compliance/non-compliance by local authorities. The DSWM also realised that organising recycling schemes was an added responsibility for local authorities, which might require more manpower and additional resources, but was adamant that in the long run it would save them money in collection and disposal costs. The envisaged scenario was that recycling private companies, as opposed to the local authority, would collect recyclable materials.

At the time of the interview, there were no national incentives to support recycling, however, Citizen Entrepreneurial Development Agency (CEDA) – a low interest loan scheme for citizen empowerment - was open for use in setting up recycling schemes. However, to qualify for funding, waste collectors and recyclers had to have a product as a result of a processing step, that is, either baled metal scrap or crushed bottle scrap (GoB 1999). The government also had no intention of initiating procurement policies that supported materials with recycled content. This was attributed to that there were limited products made locally from recycled material. However, this worked against efforts to setting up organised recycling schemes because limited demand for materials with recycled content could limit the demand for post-consumer materials..
The following key points emerged from the key informant interview with DSWM. The key points are summarised below as possible constraints for organised recycling.

- Despite the regulatory requirements for municipalities to formulate recycling plans, there were incentives/disincentives for doing so. The attitude of the DSWM was that the local authority did not need incentives because they would benefit from reduction of waste disposal and collection costs in the long run.
- The DSWM did not intend to introduce policies that supported products with recycled content.

6.6 Other significant findings

This section includes other significant findings from stakeholders' perceptions and attitudes surveys that do not necessarily support the thesis, but are included here for completeness and for information purposes. Some of these findings could be pertinent to the formulation of recycling plans or for future research in Gaborone. The findings are discussed in the sections below.

6.6.1 Type of collection service and income

It was found that the nature of households' collection service was significantly related to income, with a Pearson Chi-square of 0.003, as shown by a cross-tabulation of income by collection service in Table 6.5. Even though kerb side collection is the most prevalent method of waste collection, covering 86.3 percent of the sampled households, 97.7 percent of households with high-income have a kerbside collection service compared to 76.6 percent of their counterparts with low-income. The results mean that there is a possibility for a source separation scheme to succeed if is built onto the existing kerbside waste collection system. Any recyclables collection system that is significantly different
from the current waste collection method, may limit participation in source separation if it is judged to be inconvenient.

Table 6.5: Cross-tabulation of income by type of collection service

<table>
<thead>
<tr>
<th>Income</th>
<th>Type of collection service</th>
<th>Carry waste to nearby skip (r%, c%)</th>
<th>Carry waste to shared bin on street (r%, c%)</th>
<th>Put it in bin at gate (r%, c%)</th>
<th>Other (r%, c%)</th>
<th>Row Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than P1350</td>
<td></td>
<td>17 (13.7, 77.3)</td>
<td>7 (5.6, 77.8)</td>
<td>95 (76.6, 42.0)</td>
<td>5 (4.0, 100.0)</td>
<td>124 (47.3)</td>
</tr>
<tr>
<td>Between P1350 and P7000</td>
<td></td>
<td>4 (4.3, 18.2)</td>
<td>2 (2.1, 22.2)</td>
<td>88 (93.6, 38.9)</td>
<td>0 (0.0, 0.0)</td>
<td>94 (35.9)</td>
</tr>
<tr>
<td>More than P7000</td>
<td></td>
<td>1 (2.3, 4.5)</td>
<td>0 (0.0, 0.0)</td>
<td>43 (97.7, 19.0)</td>
<td>0 (0.0, 0.0)</td>
<td>44 (16.8)</td>
</tr>
<tr>
<td>Column Total (%)</td>
<td></td>
<td>22 (8.4)</td>
<td>9 (3.4)</td>
<td>226 (86.3)</td>
<td>5 (1.9)</td>
<td>262 (100)</td>
</tr>
<tr>
<td>$\chi^2$ Value</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuity Correlation</td>
<td></td>
<td>19.959</td>
<td></td>
<td></td>
<td></td>
<td>0.003</td>
</tr>
</tbody>
</table>

6.6.2 Gender and knowledge of final disposal

There is a significant relationship between gender and knowledge of final destination of collected waste, with a Continuity Correlation of 0.015, as shown in Table 6.6. It was found that the majority of women (60 percent), even though responsible for handling most of the waste at household level, do not know its final destination once collected. The results show that there is some variation of knowledge of waste management issues across gender groups. This variation can have an impact on the design of public awareness campaigns on waste management issues. For example, the saving of landfill space will probably not be an appealing motive for women to recycle, because the majority of them are not aware of the final destination of their waste. However, the environmental benefits of recycling are expressed across all gender groups and may be an appealing motive for all to participate in source separation.
Table 6.6: Cross-tabulation of sex by knowledge of final disposal

<table>
<thead>
<tr>
<th>Sex</th>
<th>Knowledge of final disposal</th>
<th>Row Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes (row %, column %)</td>
<td>No (row %, column %)</td>
</tr>
<tr>
<td>Male</td>
<td>44 (57.1, 36.1)</td>
<td>33 (42.9, 22.0)</td>
</tr>
<tr>
<td>Female</td>
<td>78 (40.0, 63.9)</td>
<td>117 (60.0, 78.0)</td>
</tr>
<tr>
<td>Column Total (%)</td>
<td>122 (44.9)</td>
<td>150 (55.1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Value</th>
<th>Pearson</th>
<th>Continuity Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.884</td>
<td>0.015</td>
<td>0.015</td>
</tr>
</tbody>
</table>

6.6.3 Age and heard/read about recycling

A cross-tabulation of age by heard/read about recycling shows that among the 97.1 percent of respondents who had heard/read about recycling, 81.8 percent were between the ages of 16-24 years. The proportion of younger people who had heard/read about recycling is significantly different from older people who had heard/read about recycling with a Pearson Chi-square of 0.023 (which is less than 0.05), with the majority of younger people having heard/read about recycling. This can be explained by the fact that there is high literacy rate among the younger generation, and since the Rio Declaration of 1992 environmental issues such as recycling have been part of the school curriculum. The relationship is shown in a cross-tabulation of age by heard/read about recycling in Table 6.7. This information could be useful in designing public education programmes that target specific age groups.

Table 6.7: Cross-tabulation of age by heard/read about recycling

<table>
<thead>
<tr>
<th>Age</th>
<th>Yes (row %, column %)</th>
<th>No (row %, column %)</th>
<th>Row Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16-24</td>
<td>108 (81.8, 53.5)</td>
<td>24 (18.2, 31.6)</td>
<td>132 (47.5)</td>
</tr>
<tr>
<td>25-34</td>
<td>47 (63.5, 23.3)</td>
<td>27 (36.5, 35.5)</td>
<td>74 (26.3)</td>
</tr>
<tr>
<td>35-49</td>
<td>35 (67.3, 17.3)</td>
<td>17 (32.7, 22.4)</td>
<td>52 (18.7)</td>
</tr>
<tr>
<td>50-64</td>
<td>10 (62.5, 5.0)</td>
<td>6 (37.5, 7.9)</td>
<td>16 (5.8)</td>
</tr>
<tr>
<td>65+</td>
<td>2 (50.0, 1.0)</td>
<td>2 (50.0, 2.6)</td>
<td>4 (1.4)</td>
</tr>
<tr>
<td>Column Total (%)</td>
<td>202 (72.7)</td>
<td>76 (27.3)</td>
<td>278 (100)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Value</th>
<th>Pearson</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.305</td>
<td>0.023</td>
<td>0.023</td>
</tr>
</tbody>
</table>

180
6.6.4 Education and heard/read about recycling

The proportion of respondents with lower education standards who had heard/read about recycling is significantly different from respondents with higher education who had heard/read about recycling with a Pearson Chi-square of 0.000. The relationship is shown in the cross-tabulation of education by heard/read about recycling in Table 6.8. Of the 198 respondents who had heard/read about recycling, 35 (17.7 percent) had primary education and below while 163 (82.3 percent) had secondary education and above. The direct relationship between awareness and education level means that as education level increases so does access to the range of media outlets that carry information about recycling. This means that programmes aimed at creating awareness about recycling and recycling activities should be spread across different information media to cater for the different educational levels.

The relationship of education and heard/read about recycling explains why 61 percent of the respondents who had heard/read about recycling, had heard through education-related media, as shown in Table 6.9. Of the 61 percent who had heard/read about recycling through education related media:

- 31 percent had heard/read about recycling through newspapers, magazines, newsletters, and billboards
- 28 percent had heard through their school curriculum (which was part of other media).

However, 24 percent of the respondents had heard of recycling through the radio, which is the highest percentage recorded by a single information dissemination medium apart from school. This could be explained by the fact that nationally, 457 out of 1000 people have access to radio (The World Bank 2002). Access to radio may be higher in urban areas like Gaborone than rural areas. The radio is also the main means of information dissemination by government and non-government agencies, and the dissemination is done for free on the main government owned radio station, Radio Botswana One (RB1).
Table 6.8: Cross-tabulation of education by heard/read about recycling

<table>
<thead>
<tr>
<th>Education</th>
<th>Yes (row %, column %)</th>
<th>No (row %, column %)</th>
<th>Row Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>12 (57.1, 6.1)</td>
<td>9 (42.9, 12.2)</td>
<td>21 (7.7)</td>
</tr>
<tr>
<td>Primary</td>
<td>23 (47.9, 11.6)</td>
<td>25 (52.1, 33.8)</td>
<td>48 (17.6)</td>
</tr>
<tr>
<td>Secondary</td>
<td>114 (76.5, 57.6)</td>
<td>35 (23.5, 47.3)</td>
<td>149 (54.8)</td>
</tr>
<tr>
<td>Tertiary</td>
<td>49 (90.7, 24.7)</td>
<td>5 (9.3, 6.8)</td>
<td>54 (5.8)</td>
</tr>
<tr>
<td>Column Total (%)</td>
<td>198 (72.8)</td>
<td>74 (27.2)</td>
<td>272 (100)</td>
</tr>
<tr>
<td>( \chi^2 ) Value</td>
<td>27.419</td>
<td>3</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Table 6.9: Distribution of heard/read about recycling by media

<table>
<thead>
<tr>
<th>Media</th>
<th>Heard/read about recycling through media</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
</tr>
<tr>
<td>Newspaper</td>
<td>61</td>
</tr>
<tr>
<td>Magazine/newsletters</td>
<td>42</td>
</tr>
<tr>
<td>Billboards</td>
<td>16</td>
</tr>
<tr>
<td>Other (school)</td>
<td>99</td>
</tr>
<tr>
<td><strong>Education related sub-total</strong></td>
<td><strong>218</strong></td>
</tr>
<tr>
<td>Television (TV)</td>
<td>52</td>
</tr>
<tr>
<td>Radio</td>
<td>87</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>357</td>
</tr>
</tbody>
</table>

6.6.5 Education and income

A cross-tabulation of education by income shows a significant relationship with a Pearson Chi-square of 0.000 as shown in Table 6.10. The table shows that acquisition of secondary education and more provide an opportunity to earn a relatively high income. This could be explained by that the majority of income earners are in formal sector employment that requires a certain standard of educational achievement. This relationship means that, for future household surveys that intend to stratify households by income in Gaborone, education can be used as a proxy to reflect household income.
Table 6.10: Cross-tabulation of education by income

<table>
<thead>
<tr>
<th>Education</th>
<th>&lt;P1350 (r%, c%)</th>
<th>Between P1350 and P7000 (r%, c%)</th>
<th>&gt;P7000 (r%, c%)</th>
<th>Row Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>19 (100.0, 15.6)</td>
<td>0 (0.0, 0.0)</td>
<td>0 (0.0, 0.0)</td>
<td>19 (7.4)</td>
</tr>
<tr>
<td>Primary</td>
<td>29 (60.4, 23.8)</td>
<td>16 (33.3, 17.6)</td>
<td>3 (6.3, 7.0)</td>
<td>48 (18.8)</td>
</tr>
<tr>
<td>Secondary</td>
<td>62 (45.3, 50.8)</td>
<td>49 (35.8, 53.8)</td>
<td>26 (19.0, 60.5)</td>
<td>137 (53.5)</td>
</tr>
<tr>
<td>Tertiary</td>
<td>12 (23.1, 9.8)</td>
<td>26 (50.0, 28.6)</td>
<td>14 (26.9, 32.6)</td>
<td>52 (20.3)</td>
</tr>
<tr>
<td>Column Total (%)</td>
<td>122 (47.7)</td>
<td>91 (35.5)</td>
<td>43 (16.8)</td>
<td>256 (100)</td>
</tr>
</tbody>
</table>

**χ²** Value | Df | Significance
---|---|---
Pearson | 39.132 | 6 | 0.000

6.6.6 Household willingness to participate in source separation schemes

The questions in section D of the questionnaire for the ‘general households’ and section E of the questionnaire for ‘specific households’ were designed to establish the willingness of households to participate in waste source separation schemes. In particular two questions were asked to establish their willingness to participate and their preferred system of source separation respectively, being:

- If Gaborone City Council started collecting separated glass, metal and other recyclables for recycling, would you be willing to separate your household waste for recycling?
- Under which system would you be more likely to participate? (commingled kerbside, separate kerbside, drop-off systems)

It was found that an overwhelming majority of households were willing to participate in source separation schemes. Of the sampled ‘general household’ respondents, 97.9 percent were willing to sort their household waste. Even though sample for ‘specific households’ was small for any statistical significance, 88 percent those interviewed were willing to participate in source separation. The explanation for such a high willingness to participate among the ‘general households’ could be attributed to a lack of first hand
experience of the source separation schemes. The respondents might not have been aware of the practical implications that go with source separation. Overall, the high willingness to participate could have been enhanced by the fact that in recent years the local media had been carrying articles on recycling through source separation (BOPA 2003). The high willingness to participate in source separation supports the findings of research by Chung and Poon (1999), who found that even though Guangzhou citizens did not have waste sorting schemes, there was wider support for such schemes with 84 percent of the respondents willing to separate their household waste. Somarelang Tikologo (2001) also reported that participants in a pilot source separation project were willing to participate in future projects. The pilot source separation project described in Box 4.1 in Chapter 4 reported a participation rate of 87 percent.

A comparison of studies on willingness to participate in source separation in areas where there were no operational schemes in place is shown in Table 6.11. Table 6.11 shows that there was a general willingness to participate in source separation schemes with more than 76 percent of the general public and households willing to participate in such schemes. The willingness to participate varies between cities and countries. This could be explained by the fact that the willingness to participate might be influenced by several conditions, such as economic conditions, environmental awareness, incentives and literacy levels.

The author was not able to identify previous research that compared willingness to participate and actual participation. The study in Petaling Jaya, Malaysia carried out a willingness to participate survey before the inception of a source separation project, but the actual participation was not reported once the project was operational (Noor 1996). Chung and Poon (1994) concluded that with 31 percent of Hong Kong citizens already source separating their waste in the absence of a convenient recycling network compared with 76.7 percent of them willing to participate in source separation schemes, it was reasonable to assume that actual participation would be more than 30 percent. If we apply
the same reasoning to Gaborone with 97.9 percent of households willing to participate in source separation schemes and 47 percent presently setting aside some material for reuse or recycling, it would be reasonable to assume that at least 47 percent would participate provided there are incentives to do so. However, possibly the best way to test if people’s willingness to participate in source separation schemes represents actual behaviour would be to introduce pilot source separation schemes. Further research is required to establish the relationship between willingness to participate and actual participation.

The majority of households in Gaborone (65.3 percent) preferred to participate in kerbside collection schemes. This is probably because the existing waste collection system was mainly kerbside, hence households support the status quo even in the collection of recyclables. The results are in agreement with the findings of other studies in other areas (Chung and Poon 1994; Chung and Poon 1999; Noor 1996) that generally people prefer to separate and transport waste over shorter distances.

<table>
<thead>
<tr>
<th>Sources</th>
<th>Place and year of survey</th>
<th>Sample size</th>
<th>Target population</th>
<th>% Willingness to participate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noor (1996)</td>
<td>Petaling Jaya, Malaysia, 1990</td>
<td>Not indicated</td>
<td>General public</td>
<td>82.9</td>
</tr>
<tr>
<td>Current study (general households)</td>
<td>Gaborone, 2001</td>
<td>284</td>
<td>Households</td>
<td>97.9</td>
</tr>
<tr>
<td>Current study (specific households)</td>
<td>Gaborone, 2001</td>
<td>17</td>
<td>Households</td>
<td>88</td>
</tr>
</tbody>
</table>

It can be concluded that there is an overwhelming willingness to participate in source separation schemes. The overwhelming willingness to participate could provide an opportunity for setting upon organised recycling that may achieve high participation rate provided other pre-conditions as outlined in section 6.2 are met.
6.6.7 Households’ attitudes

The results of the ‘specific household’ attitude surveys are shown in a tabular matrix in Table 6.12. Even though the sample was too small for any statistical significance, it shows a trend of opinions of households who participated in the pilot source separation scheme based on their practical experience. Of the 17 respondents who were interviewed, an overwhelming majority of them (93.8 percent) supported the pilot scheme. This could be because the representatives of the piloting authorities explained the perceived benefits of the scheme to them in detail at the time when they were recruited to participate. It also emerged that 100 percent of the respondents who supported source separation schemes were willing to participate in future schemes. Among those who were willing to participate, the majority of them (68.8 percent) were willing to participate in a scheme with separate kerbside collection of recyclables. This could be because the pilot scheme in which they participated had separate kerbside collection of recyclables.

The responses pertaining to respondents’ attitudes on source separation, as shown in Table 6.12, suggest that there was a much stronger feeling on the environmental value of recycling. Most respondents either ‘agreed’ or ‘strongly agreed’ with issues that are deemed to enhance environmental acceptability of recycling. For example 50 percent, 33.3 percent and 28.6 percent of the respondents respectively ‘agreed’ that source separation is good for the environment, creates environmental awareness and reduces the quantity of waste destined for disposal. Furthermore, 50 percent, 53.3 percent and 71.4 percent of the respondents respectively ‘strongly agreed’ that source separation is good for the environment; creates environmental awareness and reduces the quantity of waste destined for disposal. In addition to the environmental value attached to source separation, 29.4 percent and 35.3 percent ‘agreed’ and ‘strongly agreed’ respectively that they would be more motivated to participate in source separation if it brought them money. However, householders generally disagreed with some potential negative aspects of source separation. Among the respondents, 52.9 percent, 52.9 percent and 41.2 percent
respectively ‘disagreed’ that source separation is time consuming, it is a health risk and takes a lot of space.

Table 6.12: Matrix of attitudes of households on source separation

<table>
<thead>
<tr>
<th>Opinion issues</th>
<th>Percentage (frequency) of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SDA</td>
</tr>
<tr>
<td><strong>Positives</strong></td>
<td></td>
</tr>
<tr>
<td>Reduces the quantity of waste disposed of</td>
<td>-</td>
</tr>
<tr>
<td>Good for the environment</td>
<td>-</td>
</tr>
<tr>
<td>Creates environmental awareness</td>
<td>-</td>
</tr>
<tr>
<td>Motivated to participate if it brings money</td>
<td>17.6 (3)</td>
</tr>
<tr>
<td><strong>Negatives</strong></td>
<td></td>
</tr>
<tr>
<td>It is time consuming</td>
<td>17.6 (3)</td>
</tr>
<tr>
<td>It is a health risk</td>
<td>23.5 (4)</td>
</tr>
<tr>
<td>Takes a lot of space</td>
<td>29.4 (5)</td>
</tr>
</tbody>
</table>

Notes: SDA—strongly disagree; DA—disagree; DK—don’t know; A—agree; SA—strongly agree

The household attitude survey showed a stronger support for the environmental values associated with source separation. This indicated that households are willing to participate in source separation for the benefit of the environment, but they would be even more motivated to participate if they derived financial gain. The willingness of households to participate in source separation because they generally believe it is good for the environment is supported by other studies by Huhtala (1999) and Vining and Ebreo (1990).

It can be concluded that the attitude of households was to support source separation because it was seen as good for the environment, even though they would be more motivated to participate if there was financial gain. This support for source separation was against the thesis of this study, but it however provide an opportunity for establishment of source separation schemes.
6.7 Summary

The critics of development of organised recycling schemes in developing countries often attribute its likely failure to lack of knowledge and support by key stakeholders of municipal officials and the general public. This emanates from the high dependence on organised recycling scheme on these stakeholders. For example households are expected to participate in source separation schemes, while municipal officials are often assigned the responsibility to plan and implement organised recycling schemes.

This chapter discusses a number of constraints of organised recycling relating to stakeholder perceptions and attitudes. It was found that household awareness of recycling and recycling initiatives does not necessarily translate into practising recycling in the absence of recycling systems and incentives. The attitude of households is that they would be more inclined to separate materials if there were associated direct financial incentives. The major constraint of organised recycling is municipal officials' attitudes. The general attitude of municipal officials is to maintain the status quo of conventional waste collection and disposal as a social responsibility. Organised recycling is seen as a waste management strategy that could not be undertaken by the municipality primarily because of manpower, transport and financial constraints.

It also emerged that despite being aware of the potential benefits of recycling, municipal officials have limited knowledge and practical experience of organised recycling schemes. Furthermore, there was an opinion gap between the local authority officials and the NGO on who should take the lead in recycling. In addition, despite the legislative requirements for municipalities to formulate recycling plans, there were no incentives/disincentives for doing so. The national authority that gives policy direction on recycling does not intend to introduce policies that support products with recycled content.
7 POST-CONSUMER MATERIAL MARKETS

7.1 Introduction

Chapter 6 discussed perceptions and attitudes of key stakeholders to organised recycling and highlighted the possible constraints. This chapter discusses post-consumer material markets and the possible constraints they might have on organised recycling schemes. In particular, the chapter sets out to provide evidence to support the research question:

What is the nature and capacity of post-consumer material markets to absorb materials that can potentially be recovered by organised recycling schemes?

The results and analysis are presented around the guiding hypothesis that says:

Despite the projection of organised recycling as an effective means to enhance waste recycling, its practicality as a waste management strategy in developing countries is constrained by the realities on the ground.

The chapter is organised into: the existing state of recycling in Gaborone; the major producer initiated recovery schemes, regional end-user markets and a summary of the main points.

7.1.1 Notes on terminology

To understand the discussion on post-consumer material markets, it is important to explain some of the terms used in this chapter as adapted from definitions by LDEQ (1999) and Sutherland (2001).

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Post-consumer materials are materials generated from residential and commercial waste, excluding those materials from industrial processes that had not reached the consumer.
A Market is a customer (or group of customers) who is willing and able to accept the commodity that is being offered. There are two types of recycling markets being: intermediate and end-user markets. Intermediate markets include collectors, processors and brokers while end-users manufacture products directly from recovered materials. Recycling markets may be positive or negative. When a customer pays for the recyclables, it is called a positive market, but when the collector of recyclables pays the customer to accept recyclables, it is called a negative market. Marketing refers to the process of identifying intermediate and end-user markets and making arrangements for those markets to accept recyclables.

The term supply refers to the quantity of recovered material generated, collected and transported for ultimate use in the manufacturing of a new finished product. The total amount of material that is generated by the consumer is the potential supply of recyclable material. The quantity of recovered materials that are offered to a broker, a processor or end-user either for free or for purchase is the recovered supply of the recyclable material. This quantity consists of material available prior to any significant processing. The term demand refers to the amount of post-consumer material that is sought by a broker, a processor or an end-user with the ultimate objective of reusing, or passing on to the end-user to manufacture a finished good.

The performance of the entire recycling markets would depend on the relationship between supply and demand of post-consumer materials. For example, other things being equal, the demand and supply of post-consumer materials must be equal for the markets to function properly. This would mean that, for post-consumer material markets to function properly in Gaborone, the demand must be equal to the supply. In part, the market survey is intended to establish the relationship between demand and supply in Gaborone and their potential impact on the sustainability of recycling markets.
7.2 The existing state of recycling in Gaborone

The existing state of recycling in Gaborone was established by a market survey for post-consumer materials carried out in Gaborone in July 2002 by the author. The detailed market survey methodology is discussed in section 3.9.4 in chapter 3. The market survey form used in the survey is contained in Appendix E. The following parameters were used to assess the existing state of recycling in Gaborone:

- Number of recyclers - refers to the number of companies/organisations that collect and process and/or make finished products from secondary materials
- Materials recycled - refers to types of post-consumer materials collected and processed or made into finished products
- Number of recyclers by material fraction - refers to the number of companies/organisations that collect, process and/or make finished products from certain specific post-consumer material fractions
- Quantity of material recycled - refers to the quantity of materials collected, processed and/or made into finished products
- Available capacity - refers to the potential of recyclers to collect, process and/or make finished products from additional post-consumer materials over and above the existing level of operation
- Sources of materials and nature of collection networks
- Nature of official support for post-consumer material markets creation and sustenance
- Post-consumer material prices

The data reported by the recyclers through market survey were triangulated by physical observations. In particular the available collection capacity and the effectiveness of the collection network were triangulated by observations around commercial areas, which were the main sources of the materials, and at recycling centres. Observations focused on parameters where measurement was possible such as:
• Availability and utilisation of collection vehicles – this would indicate the ability of the recycler to collect more material than they currently do
• Presence of materials with established markets at disposal sites, at commercial areas or as litter – this would indicate the effectiveness of the existing post-consumer material collection network

These parameters are discussed in detail in the following sections.

In addition to local recycling markets, regional post-consumer material end-user markets were also assessed for materials that were recovered and exported. The findings from the end-user material market survey are discussed in section 7.4.

7.2.1 The structure of the recycling industry in Gaborone

The recycling activities in Gaborone are made up of mainly private sector entrepreneurs and producer initiated recycling schemes\(^\text{12}\). The market survey established that there were 10 companies/organisations in Gaborone and the surrounding areas that dealt with post-consumer materials. The nature of companies/organisations that dealt with secondary materials could be broadly categorised into:

• Private sector recycling enterprises (six companies) – collect and process post-consumer materials for export. The main motive for operation is economic consideration
• NGO (Somarelang Tikologo) – acts as an agent for other recyclers through operating a ‘bring site’ for glass, paper, metal cans and plastic. It also collects and processes glass bottles for export. The main motive for operation is raising public awareness.

\(^{12}\) These were initiated by private sector without any legislative requirements to take back the materials that are introduced into society by virtue of the products they sell and/or the packing they produce.
• Producer initiated recycling schemes. There are two producer initiated recycling schemes that are summarised here and discussed in detail in section 7.3. These include:
  o Deposit refund scheme for returnable beverage bottles – operated by Segwana LTD a subsidiary of Kgalagadi Breweries LTD who are the main bottlers of beer and soft drinks.

In addition to private sector entrepreneurs and producer initiated recycling schemes, there was limited waste picking at the landfill and around the city for metal scrap for personal use and steel metal cans to sell to Collect-A-Can. Waste picking is done by individuals and schools respectively for earning additional income and fundraising. It was difficult to establish the extent of materials recovered through waste picking and the number of pickers involved because it appeared to be sporadic. However, Collect-A-Can revealed that they were aware of about five regular metal can pickers who sold the materials to them. At the time of the fieldwork, two schools were involved in picking steel metal cans to sell to Collect-A-Can. Further observations by the author indicated that the scale of waste picking operations was very small in terms of the number of waste pickers and the quantity of materials they picked.

There were limited working relationships\textsuperscript{13} within the recycling sector and, between recyclers and the official authority. Working relationships were limited to Somareleng Tikologo acting as an agent for some recyclers by collecting materials for them through its 'bring site'. Other linkages were mainly trade related with metal can collectors selling the collected cans to Collect-A-Can, the main metal can collector and processor. Apart from that, the recycling industry was fragmented and operated secretly pertaining to their

\textsuperscript{13} Interactions relating to recycling that can be of mutual benefit to all the parties involved
records on prices for their materials (probably normal in a competitive market). For example, when asked:

- Is your company a member of any local recycling association? Seven of the ten recyclers said ‘No’ while one said Somarelang Tikologo, which is not a recycling association but an NGO. The corporate membership of Somarelang Tikologo was to facilitate the NGO to act as their agent for the materials they collect through the bring site.

- Do you have any working relationship with the government? In exception of the NGO, all the other recyclers answered with ‘No’.

- Do you get any support from government? In exception of the NGO, all other recyclers answered with ‘No’.

- What is the current price paid for your materials per ton?’ The two main paper collectors and processors responded by saying ‘its confidential’.

In addition, the key informant interview with the Chief Executive Officer of Somarelang Tikologo reported in chapter 6 revealed that one of the difficulties they experienced in trying to evaluate the financial viability of the pilot project was the refusal by the paper collector to avail the financial gains of selling the paper to them.

Experience in South Africa and UK has shown that recycling associations facilitated cooperation between certain sectors of the economy to create markets for some material fractions as well as contributing towards local, regional ad national policy on waste recycling (Nampak 1999; NRF 2002). In addition, recycling associations also act, as a central hub for acquisition of data on recycling that could be important in planning organised recycling schemes. Failure by recyclers to cooperate may limit their influence on policy direction in favour of organisation of recycling schemes.
Key point

The key point from the discussion of the structure of the recycling industry in Gaborone is that the recycling sector is fragmented. This fragmentation could limit their ability to lobby the official authority and influence public policy direction in favour of establishment of organised recycling schemes that could ensure reliable supply of recyclables. In addition, fragmentation could undermine their ability to influence the official authority to offer incentives that could lead to development and sustenance of post-consumer material markets. Limited development of sustainable post-consumer material markets could lead to reduced demand for materials recovered through organised recycling schemes hence undermining their development.

7.2.2 Local post-consumer material markets

A summary of the materials with or without established local intermediate markets (brokers, collectors and processors) and the number of recyclers involved are summarised in Table 7.1. The table shows that the majority of recyclers collect and process paper and steel beverage metal with five and four collectors each respectively. The quantity of materials collected by these recyclers and their available capacity are discussed in section 7.2.3. Apart from paper and beverage metal cans, some post-consumer materials such as food and non-returnable glass, food preserve cans and hard plastic do not have established recyclers. Lack of recyclers for some materials could undermine their recovery through organised recycling schemes.
Limited development for intermediate post-consumer material markets for some materials as shown in Table 7.1 could be attributed to a variety of factors. The story of Mr D.K. Roy (not real name) in Box 7.1 demonstrates some of the difficulties of setting up recycling entrepreneurship in Gaborone. First, despite the support for recycling by legislation and policies, there was lack of practical official support when it comes to implementing them, such as facilitation of access to land for the recycling industry. Land available for recycling industry was usually in the periphery with no supporting infrastructure. Secondly, there was no preferential treatment for the recycling industry when it competes with other industries as indicated by double allocation of a plot that was first allocated for recycling. Third, plastic collectors wanted Mr Roy to increase the price he buys the plastic from them because they felt it was too demanding to collect, this was not possible because it would undermine his ability to operate at a profit.

The difficulties of the recycling industry in Gaborone are further demonstrated by brief profile of each of the recyclers as contained in Appendix F. About fifty percent of these post-consumer material collectors operate in the peri-urban villages around Gaborone while the sources of their materials are in and around the city centre. This is mainly

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**Table 7.1: Established local markets and number of recyclers by material fractions**

<table>
<thead>
<tr>
<th>Material fractions</th>
<th>Number of recyclers in and around Gaborone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper</td>
<td>5**</td>
</tr>
<tr>
<td>Mixed paper</td>
<td>4</td>
</tr>
<tr>
<td>Cardboard</td>
<td>4</td>
</tr>
<tr>
<td>Printing paper</td>
<td>5</td>
</tr>
<tr>
<td>Glass</td>
<td>2</td>
</tr>
<tr>
<td>Returnable bottles</td>
<td>1</td>
</tr>
<tr>
<td>Food and non-returnable glass</td>
<td>1***</td>
</tr>
<tr>
<td>Metal cans</td>
<td>4</td>
</tr>
<tr>
<td>Steel beverage metal cans</td>
<td>4</td>
</tr>
<tr>
<td>Food preserve cans</td>
<td>None</td>
</tr>
<tr>
<td>Plastic</td>
<td>2</td>
</tr>
<tr>
<td>Film plastic</td>
<td>2</td>
</tr>
<tr>
<td>Hard plastic</td>
<td>None</td>
</tr>
</tbody>
</table>

**Number of recyclers of the major material waste stream fractions (paper, glass, metal cans, plastic

***Recovered by Somarelang Tikologo's single ‘bring site’

14 Villages within 20km of the Gaborone City centre, which use most of the city’s infrastructure
because industrial space costs are lower in these areas. The location of recyclers in peri-urban villages could make them inaccessible to those who want to deliver materials to them. In addition, since most of the materials are collected from the city centre, daily travel to collect the materials could increase recyclers' transportation costs. Lack of accessible and affordable land for recyclers close to the sources of materials could increase their operational costs hence undermining their continued existence.

When recyclers were asked 'How can the government assist you in your recycling efforts?' The areas listed and ranked in Table 7.2 emerged as key to sustenance of post-consumer material markets. A provision of subsidies by the official authority ranked high and was expressed by three of the recyclers. Access to land, organisation of source separation schemes, raising public awareness, implementation of management strategy also emerged as key with two recyclers each advocating for support in these areas. Advocating for organising recycling schemes could indicate limited supply of post-consumer materials to recyclers, while implementation of the waste management strategy could signal frustration of the recyclers from lack of official support.

Table 7.2: The key areas that recyclers wanted official support

<table>
<thead>
<tr>
<th>Official support areas</th>
<th>Number of recyclers advocating for support in each area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsidies</td>
<td>3</td>
</tr>
<tr>
<td>Access to land</td>
<td>2</td>
</tr>
<tr>
<td>Organisation of source separation schemes</td>
<td>2</td>
</tr>
<tr>
<td>Implementation of waste management strategy</td>
<td>2</td>
</tr>
<tr>
<td>Raising public awareness</td>
<td>2</td>
</tr>
<tr>
<td>Access to materials in government institutions</td>
<td>1</td>
</tr>
</tbody>
</table>

Despite the general lack of direct incentives to encourage recycling, a low interest loan scheme, Citizen Entrepreneurial Development Agency (CEDA) for promoting citizen empowerment is available for use by recyclers. The recyclers can use the schemes to set-up or expand recycling business. Waste recyclers only qualify for CEDA funding, if the output of their activity is a 'product', that is, the result of a processing step (e.g. baling, crushing, sorting and washing). The difficulty with CEDA is that it is not specifically
reserved for recycling. Recycling enterprises have to compete for the loan with other businesses on the basis of financial viability of the proposed projects.

Box 7.1: The Story of Mr D.K. Roy

Mr D.K. Roy met representatives from the Government of Botswana's Trade Investment and Promotion Agency (TIPA) in Thailand in a business fair. He was impressed with the general investment environment in Botswana as explained to him by the representatives, which tended to support various business initiatives. Mr Roy transferred all his lifetime savings to Botswana with the objective of starting a film plastic (HDPE, LDPE) recycling business. The envisaged business was to produce ground plastic, pellets and granules for use by local and regional end-users. On arrival in Botswana, he identified potential end-users who were all local. The difficulty came when he tried to get a place from which to operate. With the belief that recycling business will pollute the surroundings and scare away other potential tenants, no one wanted to rent him a place from which to operate. But in the mean time he was expecting delivery of the machinery to be used in the business. He then went from one government office to another looking for assistance until someone advised him to apply for a business plot from the Land Board in the nearby village. The Land Board eventually allocated Mr Roy a plot. After clearing the plot with the intention of putting up a structure to house his machinery, he was surprised one day when he got to the plot, only to realise that it had been allocated to a construction company to use as site offices. Instead of despairing, he negotiated with the contractor to allow him to use part of the plot for his activities. The contractor agreed. The next challenge was to obtain post-consumer materials for processing. Initially a few individuals were interested in collecting the materials and selling to him. He was initially buying the materials for P0.50 per Kg. The price paid by end-users for the processed material was P1.50 per Kg. However, the collectors felt the price he was paying was too low and wanted it to be increased to P1.30 per Kg. But that was not feasible so they then stopped supplying him with the materials. He eventually met a lady who was willing to collect and sell him plastic at P0.30 per Kg. The lady was able to supply him with plastic for two months even though the supplied quantity did not meet his processing capacity. After two months the lady was deported for not having a work permit. Mr Roy approached the Gaborone City Council with a proposal of cooperating with him by recovering plastic through source separation, but they were not able to help citing manpower and financial constraints. He also approached Somarelang Tikologo, an environmental NGO. The only assistance they could offer was to act as agents for the materials he required and that was of no use to him either. Due to the unavailability of the suppliers for secondary plastic, the business is barely operating. He has hired labourers to collect plastic from commercial areas, dumps and other areas, but this is barely enough and the business has always been operating at a loss.
In addition to the number of recyclers by material fractions as shown in Table 7.1, some of the key parameters that reflect the existing state of recycling in Gaborone are summarised in Table 7.3. The table indicates that there are limited end-user markets for post-consumer materials with only one paper collection and processing company manufacturing tissue paper. The majority of recyclers (8 out of 10) are mainly collectors and processors who export the materials to regional end-user markets\(^\text{15}\). For example, paper is collected and processed by five recyclers primarily for export to Zimbabwe and South Africa. Steel metal cans are also processed and exported to South Africa.

<table>
<thead>
<tr>
<th>Material fraction</th>
<th>Number and type of recyclers</th>
<th>Name of recyclers</th>
<th>Geographical location of end-user</th>
</tr>
</thead>
</table>
| Paper             | • 5 collectors and processors  
|                   | • 1 end-user | • Pyramid Holdings  
|                   |               | • Botswana Tissue  
|                   |               | • Boswa Recycling  
|                   |               | • Alman metals  
|                   |               | • NGO  
|                   |               | • South Africa  
|                   |               | • Zimbabwe  
| Glass bottles     | • 2 collectors and processors  
|                   |               | • Segwana LTD  
|                   |               | • NGO  
|                   |               | • Returnable bottles reused locally  
|                   |               | • South Africa  
| Metal cans        | • 4 collectors  
|                   | • 1 processor | • De Bruins  
|                   |               | • Collect-A-Can  
|                   |               | • Alman metals  
|                   |               | • NGO  
|                   |               | • Power Metals  
|                   |               | • South Africa  
| Plastic           | • 2 collectors and processors  
|                   |               | • F.R.K trading  
|                   |               | • Botswana Tissue  
|                   |               | • South Africa  
|                   |               | • 1 tonne/month locally  

Lack of local end-user markets could be attributed to:

- Outflow of materials to larger established end-user markets in the region. For example, post-consumer paper from Gaborone is exported to the major recyclers in South Africa of Mondi and Sappi while metal cans are exported to Collect-A-Can, South Africa. Outflow of materials to large-scale industries in India was also found to limit the development of recycling industry in Nepal (van Beukering and Badrinath

\(^{15}\) These are industries that are willing and able to accept post-consumer materials that are being offered for reprocessing within the Southern African Region
The outflow of materials to larger established end-user markets could have both positive and negative impacts. The positive impact is that these established end-users provide a market for local recovered materials hence diverting them from disposal. On the negative side, outflow of materials to established regional end-users might deprive the local population the socio-economic benefits of developing the waste recycling industry locally, such as employment. But overall, the significance of material outflows to regional end-user markets will depend on the objective of local recycling initiatives and emphasis should be placed on where maximum benefit would be derived.

- Low volumes of recyclables. The waste quantity and composition survey in chapter 5 revealed that volume of recyclables in Gaborone is relatively low with a generation rate of 8 tonnes/day, 4 tonnes/day, 5.1 tonnes/day and 2.4 tonnes/day of paper, glass, plastic and metal respectively. Low volumes of recyclables could impact on the stability of supply of raw materials to recycling industry. For example, a plastic recycling industry in Sri Lanka closed down because of lack of regular supply of post-consumer plastic that often resulted in loss of production (GARNET 2000).

- Low demand for recycled products. The low demand for some materials with recycled content in Gaborone is caused by concerns over quality. For example, it was revealed that government does not intend to use recycled paper because of its perceived inferior quality (GoB 1998c). In addition, with a population of 1.7million (CSO 2001) Botswana is unlikely to be a large market for recycled products. Low demand for locally recycled products as a result of competing products from India was also found to restrict the development of the recycling industry in Nepal (van Beukering and Badrinath 1995).

**Key points**

The key points from the discussion of local post-consumer material markets are that:

- Intermediate post-consumer material markets are not available for some materials that constitute a significant proportion of the waste stream because of:
• Lack of practical official support
• Lack of incentives
• Limited local end-users markets
• End-user post-consumer material markets are limited because of:
  • Lack of incentives
  • Low volumes of recyclables
  • Outflow of materials to larger established end-users in the region
  • Low demand for recycled products

7.2.3 Sources, collection network and capacity for different material fractions

Materials handled by recyclers are usually delivered by or collected from different sources through different collection networks. Most of the materials collected are obtained from the commercial sector and institutions. Figure 7.1 through Figure 7.4 shows the different sources and collection networks of the different material fractions.

Paper
The existing recovery rate for paper from commerce and institutions is approximately 26 tonnes/day. The waste quantity and composition survey reported in Chapter 5 showed that apart from the existing recovery rate, households and commerce generated 11.1 tonnes/day of paper. Out the 11.1 tonnes/day of paper generated, 6.4 tonnes/day was potentially recyclable (see section 5.3.3). This meant that approximately 6.4 tonnes/day of paper was available for recycling over and above the current recovery rate of approximately 26 tonnes/day. A comparison of the total paper recovered (approx. 26 tonnes/day) and that available for recycling (approx. 32.4 tonnes/day) represents about 80 percent recovery rate, which is significantly high by international standards. This means that the quantity of paper that could be recovered by organised recycling schemes over and above the existing recovery rate is limited. The limited quantity of paper available for recovery by organised recycling schemes could limit the ability of the local authority to...
recoup the money invested in organising recycling schemes by selling post-consumer paper. In addition, high recovery rate could mean that organised recycling schemes may not divert significant quantities of waste paper from disposal over and above the quantity diverted by the existing post-consumer paper recovery systems. Overall, the existing high recovery rates could be disincentive for the municipality to recover paper through organised recycling schemes.

Figure 7.1 shows sources and collection networks for paper. Approximately 26 tonnes/day of paper collected from the commercial sector and institutions by recyclers. The two main players of Pyramid Holdings and Botswana Tissue claim to collect 23 tonnes/day between them. Pyramid Holdings claimed to collect 13 tonnes of paper daily with 10 collections trucks. Botswana Tissue claimed to collect 10 tonnes of paper daily with 12 collections trucks. Other small-scale collectors of Boswa Recycling, Alman Metals and Somarelang Tikolo, claim to collect approximately three tonnes of paper between them. In addition, three newspaper companies deliver unsold paper to the ‘bring site’ operated by Somarelang Tikolo, while one directly deliver to a recycling enterprise. Furthermore, one major paper recycler, Botswana Tissue has hired about 10 labourers to pick paper mainly cardboard from the landfill when is delivered for disposal. The paper collected was mainly sorted, baled and exported. A reported 1 tonne of printing paper was used by Botswana Tissue to make tissue paper.

Paper was obtained free of charge from its sources and sold to end-user markets at approx. P200 - P500/tonne. A change in scenario with intermediate markets having to pay for post-consumer paper collected by the local authority could undermine their ability to make profits from selling the material to end-users. Reduced profits could undermine the continued existence of paper collectors, hence limit the provision of a market for paper recovered through organised recycling schemes.
Paper collected from the commercial sector was source separated as shown in Plate 7.1 and Plate 7.2. However, the source-separated paper was often not stored in any receptacles, but just piled behind the commercial buildings alongside receptacles for other waste fractions. This exposed source-separated paper to dispersion by wind, human beings and other elements. In addition, some commercial enterprises that had arrangements with recyclers for collection of paper reported that recyclers often fail to collect the source-separated paper, which end-up being disposed at the landfill. Failure to collect source-separated paper could indicate inefficient collection network or limited collection capacity by recyclers. Ineffective collection network or limited collection capacity by recyclers could limit their ability to collect source-separated materials from organised recycling schemes hence limiting their development.
Plate 7.1: Source separated paper with a skip for other fractions at a commercial area

Plate 7.2: Source separated paper piled outside a commercial area with no primary storage
Metals cans

The waste stream analysis in Chapter 5 showed that 3.1 tonnes of metal cans are generated daily over and above that recovered by Collect-A-Can, of which 2.7 tonnes/day was potentially recyclable. It was however not possible to compare the generation rate and the recovery rate by Collect-A-Can since the recovery rate represents a national figure while the generation rate was a local figure. At national level, Collect-A-Can claims to recover 65 percent of the distributed beverage steel cans. Apart from that, the 3.1 tonnes produced daily consisted of both beverage metal cans and other metal cans that did not have an established market. Lack of established markets for these metal fractions could undermine their recovery through organised recycling schemes.

Figure 7.2 shows the different sources and collection network for metal cans. Beverage steel cans were collected from pubs, hotels, restaurants and schools by Collect-A-Can. Collect-A-Can had established a national collection network with beverage distributors in which delivery trucks return with empty beverage metal cans from other parts of the country where possible. At national level, the company claimed to recover 11 tonnes of metal cans daily. Two schools in Gaborone were found to often require students to pick up beverage metal cans around the city to eliminate litter as well as a means of fundraising for the school by selling them to Collect-A-Can during spare time. Collect-A-Can indicated that they were five regular waste pickers who picked beverage metal cans from the landfill to sell to them. The collected materials were baled and exported to South Africa.

Despite the presence of the buy back scheme, observations in the study area by author showed that not all the generated beverage metals cans were recovered, hence their dispersion as litter and presence at the landfill. Observations around pubs and beer shebeens\textsuperscript{16} revealed that there were lots of beverage metal cans widely dispersed and not collected. This could indicate ineffective collection network or limited collection

\textsuperscript{16} Informal beer trading outlets, usually in low-income areas
capacity. In addition, the disposal of other fractions of packaging metal cans could indicate limited demand. Ineffective collection network and limited demand for other fractions of metal could limit the recovery of recyclables by organised recycling schemes.

Figure 7.2: Sources, collection and processing of post-consumer metal can

**Glass**

The waste stream analysis showed a generation rate of 4.8 tonnes/day of glass over and above the recovered one, of which 2.7 tonnes/day were potentially recyclable. However, it was not possible to compare the generation rate and recovery rate because the recovery rate by Segwana LTD represents a national figure while the generation rate was a local figure. Apart from that, the 4.8 tonnes generated daily consisted of a proportion of returnable beverage bottles and other bottles that had a limited market. Limited market for the other stream of glass could undermine their recovery through organised recycling schemes.
Figure 7.3 shows the sources and collection networks for glass bottles. Returnable beverage bottles are source separated at pubs, hotels, restaurants, and delivered to Segwana LTD to recover the deposit. In addition, householders returned beverage glass bottles to beverage outlets or directly to Segwana LTD to recover their deposit. Other glass bottles are delivered to Somarelang Tikologo's ‘bring site’. The return of glass bottles to Somarelang Tikologo's ‘bring site’ is voluntary and does not attract any monetary incentive. The glass recovered by Somarelang Tikologo is crushed manually and exported to South Africa, while returnable bottles returned to Segwana LTD are cleaned and reused.

Observations in the study area showed that the collection network of the deposit refund scheme for returnable glass bottles was successful on the basis that one can hardly see returnable beverage bottles in the waste at the landfill or dispersed as litter. In addition, the reported recovery rate of 90 percent of returnable bottles demonstrates the success of the scheme. This could be a result of the deposit paid back on returning the bottles. However, the collection network for other glass bottles including that collected by Somarelang Tikologo’s ‘bring site’ was not as effective. This stream of glass bottles was observed to occur as litter and was prevalent at the landfill. This could be an indication that the demand for this stream of glass was limited. Lack of demand and ineffective collection network for this stream of glass bottles could limit their recovery by organised recycling schemes.
Plastic

The existing recovery rate for film plastic from commerce and the landfill is estimated at approximately 1 ton/day. The waste quantity and composition survey reported in Chapter 5 showed that apart from the existing recovery rate, households and commerce generated 6.6 tonnes/day of plastic. Out the 6.6 tonnes/day of paper generated, 4.2 tonnes/day was potentially recyclable (see section 5.3.3). Of the 4.2 tonnes/day of plastic potentially recyclable, 2.2 tonnes/day was film plastic while 2.0 tonnes/day was hard plastic, which did not have an established market. Lack of established markets for hard plastic could undermine its recovery by organised recycling schemes.

Figure 7.4 shows sources and collection network for plastic. About 1 tonne of film plastic was source separated by commercial sector for collection by Botswana Tissue. One of the recyclers, F.R.K Trading had hired five labourers to pick film plastic from the landfill and commercial enterprises. The company reported that it collects about 30kg/day of film
plastic through these methods of collection. The majority of collected film plastic (about 1 tonne/day) was sorted bailed and exported to South Africa while a small proportion (about 30kg/day) was cleaned, dried and processed into ground plastic, pellets and granules. There was no established collection network for hard plastic.

Observations in the study area revealed that plastics were the most predominant litter, particularly plastic shopping bags. The author found that plastic shopping bags clogged open storm water drainage systems and were also trapped on fences and trees. F.R.K trading reported to be barely operating because of shortage of plastic. Shortage of post-consumer plastic was attributed to lack of public interest in collecting plastic as a result low prices paid by recyclers. For example, F.R.K trading reported that it initially paid P500/tonne to plastic agents, but the agents wanted the price to be increased to P1300/tonne (Ray 2002). The company was however not able to pay the required amount, because the revenue they got from selling processed plastic was P1500/tonne.
The inability of recyclers to pay higher prices for post-consumer materials could restrict their recovery by organised recycling schemes, hence constraining their development.

**Key points**

The key points from the discussion of sources, collection networks and capacity for different material fractions are:

- There are no established collection networks for some material fractions such as non-beverage metal cans, non-returnable glass bottles and hard plastic because of lack of markets. Lack of established markets for these fractions could undermine their recovery by organised recycling schemes.

- Most materials are obtained free of charge from their sources by recyclers. Municipal organisation of recycling schemes would mean that the municipality have to sell the recovered materials to recyclers. This change in scenario with recyclers having to pay the municipality for the material it recovers could undermine their ability to make profits, hence undermining their continued existence. This could constrain the development of organised recycling schemes.

- Collection of some materials with established markets was compromised by inefficient collection network or inadequate collection capacity provided by recyclers. However, it was revealed in chapter 6 that the key stakeholders of municipal and national governmental officials envisage organised recycling to be beneficial when recyclers collect the recyclables. Ineffective collection network or limited collection capacity by recyclers could limit their ability to collect source-separated materials from organised recycling schemes hence undermining the sustainability of the schemes.

- Depending on the nature of the municipal recovery schemes, the high recovery rate achieved by paper collectors could make it difficult for municipalities to recoup the money invested in organised recovery schemes through selling paper over and above that already recovered. This could particularly be the case where municipal schemes
operate in parallel to the existing recycling enterprises competing for the same materials. When this occurs, it could undermine the continued existence of the organised recovery schemes.

7.3 The major producer initiated recovery schemes

There are two major schemes that deserve a special mention. These are the returnable bottles deposit refund scheme operated by Segwana LTD and the beverage steel cans buy back scheme operated by Collect-A-Can, Botswana. The schemes deserve a special mention because they represent creation of post-consumer material markets through producer initiatives. Producers of packaging materials or products packaged have established collection networks and incentives to facilitate the return of post-consumer materials for reuse and recycling. Experience in Brazil and South Africa shows that such producer initiatives substantially increased recycling rates. For example, non-profit association founded by multinational companies and major Brazilian corporations to promote recycling set up a recycling co-operative that collected recyclables equivalent to half the amount collected by the entire official Sao Paulo city recycling programme but at a much lower cost (BRC 1996). In South Africa, the Collect-A-Can initiative increased collection of metal cans from 18 percent in 1993 to 63 percent in 1998 (Nampak 1999).

7.3.1 The Deposit Refund Scheme

The deposit refund scheme for returnable beverage bottles (beer and soft drink) is intended to recover bottles primarily for reuse. Segwana LTD, a subsidiary of Kgalagadi Breweries LTD, operates the deposit refund scheme. The company estimated that of all the bottles used for bottling soft drinks and beer, 20 percent and 15 percent respectively were returnable. The scheme recovers bottles by inducing consumers of beverage drinks in returnable bottles to return them to stores where they bought the drinks or directly to Segwana LTD for a deposit. The scheme targets only those bottles used for bottling by
Segwana LTD, excluding those of imported beverages. In 2002, Segwana LTD claimed to be recovering 90 percent of the returnable bottles that it distributes nationally. The high recovery rate could be attributed to the deposit paid back upon returning the bottles. Table 7.4 summarises the deposit level attracted by the different sizes of returnable bottles in 2002. The deposit level is directly related to the size of the bottle. In addition, Table 7.4 shows that the deposit level had not been stagnant, for example the deposit level for 350ml of soft drink bottle has doubled from P0.25 in 1996 to P0.50 in 2002. However, the reported recovery rate of 90 percent achieved by the deposit refund schemes is significantly high even though it represented recovery of a lower proportion of glass in the total waste stream. This is demonstrated in the discussion below.

In 1996 it was estimated that at national level, out of a total of 15 400 tonnes of glass bottles generated, 4 900 tonnes were returnable glass bottles (GoB 1998c). This meant that the recovery of all returnable glass bottles represented a total recovery rate of 32 percent of the total glass in the waste stream. A larger proportion of post-consumer glass bottles at 68 percent remained not recovered because of a lack of local markets. The apparent lack of local markets for a larger proportion of post-consumer glass could constrain its recovery through organised recycling schemes.

Table 7.4: Deposit attracted by different beverage bottles

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>340</td>
<td>P0.50</td>
<td>-</td>
<td>P0.25</td>
<td>P0.50</td>
</tr>
<tr>
<td>350</td>
<td>-</td>
<td>P0.25</td>
<td>P0.50</td>
<td>-</td>
</tr>
<tr>
<td>750</td>
<td>P0.75</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1000</td>
<td>-</td>
<td>P0.65</td>
<td>P1.00</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: ¹Phoi (2002); ²GoB (1998c)
7.3.2 Steel beverage cans buy back scheme

Collect-A-Can, Botswana was established in 1993 to recover beverage steel metal cans for recycling as an initiative of Collect-A-Can, South Africa. The company operates a buy back scheme for beverage steel metal cans in Gaborone. The South African Canning and Steel Industry generate the money for the payment of can collectors as well as for the installation of the necessary infrastructure (GoB 1996). Collect-A-Can collects beverage steel metal cans from pubs, hotels and restaurants. The cans collected from the commercial sector were obtained free of charge. In addition, individual waste pickers and some schools collected and sold metal cans to Collect-A-Can as described in section 7.2. Kgalagadi Breweries (LTD) as the distributor of over 90 percent of all beverage cans assisted Collect-A-Can by transporting scrap metal cans in bags or bales from all over the country to Gaborone after the delivery of the beverages (GoB 1998c).

Prices paid for steel beverage metal cans collected and delivered to Collect-A-Can depots are detailed in Table 7.5. Delivery of cans to the company’s depot presents more opportunity for collectors to obtain more money from Collect-A-Can at P280/tonne as compared to collection by the company from the different sources at P100/tonne. At the time of the survey about 320 tonnes per month of steel metal cans were collected and delivered to South Africa by the company. Collect-A-Can currently claim that they recover 65 percent of the cans distributed in the country as a whole. A recovery rate of 65 percent is significantly high for large proportion of the metal cans in the waste stream by international standards. A study of metal cans in Botswana estimated that of the 6 750 tonnes of metal cans generated in 1996, 6 300 tonnes were beverage steel cans, 440 tonnes were food packaging cans and 10 tonnes included other metal cans such as paint containers, aluminium cans (GoB 1996). A higher recovery rate could imply that the quantity of post-consumer metals that could potentially be recovered by organised recycling schemes would be limited. This means that even though there is an established

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17 Buy back centre is a facility where individuals bring recyclables for payment
market for beverage steel cans, it may not be beneficial for municipally established organised recycling schemes.

Table 7.5: Prices for steel beverage cans collected and delivered to Collect-A-Can depot

<table>
<thead>
<tr>
<th>Forms the cans are sold in</th>
<th>Price (P/tonne)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Loose cans delivered to Gaborone depot</td>
<td>280</td>
</tr>
<tr>
<td>b) Loose cans collected from household or commercial places</td>
<td>100</td>
</tr>
<tr>
<td>c) Crushed cans baled and delivered to Gaborone depot</td>
<td>304</td>
</tr>
</tbody>
</table>

Source: Sekate (2002)

7.3.3 Conclusion

The key conclusion from the major producer initiated recovery schemes is that, the deposit refund scheme and the buy back scheme for returnable beverage bottles and beverage steel cans respectively achieved relatively high recovery rates. The relatively high recovery rates could imply there would be very limited potential to improve on existing recovery rates through organised recovery schemes.

7.4 Regional end-user markets

Regional end-user markets are the main driver of recycling activities in Gaborone with 8 out of 10 recyclers collecting and processing materials for export to South Africa. In recognition of these, an e-mail questionnaire was sent out to the identified post-consumer material end-users in South Africa. The regional end-users were identified through a local market survey. The e-mail addresses of the end-users were obtained from the Institute of Waste Management of Southern Africa. The main end-users identified are listed in Table 7.6. Sappi was the only end-user that did not respond to the e-mail questionnaire. The objectives of the questionnaire were to establish availability of capacity to absorb materials from Gaborone, prices paid for materials sourced in South Africa and possible constraints of importing materials from Gaborone. Even though some of the answers to
the questions were relative and did not give absolute figures, there are indications that there is available reprocessing capacity.

Table 7.7 shows some post-consumer material prices paid by the end-users in South Africa for material delivered from Botswana and that sourced from South Africa in the Johannesburg region. Even though the prices were reported to vary from time to time and between regions depending on transportation costs, they indicate that overall relatively higher prices are paid for materials imported from Botswana. The willingness of the end-users to pay high prices for imported post-consumer materials could further indicate that the available capacity is not fully utilised by locally obtained materials.

Table 7.6: Regional end-users and indications of reprocessing capacity

<table>
<thead>
<tr>
<th>End-users identified</th>
<th>Materials reprocessed</th>
<th>Reported existing capacity (tonnes/year)</th>
<th>Utilised capacity (%)</th>
<th>Approx. quantity of materials imported from Botswana (tonnes/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collect-A-Can, S.A (Nampak)</td>
<td>Metal cans</td>
<td>Capacity is not a problem, can easily be increased</td>
<td>64</td>
<td>27</td>
</tr>
<tr>
<td>Mondi²</td>
<td>Paper</td>
<td>350 000 (900 000)*</td>
<td>86</td>
<td>600</td>
</tr>
<tr>
<td>Sappi</td>
<td>Paper</td>
<td>No response</td>
<td>No response</td>
<td>No response</td>
</tr>
<tr>
<td>Glass-Recycling³</td>
<td>Glass</td>
<td>72 000</td>
<td>40</td>
<td>540</td>
</tr>
</tbody>
</table>

*The number in brackets is the reported total reprocessing capacity for paper mills in South Africa

Sources: ¹Christie (2003); ²Cannon (2003); ³Poultney (2003)

There were indications that there was available regional end-user capacity for the material that were collected in Gaborone and Botswana in general. This does not support the thesis of this study. However, the domination of the post-consumer material markets in Gaborone by collectors and processors who export their materials to regional end-users markets raises three critical issues that could impact on their sustenance. These issues are primarily related to local policies and incentives to sustain and expand existing demand; transportation costs to regional end-user markets and regional competition.
Table 7.7: Prices paid by end-users for imported and locally recovered materials in South Africa

<table>
<thead>
<tr>
<th>Material</th>
<th>Price for materials imported from Botswana (P/ton)</th>
<th>Price paid for materials at buy back centres in South Africa (P/ton)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardboard</td>
<td>300</td>
<td>297–363</td>
</tr>
<tr>
<td>Printing paper</td>
<td>250-500</td>
<td>549-646</td>
</tr>
<tr>
<td>Mixed paper</td>
<td>200-250</td>
<td>165–194</td>
</tr>
<tr>
<td>Newsprint</td>
<td>200-300</td>
<td>194/264</td>
</tr>
<tr>
<td>Steel beverage metal cans</td>
<td>280</td>
<td>224</td>
</tr>
<tr>
<td>Glass</td>
<td>195</td>
<td>139</td>
</tr>
<tr>
<td>Film Plastic</td>
<td>400</td>
<td>194</td>
</tr>
</tbody>
</table>

*Converted from South African Rands (R) to Botswana Pula (P) using the exchange rate at the time of the survey.

- Local policies and incentives

Local policies and incentives to sustain and expand existing demand for post-consumer materials may not have an effect on end-user demand at regional level. Local policies and incentives could increase collection and processing capacity without a corresponding increase in end-user capacity. This could lead to disposal of materials collected and processed.

The main end-user markets for local post-consumer materials are in South Africa. However, the South African Waste Strategy proposes to set up source separation schemes to enhance material recovery (GoSA 1999). The increased recovery in the region could limit regional demand of locally recovered materials leading to their disposal or lowering their prices. This could inhibit the continued existence and growth of local secondary material collection and processing industry in Gaborone. This effect was demonstrated in Europe with the introduction of new laws in Germany that forced producers to take back their packaging material resulting in supply surpassing the available local recycling capacity. A large amount of paper was exported to the neighbouring countries. The increased recovery of paper in Germany lead to a decline in the price of paper, and almost a collapse waste recovery sector in the region (van Beukering and Curlee 1998).
• Transport costs

The regional location of end-users could impose high transport costs on collectors and processors. The high unit transportation costs might offset the gains of selling the materials to regional end-user markets. Unit transportation costs from Gaborone to the South African boarder by rail are summarised in Table 7.8. The table shows that unit transportation costs are the same for all materials and depends on the overall weight to be transported. For example, it is relatively cheaper to transport quantities of materials heavier than 35 tonnes. This could mean that collectors and processors who export less than 35 tonnes per consignment would experience relatively higher unit transportation costs. In addition, collectors and processors of low-density materials such as paper and plastic would have to collect large volumes of these materials to minimise transportation costs. Table 7.9 shows transportation costs as a proportion of the selling price for the exported post-consumer materials. The table shows that collectors and processors who export less than 35 tonnes/consignments would experience relatively high unit transportation costs comprising approximately 47, 50 and 72 percent for cardboard, metals and glass respectively. Higher transportation costs could limit the ability of recyclers to export the recovered materials hence limit the recovery of material through organised recycling schemes.

Table 7.8: Unit transport costs for post-consumer materials

<table>
<thead>
<tr>
<th>Material</th>
<th>Price of light material (&lt;35 tonnes) P/ton</th>
<th>Price of heavy material (&gt;35 tonnes) P/ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper</td>
<td>140</td>
<td>37</td>
</tr>
<tr>
<td>Glass</td>
<td>140</td>
<td>37</td>
</tr>
<tr>
<td>Metals</td>
<td>140</td>
<td>37</td>
</tr>
</tbody>
</table>

Table 7.9: Comparison of transportation costs and selling prices

<table>
<thead>
<tr>
<th>Material</th>
<th>Price of light material (&lt;35 tonnes) P/ton</th>
<th>Price of heavy materials (&gt;35 tonnes) P/ton</th>
<th>Selling price (revenue)(P/ton)</th>
<th>Transport costs proportion – light (%)</th>
<th>Transport costs proportion – heavy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper</td>
<td>140</td>
<td>37</td>
<td>300</td>
<td>47</td>
<td>12.3</td>
</tr>
<tr>
<td>Glass</td>
<td>140</td>
<td>37</td>
<td>195</td>
<td>72</td>
<td>19</td>
</tr>
<tr>
<td>Metals</td>
<td>140</td>
<td>37</td>
<td>280</td>
<td>50</td>
<td>13.2</td>
</tr>
</tbody>
</table>

As a testimony to transport costs being restrictive to export of post-consumer materials to regional markets, Somarelang Tikologo reported that they were able to sell glass to Enviro-Glass, an agent of Glass Recycling in South Africa mainly because the railway company, Spoornet, paid 75 percent of their railway transport costs.

A discussion with Christie (2003) of Nampak, one of the major recycling industry in South Africa, revealed that prices for post-consumer materials in South Africa were not high enough and were unlikely to compensate for the transportation costs of small volumes of materials from Botswana further inside South Africa. This has limited delivery of these materials to markets closer to Botswana/South African border. Transportation costs were also found to be limiting recovery of low volume materials in Namibia for recycling in South Africa (Kohrs 1996)

- Regional competition

Export of recyclables to regional end-user markets means that local collectors and processors have to compete with others in the region who sell their materials to the same end-users. For example, Kohrs (1996) reported that because of lack of end-user markets in Namibia, recyclables are exported to South Africa. Availability of materials at lower prices elsewhere in the region could undercut the prices of recyclables from Gaborone, hence undermining the sustainability of local collectors and processors.
**Key point**
Even though the regional end-user capacity provide valuable markets for post-consumer materials recovered in Gaborone by intermediate markets, it exposes them to high transportation costs, regional competition, and may limit the effect of local policies and incentives that are intended to support them. This could undermine the continued existence of local intermediate markets hence limiting the organisation of recycling schemes.

### 7.5 Summary

This chapter discusses a number of constraints to organised recycling related to market and market development for post-consumer materials. The constraints range from local policy issues to regional factors. Private sector entrepreneurs carry out collection of recyclables, but these recyclers are not unified to enable them to lobby the official authority and influence policy towards organisation of recycling schemes. The other constraint is that local intermediate and end-user markets are not well developed for several reasons including lack of practical official support, lack of incentives and regional competition. In addition, collection of some post-consumer materials with established markets is compromised by inefficient collection network and/or inadequate collection capacity. Apart from that, most materials collected are obtained free of charge from their sources, a change in scenario with collectors having to pay for the materials collected by the municipality could undermine their ability to make profits and undermine their continued existence.

There are also indications that the market created by producer initiated recovery schemes will not be of any significance to organised recycling schemes because they already achieve high recovery rates. Similarly, the high recovery rate achieved by paper collectors would make it difficult for municipalities to recoup the money they invested in organised recovery schemes through selling the recyclables. Furthermore, exporting
materials to regional end-user markets exposes collectors to high transportation costs, regional competition and may limit the effect of local policies and incentives that are intended to support them.
8 SUMMARY OF RESULTS AND IMPLICATIONS

8.1 Introduction

Chapter 4 through chapter 7 presented the results and analysis of the thesis. This chapter presents a synthesis of the key findings from the thesis and their implications. First, the guiding hypothesis and research questions that directed the study are revisited with a view to testing the evidence that supports them. Secondly, the findings from waste sampling surveys, key informant interviews, field observations and market surveys are refined into a discussion of implications.

8.2 Research questions and guiding hypothesis

This section presents the findings in relation to the primary and specific research questions that were identified and presented in chapter 3 (section 3.5) and examines the thesis' hypothesis in relation to evidence from the data analysis.

Primary research question

What are the practical constraints of developing organised recycling schemes in cities in developing countries with similar characteristics to Gaborone?

The data supports three fundamental blocks that could impact on successful implementation of organised recycling schemes in cities in developing countries with similar characteristics to Gaborone of:

- Quantity and quality of recyclables in the waste stream
- Stakeholder perception and attitudes
- Post-consumer material markets

Exploration of these key fundamental blocks is carried out in more detail in the examination of the specific research questions as done below.
Specific research question 1

What constraints could the proportion of municipal solid waste generated in Gaborone that is potentially recyclable impose on organised recycling?

The data indicates:

- There is limited baseline data in Gaborone on waste quantity and composition in the appropriate format to enable estimation of municipal solid waste that is potentially recyclable.
- At 0.33 kg/capita/day, household waste generation rate is relatively low and could place relatively limited pressure on disposal facilities.
- The inorganic fraction of the waste stream that is often a target for organised recycling schemes is relatively low.
- At 67.9 percent, organic waste constitutes a higher proportion of household waste.
- The quantity of waste that could be diverted from disposal through recycling would depend on the extent of contamination, public participation and post-consumer material markets.

Implications

- There is a need to improve an understanding of the local waste stream through collection of baseline data on waste quantity and composition in an appropriate format to facilitate planning and execution of recycling initiatives.
- Organised recycling schemes that target the inorganic fraction of the waste stream may not divert significant waste from disposal over and above the existing recycling activities.
• In cases where the quantity of waste that could be diverted from disposal through recycling is low, diversion of waste from disposal may not be the main objective for a recycling strategy. In this case, the emphasis of a recycling strategy might be to achieve multiple objectives such as conservation of resources, raising environmental awareness through practical projects etc.

Specific research question 2

What are the perceptions and attitudes of key stakeholders of households, municipal officials and NGOs to organised recycling schemes? How are these perceptions and attitudes likely to constrain organised recycling?

The data indicates:

• There is limited local authority institutional reform in accordance with waste management legislation and policy direction
• In the absence of recycling systems and incentives, household awareness of recycling may not necessarily translate into participation in recycling initiatives.
• The attitude of households is that they would be more inclined to separate materials that have financial incentives
• The general attitude of local authority officials is to maintain the status quo of waste collection and disposal, and not to embrace waste management reforms such as recycling, which they think is the responsibility of the private sector
• Despite being aware of the potential benefits of recycling, local authority officials have limited knowledge and practical experience of organising recycling schemes
• There is an opinion gap between the local authority officials and the NGO as to who should take the lead in recycling
• The attitude of national government officials who formulate government policy and legislation on recycling is that the local authority does not need incentives to
stimulate their participation in recycling because they would benefit from reduction of waste disposal and collection costs in the long run.

Implications

• Recruitment and training of municipal officials to build capacity and knowledge that will enable better conception of waste management reforms that adopt a holistic and integrated approach.
• Facilitation of a change in attitude by municipal officials through minimising their direct involvement in recycling.
• Creation of recycling awareness through public education programmes should be accompanied by a presence of recycling systems that offer incentives to the general public for returning the recyclable materials.
• Creation of an environment of knowledge sharing and cooperation between local authority and NGO officials could narrow the opinion between the two stakeholders
• The potential financial benefits of recycling to the local authority are ill conceived by the national authority. National policy makers should be trained to better understand the applicability of some policy decisions that work in other areas to their local conditions. In this case, for recycling to be a success, the accompanying government policy should be supported by a regime of incentives for key stakeholders.

Specific research question 3

What is the nature and capacity of post-consumer material markets to absorb materials that can potentially be recovered by organised recycling schemes?
The data indicates:

- The recycling industry is fragmented and do not have any working relationship between them or between them and the local authority.
- Local intermediate and end-user markets are not well developed because of lack of practical official support, lack of incentives and regional competition.
- Most materials are obtained free of charge from their sources by recyclers. Municipal organisation of recycling schemes would mean that the municipality would have to sell the recovered materials to recyclers. This change in scenario with recyclers having to pay the municipality for the material it recovers could undermine their ability to make profits, hence undermining their continued existence.
- Inefficient collection networks or inadequate collection capacity provided by recyclers compromised collection of some materials with established markets.
- There are no established collection networks for some material fractions such as non-returnable glass bottles and hard plastic because of lack of markets.
- Apart from plastic, materials that had established markets such as paper, returnable bottles and metal cans are already achieving high recovery rates.
- Regional location of end-user markets exposes local intermediate markets to high transportation costs, regional competition, and may limit the effect of local policies and incentives that are intended to support them.

Implications

- The recycling industry should be encouraged to form association that would enhance their ability to lobby the official authority and influence recycling policy direction
- Practical measures should be undertaken by the official authority to create markets for materials that do not have established markets through incentives.
- An authority other than the municipality has to be established to collect and make available the collected materials to the recyclers at a nominal fee.
• Creating stakeholder linkages and a central hub for material delivery by generators should improve the effectiveness of the existing collection networks.

• Explore and identify end-user markets or alternative uses of materials with no established demand before embarking on collection of the materials.

• The existing recovery schemes already achieving high recovery rates should be encouraged through incentives and enabling legislation to ensure their sustainability.

• Collected materials for export should be stored and transported in large quantities to minimise transportation costs.

Guiding hypothesis

The guiding hypothesis that directed this study is:

*Despite the projection of organised recycling as an effective means to enhance waste recycling, its practicality as a waste management strategy in developing countries is constrained by the realities on the ground.*

The guiding hypothesis directed the thesis towards examining the constraints of organised recycling in developing that could limit its practicality as a waste management strategy. The findings that emerge from the research provide strong evidence that contrary to the general expectations in developed countries, organised recycling in cities in developing countries with similar characteristics to Gaborone has limited potential. The main constraints established are around the key fundamental blocks of recyclable content of the waste stream, stakeholder perceptions and attitudes, and post-consumer material markets.

8.3 Implications of findings

The research found that, the main factors that could limiting the success of organised recycling in cities in developing countries with similar characteristics to Gaborone are:
• Municipalities experiencing relatively lower waste generation rates of inorganic waste are unlikely to realise high diversion rates through organised recycling schemes over and above existing recovery rates.
• Municipal officials' attitudes favour the maintenance of the status quo of waste collection and disposal, and leave recycling to private sector.
• Municipal and NGO officials have limited capacity and practical knowledge to organise recycling schemes.
• Public awareness of recycling does not necessarily translate into participation in recycling without financial incentives and 'visible' recycling systems.
• Private recycling enterprises and producer initiated recycling initiatives already achieve relatively high recovery rates for the materials they target.
• Regional location of end-user markets exposes intermediate markets to high transportation costs, regional competition, and may limit the effect of local policies and incentives that are intended to support them.
• Development and sustenance of post-consumer material markets is undermined by lack of official support through incentives.

The reviewed literature shows that the main concerns over the appropriateness of organised recycling in developing countries are based on:
• Limited amount of available recyclables
• Lack of public support
• Lack of official support
• Failure of post-consumer material markets

*Limited amount of recyclables*

This concern is based on the understanding that in most developing countries, a high level of waste recovery already takes place through informal activities for economic
reasons. Despite limited informal recycling enterprises, this study shows that private sector recycling enterprises already achieve relatively high recovery rates for the fractions they target in the waste stream without municipal involvement. High recovery rates could also be a disincentive for municipal involvement in the recovery of recyclables since it could undermine its ability to make revenue from selling the recyclables. This implies that any recycling strategy must place emphasis of supporting private sector enterprises.

**Lack of public support**

This concern is based on the understanding that organised recycling schemes depend on households' participation in source separation of recyclables. It is argued that because of lack of awareness of the environmental benefits of recycling, households in developing countries are unlikely to support source separation schemes. In addition, households would be more inclined to separate and sell the materials for economic gain rather than voluntarily separating it for municipal collection. This study shows that households are generally aware of recycling and recycling initiatives. But this awareness does not necessarily translate into participation in recycling without direct financial incentives and the availability of visible recycling systems. This implies any recycling strategy must have within it a component that directly rewards households for separating materials for recycling. The strategy must also provide for provision of visible recycling systems.

**Lack of municipal support**

This concern is based on the understanding that municipalities in developing countries are understaffed, have limited resources and are unlikely to cope with the additional responsibility of collecting recyclables. This study showed that because of limited resources, limited technical knowledge, the attitude of municipal officials is to maintain the status quo of waste collection and disposal as a social responsibility and leave
recycling to private sector. This implies that any recycling strategy should aim at changing the attitude of municipal officials towards recycling by relieving the municipality the financial and administrative burden of separate collection of recyclables. Municipal officials must also be trained to appreciate waste management reforms such as recycling.

Failure of post-consumer material markets

Market failures are attributed to imbalances between supply and demand of recyclables. Such an imbalance is often attributed to inefficient collection of recyclables and lack of policies to support recycling enterprises. This study found that market development for post-consumer materials was limited by lack of practical official support for the recycling sector. The study also found that export of materials by collectors exposed them to external factors such as high transport costs and competition. This implies that any recycling strategy must support recycling enterprises through appropriate incentives to cushion them against adverse effects of transport costs and competition.

8.3.1 Guidelines for recycling

The identified constraints as discussed above, mean that more flexible recycling guidelines that take into consideration the existing level of recycling would be more appropriate for developing countries' cities with similar characteristics to Gaborone. To this end, the developed guidelines proposed for developing countries as outlined in the theoretical framework would be more appropriate provided that:

- Creation of public awareness is accompanied by recycling systems that offer direct incentives to the participating public
- The municipality is relieved of the financial and administrative burden of recycling through encouraging and supporting private sector initiatives
• Post-consumer material markets are created and sustained through provision of direct incentives to recycling enterprises.

• A multiple stakeholder approach that involves the municipality, households, commerce, NGOs and recyclers is applied.

The proposed approach does not offer a blueprint but rather general guidelines to enhance recycling in developing countries. The guidelines are based on the findings in Gaborone, but it might also be valid in other cities in Southern Africa and other developing countries with similar characteristics as outlined in chapter 1 (section 1.7). However, it is beyond the scope of this thesis to prove this assertion beyond reasonable doubt.

In the context of Gaborone, the attitude of municipal officials is that recycling must be left to private sector. In addition, the findings in chapter 4 and chapter 7 show that the existing level of recycling undertaken by private sector enterprises without municipal involvement is relatively high. This scenario favours a recycling strategy centred on private sector participation.

The proposed approach should be based on stakeholder linkages that would relieve the municipality the financial and administrative burden of operating organised recycling schemes and improve collection efficiency of recyclables. The proposed stakeholder linkages are shown schematically in Figure 8.1. The envisaged role of each stakeholder is detailed below.

• The municipal authority should facilitate the establishment of a ‘recycling fund’ by working with Botswana Confederation of Commerce Industry and Manpower (BOCCIM), an association of business and industry. Through a bye-law, the municipality could require the commercial and industrial sector who establishes in Gaborone to contribute annually towards a ‘recycling fund’.
• The recycling fund should be managed by a ‘recycling board’ made up of representatives from the key stakeholders of municipal authority, BOCCIM, NGO(s), recyclers and general public.

• The ‘recycling fund’ should be used to set-up recyclables buy back centres, thereby providing an incentive for the general public to return the materials.

• The buy back centre would also serve as visible recycling system that are easily accessible to the general public.

• The ‘recycling fund’ could also be used to fund public awareness programmes.

• The NGO(s) could carry out public education programmes that would support the buy back centre.

• The recyclers could buy the materials from the buy back centre at a nominal fee.

• The buy back centre should also explore possible uses of other materials recovered.

In addition to these proposals:

• The municipal could create an enabling environment for recyclers by providing land to recycling enterprises at a nominal price. Access to land could enable recycling enterprises to recover and store large quantities of recyclables to take advantage of the economies of scale during export.

• BOCCIM should facilitate formulation of a recycling association that could act a central hub for the collection of data on recycling and enable the official authority to monitor progress. An association of recyclers could also be in a position to provide input into recycling policy.
8.4 Summary

This chapter summarised the research finding around the research questions and guiding hypothesis. The implications for the thesis are developed from the findings. The thesis proposes guidelines for recycling in cities in developing countries with similar characteristics to Gaborone that takes into consideration the practical conditions on the
ground. The core objective of the proposed guidelines is to take into consideration the existing level of recycling and the stakeholders involved to build onto them. The thesis does not provide absolute answers to improving recycling in cities in developing countries with similar characteristics to Gaborone, but sets out proposals for enhancing recycling without stretching municipal resources.
9 CONCLUSION

9.1 Introduction

Chapter 8 summarised the key findings and implication of the thesis. This chapter concludes the thesis by highlighting the most important findings that arise from the study in relation to the overall research process and outcome.

9.2 Conclusions

This research was guided by the hypothesis that "Despite the projection of organised recycling as an effective means to enhance waste recycling, its practicality as a waste management strategy in developing countries is constrained by the realities on the ground". The guiding hypothesis directed the thesis towards examining the constraints of organised recycling in developing that could limit its practicality as a waste management strategy. The examination was carried through key research questions of:

- What constraints could the proportion of municipal solid waste generated in Gaborone that is potentially recyclable impose on organised recycling?
- What are the perceptions and attitudes of key stakeholders of households, municipal officials and NGOs to organised recycling schemes? How are these perceptions and attitudes likely to constrain recycling?
- What is the nature and capacity of post-consumer material markets to absorb materials that potentially be recovered by organised recycling schemes?

A comprehensive literature review facilitated identification of research gaps in existing knowledge relating to organised recycling in developing countries and enabled formulation of research questions and guiding hypothesis. The review confirmed that the existing knowledge was weakest in identifying the practical constraints of organised recycling in developing countries. Most of the constraints to organised recycling discussed in the literature review were not based on any objective examination of the
practical conditions on the ground. This thesis is therefore a major contribution to the body of practical knowledge on constraints of organised recycling in developing countries. The thesis provides guidelines for enhancing and sustaining recycling in developing countries.

The implications from the findings were applied to the theoretical framework as outlined in the thesis and to the practical issues that are of concern to waste management planners and practitioners and the following conclusions drawn.

- Contrary to expectations in developed countries, organised recycling in cities in developing countries with similar characteristics to Gaborone has limited potential.
- An appropriate approach would development of flexible recycling guidelines with the existing level of recycling as the main criteria for determining recycling options that is centred on
  - Providing incentives to private sector recycling enterprises to sustain their operations.
  - Providing incentives and recycling systems to households to induce them to return the materials for recycling.
  - Involving other stakeholders to minimise the financial and administrative burden of recycling on the municipality.

The implications of the thesis for sector professionals are:

- Even though recycling is a good waste management principle, organised recycling in cities in developing countries with similar characteristics to Gaborone has limited potential. Recycling strategies that are adopted to promote it should take into consideration the local conditions.
- In developing countries, economic benefits are central to public participation in recycling. Recycling strategies that depend on public participation should have financial incentives built into them.
• The burden of financial and administrative responsibility for recycling should be minimised on the municipality through a holistic stakeholder involvement that includes waste generators, recyclers, NGOs and municipality.

9.3 Recommendations for further research

• The main motive for supporting organised recycling schemes in developing countries is to reduce the quantity of waste to be disposed, which is expected to lead to reduced collection and disposal costs. Further research is required to establish the costs and benefits of organised recycling schemes in developing countries, compared to landfill disposal, with emphasis on specific waste fractions.

• This research argued that relatively small diversion rates could be a disincentive for municipal involvement in organised recycling. There is scope for further research to establish what would be a significant diversion rate that would represent an incentive for municipal involvement in organised recycling.

• The proportion of waste that could be diverted by organised recycling would depend on the extent of contamination. Further research is required to establish the ‘clean materials’ available for recycling and possible diversion rates that could be achieved by taking contamination into consideration.

• This study showed that awareness of recycling appears not to necessary translates into participation in recycling. Further research is required to establish what factors other than the once mentioned will assist in translating awareness into participation.

• This study showed that an overwhelming majority of households are willing to participate in source separation schemes. It is however not clear how this willingness to participate translates into actual participation. Various participation rates have been reported by some source separation schemes. But further research is required to establish the relationship between willingness to participate and actual participation.

• One of the recommendations of this study is that due to low volumes of secondary materials in the study area, recovered materials should be exported to the regional end-user markets. On the other hand, it recommends that incentives should
particularly be targeted to local waste collectors and processors. It is not clear how the end-user markets will cope with increased recovery stimulated by localised incentives. There is scope for further research to establish the impact of increased recovery on end-user demand and prices as a result of incentives that cannot be extended to end-user markets.
BIBLIOGRAPHY


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Department of the Environment (DoE) (1990a). This Common Inheritance, Britain’s Environmental Strategy, London, HMSO.


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APPENDIX A

HOUSEHOLD AND COMMERCIAL WASTE SAMPLING TABLES
SURVEY TABLE 1: Preliminary household waste sampling table

<table>
<thead>
<tr>
<th>Residence No.</th>
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<tbody>
<tr>
<td>No. of persons</td>
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<td>Date</td>
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<table>
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<tr>
<th>Survey days</th>
<th>Waste generated (kg)</th>
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<td>14</td>
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<td>TOTAL</td>
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</table>
SURVEY TABLE 2: Household waste sampling table

<table>
<thead>
<tr>
<th>HOUSE NO.</th>
<th>TYPE OF HOUSE</th>
<th>DATE</th>
</tr>
</thead>
</table>

Dear resident,

You are kindly requested to participate in this study. The results of the study are purely used for research purposes. The study will take a period of three weeks. You do not need to give your name.

Thank you

<table>
<thead>
<tr>
<th>Waste Component</th>
<th>Weight (Kg)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glass</td>
<td></td>
<td></td>
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<tr>
<td>Plastic (total)</td>
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<td>Film</td>
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<tr>
<td>Hard</td>
<td></td>
<td></td>
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<tr>
<td>Food and garden waste</td>
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<td>Metals (total)</td>
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<tr>
<td>Non-ferrous</td>
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<tr>
<td>Ferrous</td>
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</tr>
<tr>
<td>Textile</td>
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<td>Other</td>
<td></td>
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<tr>
<td>TOTAL</td>
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</table>

Questions

- How many people are there in the family?
- Do you own or rent the house?
- If renting the house, what is the monthly rent?
- Do you use a television in the house?
- Monthly income of household a) P 0-1350 b) P 1350-7000 c) More than P7000
Table 1: Samples obtained for commercial waste characterisation

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Putrescible</th>
<th>Paper</th>
<th>Plastic</th>
<th>Glass</th>
<th>Metals</th>
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<td><strong>30.260</strong></td>
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<td><strong>0.225</strong></td>
<td><strong>1.080</strong></td>
<td><strong>266.100</strong></td>
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</table>
MAP OF GABORONE SHOWING SAMPLING AREAS
Sampling area for household waste composition and household interviews

LEGEND
- Road
- Rail
- River
- Residential
- Civic and Community
- Industrial
- Sport and Recreational
- Taxi Rank
- Water Areas
- Pilot project
APPENDIX C

HOUSEHOLD SURVEY QUESTIONNAIRES
You are kindly requested to spare a few minutes to help complete a survey regarding household waste source separation for recycling. The data obtained will purely be used for academic research. All information obtained will be treated in confidence.

**SECTION A**

1. **Sex**
   - A) Male
   - B) Female

2. **Education**
   - A) None
   - B) Primary
   - C) Secondary
   - D) Tertiary

3. **What is your monthly family income?**
   - A) Less than P1350
   - B) Between P1350 and P7000
   - C) More than P7000

4. **Age**
   - A) 16-24
   - B) 25-34
   - C) 35-49
   - D) 50-64
   - E) 65+

**SECTION B**

5. **Which statement best describes your household waste collection?**
   - A) I have to carry the waste to the nearby skip for collection
   - B) I have to carry the waste to a shared bin on the street for collection
   - C) I have to put the waste bin at the gate for collection
   - D) Other, please specify __________________________

6. **The waste collection service provided by the City Council is:**
   - A) Good
   - B) Satisfactory
   - C) Needs improvement
   - D) Poor

7. **Do you know where your waste goes after collection?**
   - A) Yes
   - B) No
SECTION C
8. Have you heard or read about recycling before?
   A) Yes (go to 9)
   B) No (go to 13)
9. How have you heard or read about recycling? You can choose more than one media
   A) Radio
   B) Television
   C) Newspaper
   D) Magazines or newsletters
   E) Billboards
   F) Other, please specify________________________
10. Do you usually set aside some materials from your waste for reuse and recycling?
    A) Yes (go to 11)
    B) No (go to 13)
11. What materials do you usually set aside?
    A) Glass bottles
    B) Paper
    C) Metal cans
    D) Old clothes
    E) Plastics
    F) Other, please specify________________________
12. What do you with the materials that you set aside?
    A) Sell
    B) Give it to other people
    C) Other, please specify________________________
13. Segwana currently has a scheme where you can return your beverage bottles to the store from which you brought them a fee, Are you aware of the scheme?
    A) Yes (go to 14)
    B) No (go to 15)
14. Do you usually return your beverage bottles?
    A) Yes
    B) No
15. Why don't you return your bottles?
    A) Lack of time
    B) The fee is too small
    C) It is inconvenient
    D) Just lazy
    E) Any other reason (explain)__________________________________________
SECTION D

16. If Gaborone City Council started collecting cans, glass, and other recyclables for recycling, would you be willing to separate your household waste for recycling?
   A) Yes (go to 17)
   B) No (go to 19)

17. Which of the following components would you be willing to separate? You can choose more than one category.
   A) Waste paper, such as newspapers and cardboard
   B) Film plastic, such as shopping bags
   C) Rigid plastic, such as fresh milk bottles
   D) Glass bottles
   E) Metal cans
   F) Other scrap metals
   G) Cloth, such as old clothes
   H) Other, please specify ________________

18. Under which system would you be more likely to participate?
   A) Separate the recyclables and place them into a single container and put them side by side with the rest of the waste for collection (commingled kerbside)
   B) Separate the recyclables into different categories in different containers and put them side by side with the rest of the waste for collection (separate kerbside)
   C) Separate the recyclables into different fractions and carry them to a collection point in the neighbourhood (drop-off systems)

END

19. Why would you not want to participate in recycling?
   A) Time consuming
   B) Too dirty
   C) Unsure
   D) Other, Specify ________________

20. What reason is most likely to encourage you to participate in recycling?
   A) Creation of jobs
   B) If it helps the environment
   C) If it brings you money
   D) If requirement by law
   E) Unsure

Thank you for your time.
Loughborough University

Survey instrument 2: Survey questionnaire for Households who participated in the pilot project

Interviewer's name
Plot number of interviewee
Date

You are kindly requested to spare a few minutes to help complete a survey regarding your participation in household waste source separation for recycling. The data obtained will purely be used for academic research. All information obtained will be treated in confidence.

SECTION A
1. Sex
   A) Male
   B) Female
2. Education
   A) None
   B) Primary
   C) Secondary
   D) Tertiary
3. What is your monthly family income?
   A) Less than P1350
   B) Between P1350 and P7000
   C) More than P7000
4. Age
   A) 16-24
   B) 25-34
   C) 35-49
   D) 50-64
   E) 65+

SECTION B
5. Which statement best describes your household waste collection?
   A) I have to carry the waste to the nearby skip for collection
   B) I have to carry the waste to a shared bin on the street for collection
   C) I have to put the waste bin at the gate for collection
   D) Other, please specify _______________
6. The waste collection service provided by the City Council is:
   A) Good
   B) Satisfactory
   C) Needs improvement
   D) Poor
7. Do you know where you waste go after collection?
A) Yes 
B) No

SECTION C

8. Have you heard or read about recycling before?
A) Yes (go to 9)
B) No (go to 13)

9. How have you heard or read about recycling? You can choose more than one media
A) Radio
B) Television
C) Newspaper
D) Magazines or newsletters
E) Billboards
F) Other, please specify__________________________

10. Do you usually set aside some materials for reuse and recycling?
A) Yes (go to 11)
B) No (go to 13)

11. What materials do you usually set aside? you can choose more than one
A) Glass bottles
B) Paper
C) Metal cans
D) Old clothes
E) Plastics
F) Other, please specify__________________________

12. What do you with the materials that you set aside?
A) Sell
B) Give it to other people
C) Other, please specify

13. Segwana currently has a scheme where you can return your beverage bottles to the store from which you bought them for a fee, Are you aware of the scheme?
A) Yes (go to 14)
B) No (go to 15)

14. Do you usually return your beverage bottles?
A) Yes
B) No

15. Why don't you return your bottles?
A) Lack of time
B) The fee is too small
C) It is inconvenient
D) Just lazy
E) Any other reason (explain)______________________________________________
SECTION D

16. Recently Somarelang Tikologo and Gaborone City Council piloted a source separation scheme, which you participated by separating your household waste. Do you support such schemes?
   A) Yes
   B) No

17. What is your opinion on the recycling schemes such as the one you participated in relating to the following issues?
   SDA= strongly disagree; DS= disagree; DK= Don't know; A = agree, SA= strongly agree

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<th>DS</th>
<th>DK</th>
<th>A</th>
<th>SA</th>
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<td>B) It is good for the environment</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>C) Makes people environmentally aware</td>
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<td>D) It is time consuming to separate waste</td>
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<td>E) Separating waste is a health risk</td>
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<td>F) The bins provided take a lot of space</td>
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<td>G) I will be more motivated to participate if</td>
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<td>I get money for the materials</td>
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SECTION E

18. If Gaborone City Council started collecting cans, glass, and other recyclables for recycling, would you be willing to separate your household waste for recycling?
   A) Yes (go to 19)
   B) No (go to 21)

19. Which of the following components would you be willing to separate? You can choose more than one category.
   A) Waste paper, such as newspapers and cardboard
   B) Film plastic, such as carrier bags
   C) Rigid plastic, such as beverage bottles
   D) Glass bottles
   E) Metal cans
   F) Other scrap metals
   G) Cloth, such as old clothes
   H) Other, please specify __________________________

20. Under which system would you be more likely to participate?
   A) Separate the recyclables and place them into a single container and put them side by side with the rest of the waste for collection (commingled kerbside)
   B) Separate the recyclables into different categories in different containers and put them side by side with the rest of the waste for collection (separate kerbside)
C) Separate the recyclables into different fractions and carry them to a collection point in the neighbourhood (drop-off system)

END

21. Why would you not want to participate in recycling?
   A) Time consuming
   B) Too dirty
   C) Unsure
   D) Other, Specify__________________________________________

22. What reason is most likely to encourage you to participate in recycling?
   A) Creation of jobs
   B) If it helps the environment
   C) If it brings you money
   D) If requirement by law
   E) Unsure

Thank you for your time
APPENDIX D

KEY INFORMANT INTERVIEW TRANSCRIPTS
Transcript of interview with Senior Technical Officer (Waste Management) – Gaborone City Council – Date: 29/07/02

1. **Do you have any recycling plan in place?**

   We do not have recycling plans; it is only Somarelang Tikologo that is promoting recycling.

2. **But the Waste Management Act requires you to make waste a management plan of which part of it should be a recycling plan, how far are you in developing one?**

   Those are only proposals that I believe will be looked into in the future.

3. **I have read in a report that you have participated in a joint household source separation pilot scheme with Somarelang Tikologo, how do you see such schemes benefiting the city council's waste management activities?**

   Yes we did participate in such a scheme, we are of the view that recycling can prolong the life span of the landfill, for example right now the landfill is full even before the length of time it was designed for has elapsed.

4. **Do you see any constraints that such schemes can have on the city council's waste management activities?**

   On the basis of what we have seen during piloting of the scheme, it will be very difficult for the city council to undertake the project; first it required a lot of manpower input and transport, but we already have shortage of these resources.

5. **What other lessons did you learn from the scheme?**

   We realise that there was a possibility that recovering the materials for recycling can reduce the quantity of waste that is collected for disposal.

6. **What would you single out as the most important thing(s) that will make the city council to actively participate in recycling?**

   The city council supports recycling, but if it reduces the quantity of waste collected, it will certainly be more appealing.

7. **Do you have any officers designated to oversee recycling? How many are they?**

   Not as of now, but during the pilot scheme, three officers were assigned to work with Somarelang Tikologo, to be able to experience first hand operations of such schemes.

8. **Do you have a budget component for recycling?**

   I am not very sure.
9. Do you have any previous activities in waste management involving private sector?
Yes we previously had a company called Daisy Loo that was contracted to collect waste in some parts of Gaborone, but their contract was terminated, I am not sure why, may be they did not do a good job, but right now the council is considering sourcing out some of its activities such landfill equipment, generally because there is a problem with regular maintenance

10. Do you have any incentives to support recycling?
We have environmental committees that often organise competition that encourage people to make products from waste, and the winners are often given prices. But the whole objective of this exercise is to raise environmental awareness and generate an understanding that waste is a resource. But we don’t have incentives for large-scale recyclers

11. What I gather from you is that the city council think recycling is good, is that correct?
Yes we acknowledge that recycling can reduce the quantity of waste that goes to the landfill, hence saving the city council money in both capital and operational costs. But this is something that the decision makers might not be aware, hence they are not offering incentives to stimulate recycling

12. Do you see the city council actively participating in collection of recyclables to sell to recycling companies?
As I said before, the city council has constrained resources, so I envisage the situation where recyclers collect the recyclables as some are doing now collecting paper and metal cans. But I still see a lot of paper around may be there is a problem with the market.

13. I have been talking to some recycling companies they have particularly been reporting shortage of materials particularly those collecting paper and plastic, they were of the opinion that support by the city council in operating a source separation scheme will go a long way in meeting their material demands. What is your opinion on that?
But they do not come forward to enlist our support

14. Two of the companies that I have spoken to said they have approached the city council with a view of that they must consider
operating a source separation scheme, but you cited manpower and financial resources constraints

Yes the cited constraints are a reality. Our funding comes from the Central Government, may be they should also approach the Central Government through the Department of Sanitation and Waste Management
Transcript of Interview with Senior Environmental Health Officer - Gaborone City Council - Date: 23/07/02

1. **Do you have any recycling plan in place?**

   Currently we do not have that kind of plan even though we wish we could have one, we have also been approached by various consultants offering their services for development of a waste management plan which will include a waste recycling plan. You will also realise that the Waste Management Act stipulates that we must produce a Waste Management Plan and we have not yet produced it.

2. **I have read in a report that you have participated in a joint pilot household waste source separation scheme with Somarelang Tikolo, what were your reasons for participating in piloting the scheme?**

   Having seen such schemes in other areas we visited in study tours in Europe (Sweden in particular), we wanted to see if such a scheme is workable in Gaborone. We were also trying to evaluate if it can reduce the quantity of waste destined for disposal, and we did find out that indeed it did reduce the quantity of waste to be collected for disposal which we believe could increase the life span of the landfill. We had a plan to embark on a trial, so when Somarelang Tikolo came with the idea of a pilot, we bought it immediately and provided resources in terms of bins and personnel to realise the success of the pilot. We feel that it was a good thing but it only lasted for a short time to enable a proper evaluation.

3. **Do you have any future plans in to establish such scheme or pilot them in larger areas?**

   I don't think it will be a wise thing for the city council to embark upon. But however, I think the general public should be encouraged to recover materials to earn a living from waste. I sincerely believe in producer responsibility, those who generate all sorts of packaging waste should be able to accept it back, certainly if you buy a product such as fish for example, you are not interested the container but the fish inside, so the manufacturer should take the can back.

4. **Basically you are saying it will not be wise for the city to embark on an organised source separation program, what do you see as the constraints for doing so?**

   First the city council has resource constraints both manpower and financial, for the city council to operate the scheme, it has to be self-financing. This implies that we will have to charge households directly for the collection of waste, and the local population is not used to that, so it is going to be an enormous task to get them to pay. But the city council also does not have the necessary experience in cost recovery measures in
waste management. We will probably have to contract it out to those with the know how

5. What would you single out as the most important thing(s) that will make the city council to actively participate in recycling?

We will certainly be interested if it reduces the quantity of waste that is supposed to be disposed, but as I said earlier, I have reservations if the city has the ability to embark on a fully-fledged source separation scheme for recycling.

6. What were the main lessons that you learnt from the pilot source separation scheme?

Yes, we learnt a couple of lessons:

- It might be cheaper to for a fully-fledged source separation scheme to be operated by private sector.
- In the long term, it can create employment.
- It can reduce the quantity of waste destined for disposal at the landfill, therefore increasing its life span.
- When people are approached and educated about recycling, they are prepared to participate in source separation.
- If you don't collect the source separated recyclables in time and the bins get full and overflow, the participants will get angry and stop source separating.

7. As you are required by the Waste Management Act to produce recycling plans, do you have any officers designated to oversee recycling?

Not really, but we certainly have officers who are designated to look at other aspects of waste management such as collection, storage, disposal and management of landfill management.

8. Do you have a budget component for recycling?

No, not really, we just have a budget for all our waste management activities, nothing specifically for recycling.

9. I know you said you don't see the city council embarking upon such schemes because of the associated resource constraints, what is your view on a working relationship between council and private sector particularly recycling companies regarding recycling where the city council acts as a facilitator by offering long term contracts.
to those in private sector who might be interested in organising source separation schemes and collecting recyclables?

I am of the opinion that the only facilitation role council can play is to have the producers to take back their waste, including commercial enterprises that distribute them, the expectation will be that when a company sets up an outlet in the city, before they can be given a license to operate, they must have a recycling plan, in which they undertake to take some of their packaging probably with some deposit attached to it or even buying them back to induce individuals to return them. The respective companies will have to identify end-users of such materials.

11. Do you have any policies or incentives in place that promote recycling e.g. tax rebates, incentives, preferential procurement of good with recycled content?

No, we don’t have any incentives

12. Do you have any previous activities in waste management involving private sector?

Yes we once had a company called Daisy Loo

13. What was the nature of activities?

Daisy Loo was contracted out to collect waste in some areas of Gaborone

14. How successful were they?

We as the technical staff of the city council who were tasked with evaluating its performance produced a report, which indicated that the contracting out was successful and saved the city council some money. We also observed that the company used its resources effectively and efficiently, for example to cover the same area that the city council used to cover, they were using two vehicles and 21 manpower, while we used 6 vehicles and more than 100 manpower. Even though we recommended that their contract be extended, the elected politicians recommended that their contract be terminated forthwith and we are not privy to the reasons for that.

15. Do you see any role for private sector in recycling?

Yes, I certainly believe recycling can be able handled by private sector. The public sector can only act as facilitators because in principle we support recycling, we believe it can help us achieve our primary objective of providing an effective and efficient collection service along side a safe disposal, but recycling is more business oriented and I don’t think the
public will want to see us using their taxes to support the recycling industry.
Transcript of interview with Chief Executive Officer - Somarelang Tikologo - Date: 18/07/02

1. You recently piloted a source separation for recycling scheme in Gaborone, what were primarily the reasons for piloting the scheme?
   For several reasons,
   • First, it was to see how much recyclable waste is generated by households;
   • Secondly, to assess if households will be interested in separating their waste;
   • Thirdly, we see source separation as having the potential for individuals to earn a living from collecting and selling recyclables in a safe manner, instead of waste picking at disposal sites
   • Lastly, to assess if the city council could save some money in collection costs, assuming that the recyclables will be collected by recycling companies
   • If the results were positive, Somarelang Tikologo intended lobbying the city council to pilot the scheme in a larger area

2. Are you implying that there was no environmental motivate for your part in piloting the scheme?
   We believe that by diverting the recyclables from landfill disposal will go a long way in reducing the quantity of waste disposed and prolonging the life span of the landfill by that way conserving the land resource

3. What were the reasons for targeting paper, glass and metal cans?
   We believed that these streams are available in every household waste and are easy to separate.

4. So the availability of the market for these components was not an import in deciding what materials to separate?
   No, at this stage there was no market consideration but just to verify if these components are actually available in household waste and in what quantities

5. Were the materials of any specific type or grade?
   No, the materials were not of any specific type or grade, we targeted all types of paper, all types of metal cans and all types of bottles as long as they did not contain toxic substances

6. What was the basis of choosing your participants?
The participating households were chosen on the basis of assumed income stratification, basically to establish the variation of the targeted components with income. But there was no conclusive relationship between income and the quantity of the various components generated.

7. Why did you distribute the participating households in a wider area instead of a block?

The distribution was mainly influenced by an attempt to stratify the households by income and households were picked randomly within an income group.

8. How did you recruit the participants in scheme?

Households in the selected areas were written letters introducing Somarelang Tikologo and the project that we wanted to undertake. The objectives of the project were also explained to them. Households were then asked if they were interested to participate, the chosen households were those who expressed interest to participate.

9. What constraints did you encounter during piloting? (financial, technical, logistical, participation rate and willingness to participate)

We did not experience major constraints, most participating households were committed to the project even though during initial stages they often mixed up the waste but with continued education they were finally able to separate their waste properly. There were also logistical problems of collecting the separated fractions mainly because of the distribution of households; the collecting companies were sometimes not able to locate the participating households. This led to recyclables not being collected, which undermined continued participation by householders.

10. How feasible are organised source separation schemes of the nature of the one that you piloted?

We think that source separation is very feasible and we intend to undertake phase two of the project by piloting it in a larger area, which we think this time it will be a block to avert the logistics of collection that were experienced in the first phase and also to make the scheme ‘visible’, which could develop wider community interest.

11. Would you say the pilot scheme was a success?

We think the pilot scheme was a success, however, we also found that it is an expensive undertaking, more expensive than we thought. We were also not able to account for the revenues that were obtained from collecting paper since the company that was collecting paper did not want to disclose how much money they made from selling the paper.

12. What was the nature of support you got from private sector, public sector?

We arranged with Collect-A-Can and Pyramid Holdings to collect metal cans and paper respectively, and we collected glass. They mostly fulfilled
their undertakings, but as I said previously, the company that collected paper did not want to declare the revenue they obtained from selling paper. The city council were very cooperative, they supplied bins for the recyclables and they also provided officers who recruited participating households and guided them on what materials to separate and how

13. **What lessons did you learn from piloting the scheme?**

We learnt that when dealing with private sector, we should deal with those companies that will be able to disclose their financial gains from the material, which will enable us to fully assess the financial viability of the scheme. We also learnt that since the scheme raised environmental awareness on some participating households, in the future when we approach people to participate and they are not interested, we should encourage them to participate. We also were also able to establish that the scheme can save the city council money by reducing frequency of household waste collection as a result of the reduced quantity of waste left for disposal after removing the recyclables.

14. **Did you experience any reservations about the scheme from your partners as the piloting of the schemes went on?**

No, but as I said, we were a little disappointed that one of them did not want to disclose the revenues obtained from selling the recyclables.

15. **Do you have any future plans for the expansion of the pilot scheme?**

Yes we are hoping for phase two of the project in a larger area, but this time we are hoping that we will be able to lobby city council to be an active participant. We actual want city council to take the leading role.

16. **Do you have any future plans for a fully-fledged source separation scheme?**

Yes we hope to lobby city council to embark upon source separation to avert the current scenario where the recyclables are recovered in a dangerous environment such as the landfill.

17. **Do you have any time frames for phase two?**

No, largely because we want it to be spearheaded by the Gaborone City Council. We are still having discussions with them but I don't see it happening in the next two years.
Transcript of interview with Senior Waste Management Officer - DSWM – Date: 25/07/02

1. The Waste Management Strategy, the Waste Management Act highlights recycling as one of the components of waste management, what are the motivations for recycling plans in the Act?

   The Department has adopted the internationally accepted waste management hierarchy as the guiding principle in waste management, of which recycling is part of:
   - The most important reason for encouraging and promoting recycling is to minimize waste that has to be taken to the landfill, which we believe will prolong the life span of the landfill, thereby reducing the capital expenditure on construction of new landfills.
   - We are also believe that by raising awareness that some waste materials are in fact a resource can lead to recovery and promote environmental cleanliness.
   - Recycling can also improve human and animal health by removing litter from the surrounding environment.

2. In addition to the regulatory instrument, the Act, what do you have in terms of incentives to promote recycling?

   We don’t have incentives at the moment because waste management strategies are very new in Botswana, so it means the majority of decision makers (administrators and politicians) are not yet sensitised on the issue of waste management. Once these people are sensitised, I believe that we will have policies and legislation that adequately supports recycling. The department has taken upon its-self to sensitise different levels of society on the need for proper waste management. I remember that when government used to have Financial Assistance Policy (a grant for setting up businesses) we used to encourage people to go and seek assistance to make businesses out of waste. Our collaborators GTZ from Germany when they were still around helped some recycling companies to set up, they even helped the local NGO that promotes recycling (Somarelang Tikologo) financially. At the moment there is nothing on procurement policies, mainly because there are no recycled products made in Botswana. As the department we tried to be exemplary by using recycled printing paper imported from Germany, but it was very expensive to bring it here. There was however a lot of opposition from
other government departments, and within the department when the paper was used in memorandums and letters destined for higher authorities.

3. I thought the Waste Management Act was passed by parliament; there must surely have been some level of understanding/ or awareness raised during the debating of the Bill leading to the Waste Management Act, Isn’t it so?

Well to a certain extent I will say they are aware, but one will realise that it is not that the politicians remember all the policies that are passed in parliament, but we are continuously trying to sensitise them, we even lately had a meeting with the parliamentary caucus on waste management. We even had the opportunity to address a parliamentary committee on the environment on matters of waste management.

4. Who is empowered by the Act to license recyclers?

It is this department, we have the licensing and inspection unit, they license all people who handle waste, waste carriers and other people who deal with waste in some way. But the licensing is not particularly for recyclers but mainly for those who carry waste from one area to another, which may include recyclers. But the process of licensing has only started in 2001 when a licensing and inspection officer was recruited.

5. The Waste Management Act empowers local authorities to draw recycling plans as part of their waste management plans, do you envisage the local authorities actively participating in recycling activities such as organising source separation schemes?

In fact the trend is supposed to be in that direction because is a requirement of the Waste Management Act, failing which, will not be complying with the requirements of the Act.

6. What penalties are in place for local authorities who fail to draw waste management plans?

I am not very sure; I might have to refer to the Act. But if there are currently no penalties, I think the revision on the Act will look into that as well.

7. Don’t you think the added responsibility of recycling will further constraints local authorities potential to improve the collection service and safe disposal?

Yes it is an extra responsibility, so they are expected get more manpower and other resources. This restructuring can initial be problematic in the short term, but in the long run it will save them a lot of money by sheer reduction of the quantity of waste destined for landfill disposal, few collection trips which will reducing running and maintenance cost of
their plant. But the envisaged scenario is where recyclers as opposed to the local authority collect the recyclables

8. **It is a trend in the developed world that recycling legislation and plans sets targets on what percentages of materials should be recycled over what periods, do you have any such targets?**

I don't have the exact answer on that one, but what I know is that the department is supposed to set some recovery targets and that is still being worked on. The idea is that it should be targeted towards business and industry to recover some percentage of waste packaging waste that they bring into society

9. **So the role of this department is only regulatory.**

We have been to given the mandate to provide policy direction and leadership in all issues pertaining to waste management, sanitation and waste water in Botswana. This means the policies on waste management have to come from the department to be implemented by local authorities.
Transcript of interview with Chief Technical Officer (waste management)- Gaborone City Council on 5/07/2001

1. What is the role of City Council in waste management? (primary storage, collection, disposal)
The city council is responsible for collection and safe disposal. In other instances like SHHA areas the City council provides primary storage facilities in the form of drums, it also provides skips in some commercial areas. But of late it has been noticed that skips exacerbate the littering problem because some people just dispose of their litter not into the skip but in the vicinity of the skip. Poor collection service also meant that most of the skips in open place often overflow with waste. City Council have permanently removed some of the skips, while still working on the possible remedial action.

2. What quantities of waste does the city council generate?
140 000 tons per year

3. Are you happy with the collection and disposal service of waste?
No

4. Which areas do you think need improvement?
Resources such refuse compactors and tipper trucks need to be increased

5. Do you collect waste from both households and commercial enterprises?
The City Council collects waste from all waste generators

6. What methods of collection do you use? Kerbside or drop-off
Both

7. Do you use the same method for both household and commercial waste?
Yes

8. How often do you collect the waste in a week?
For commercial enterprises and institutions, waste is collected daily but for households, it is collected twice a week

9. How much does waste management cost city council?
Approximately: P17 989 311 per annum

10. Of the above costs, how much is used in (daily, monthly or annual amounts):

- Collection fuel
  Diesel P280 80.89/annum = 134654 litres/year
  Petrol P345577.90/annum = 15576 litres/year
- Other collection related costs (labour, maintenance etc)
  Labour and maintenance = P3699596/annum
- Landfill operation fuel
  Diesel P11273776/annum = 11273776 litres/year
- Other daily landfill operations
  Services & maintenance = P11594482/annum
11. **What proportion of the Council budget is the waste management cost (collection and disposal)?**
   Approx. 12.7 percent

12. **How do you recover the cost? Direct user charges, free service or other**
   Partially direct use charges, but mainly through collection of garden refuse and construction rubble. But there is no charge for any category of waste delivered at the landfill. Some waste management fee is included in the property tax and service levy but this is not specifically targeted for waste management, but just goes into City Council’s general account.

13. **Is recycling part of the waste management strategy?**
   Yes,

14. **What benefits do you see in recycling?**
   Generates income for the low-income and above all, it prolongs the life span of the landfill by reducing the quantity of waste entering the landfill.

15. **Does the City Council encourage recycling? And How?**
   Yes, through community mobilisation, workshops, seminars and through source separation pilot projects which involve providing additional bins to households to enable source separation of materials

16. **What materials are usually recycled and by whom?**
   - Cans – Collect-a-Can
   - Paper and plastics – Paper Recovery
   - Scrap metal – South African companies

17. **Is source separation seen as enhancing recycling?**
   Yes

18. **Do you as city council encourage source separation?**
   Yes, we even got engaged in a pilot project with Somarelang Tikologo to assess the potential of source separation and the results were quiet encouraging

19. **If yes how?**
   By sensitising the public and embarking on source separation pilot projects around the city in joint venture with Somarelang Tikologo

20. **If no why?**
   N/A.

21. **What problems and benefits do you anticipate from source separation? (cleaner materials for recycling, reduction of waste for disposal, increased collection costs due to collection of separate components, lack of markets for recyclables)**
   - Lack of collection of recyclables by recyclers and lack of transport.
   - Lack of markets for recyclables, especially for tyres.
   - The envisaged benefits are more on the public health of waste pickers who currently do their picking at the landfill.
   - But there is currently no plan of integrating them into the City Council’s waste management program.
   - There will also be a required for intensive public education on source separation

22. **Litter seems to be a problem in the city, what is the city council doing to combat the problem?**
Intensified education of the community through media and public address systems going around the city

23. **Section 29 (l) of the Waste Management Act empowers City Council to arrange for collection and disposal of all household waste at a prescribed fee, what efforts have been made to effect that since the enactment of the act?**

The exercise has long been put in place before the enactment of the waste management Act of 1998.

e.g Builders’ rubble @P36/load individuals and P150/load for companies

Garden refuse @P10/load individuals and P100/load for companies

24. **The power to recycle waste and draw waste recycling plans have been entrusted on you by Section 33 of the Act, what progress has been made in that direction?**

We have started and follow-ups with Department of Sanitation and Waste Management through workshops with other Districts (Maun and Selibe Phikwe) are underway
APPENDIX E

MARKET SURVEY FORM
Company Name: _____________________________ Date: _____________
Contact Name: _____________________________ Title: ________________
Telephone Number: ___________________________
Country in which facility is located: __________________________

SECTION A (All)
Please complete the following chart, indicating what materials you accept, prices paid and purchase requirements. All information will be treated in confidence.

<table>
<thead>
<tr>
<th>Materials specifications (Baled-Loose-Crushed-Shredded)</th>
<th>Do you pick up (P) or must it be delivered (D)</th>
<th>Price/ton*</th>
<th>Quantity delivered/collected, (tons/day) or (tons/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>L</td>
<td>C</td>
<td>S</td>
</tr>
<tr>
<td>Paper</td>
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<tr>
<td>Newsprint</td>
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<td>Cardboard</td>
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<td>Printing paper</td>
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<td></td>
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<tr>
<td>Mixed paper</td>
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<td></td>
<td></td>
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<tr>
<td>Glass</td>
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<td></td>
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<td>Green</td>
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<td></td>
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<td>Clear</td>
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<tr>
<td>Brown</td>
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<tr>
<td>Metal</td>
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<td></td>
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<tr>
<td>Aluminium</td>
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<td></td>
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<tr>
<td>Steel cans</td>
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<td></td>
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<tr>
<td>Scrap metal</td>
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<td></td>
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<tr>
<td>Plastic</td>
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<td></td>
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<tr>
<td>PET bottles</td>
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<tr>
<td>HDPE bottles</td>
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<td></td>
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<tr>
<td>Film plastic</td>
<td></td>
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<td></td>
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<tr>
<td>Other</td>
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</tbody>
</table>

*We are aware that prices fluctuate frequently and do not expect you to be committed to these prices

SECTION B
1. Is your company a: (you tick more than one)
   A) Broker (Acting as agents) (complete sections B, C, E)
   B) Processor (complete sections B, C, E)
   C) Manufacturer (complete sections B, D, E)
   D) Processor and manufacturer (complete sections B, C, D, E)
E) Other, please specify________________________________________

2. How long have you been operating? ______________________________________________________

3. What were the reasons for your establishment? ______________________________________________

4. What are the sources of your materials? Who supplies how much? ________________________________

5. How reliable are these sources? ____________________________________________________________

SECTION C (Brokers/Processors)

6. Do you have any problems with storage of materials? _________________________________________

7. What is the cost of storage per day or per year? ________________________________________________

8. What type of processing do you undertake? Describe ____________________________________________

9. What average quantities of materials are processed daily? Any seasonal variations?  ______________________________

10. Under current conditions, do you have the capacity to process more materials than you are currently processing? ______________________________

11. Is your processing capacity currently all utilised? ____________________________________________

12. What is the cost per ton of processing? ______________________________________________________

13. Is there a possibility to expand your available processing capacity? ______________________________

14. What costs would you incur to expand your capacity? __________________________________________

15. Do you have any quality criteria for materials you collect? _____________________________________

16. Do you have any quality criteria for the materials you receive? _________________________________

17. Who are the buyers of your processed materials? _____________________________________________

18. Where are your end-users located (City, Country)? ____________________________________________

19. If the buyers are outside the country, do you encounter any problems in exporting the materials? ______________________________

20. Do you deliver processed materials to buyers or they are collected? ______________________________

21. If you deliver, what transportation costs that you incur per ton of material? _______________________

22. What is current price paid for your materials per ton? _________________________________________
SECTION D (Manufacturers)
23. Do you have any problems with storage of materials?
24. What is the cost of storage per day or per year?
25. What products do you make from the material you obtain?
26. What average quantities of materials are processed daily?
27. What is the available capacity for manufacturing?
28. Is your manufacturing capacity currently all utilised?
29. What is the cost per ton of manufacturing?
30. Is there a possibility to expand your available manufacturing capacity?
31. What costs would you incur to expand your capacity?
32. Do you have any quality criteria for materials you receive or collect for manufacturing?
33. Who buys your finished products?
34. Where are the buyers of your products located (City, Country)?
35. If the buyers are outside the country, do you encounter any problems in exporting the materials?
36. Do you deliver manufactured products to buyers or they collect them?
37. If you deliver, what transportation costs do you incur per ton of material?
38. What is the current price paid for your products?

SECTION E (All)
39. Do you have any working relationship with the government concerning recycling?
40. If you have, what is the nature of the relationship?
41. Is your company a member of any local recycling association?
42. Are you aware of the government's Waste Management Strategy?
43. Do you get any support from government?
44. How can the government support you in your recycling efforts?

45. Do you have contractual arrangements with your suppliers or buyers?

46. Would you be willing to provide a contract for the purchase of materials from local governments if they recover materials?

47. Any additional comments.

Thank you for your valuable time
APPENDIX F

BRIEF PROFILE OF RECYCLING ENTERPRISES
F.R.K Trading:  
The company was established in 1998 to process film plastic (HDPE, LDPE) into ground plastic, pellets and granules for the local market. It is located in Mogoditshane, one of the peri-urban villages about 15 kilometres from Gaborone city centre. The current operations of the company are limited by lack of supply of secondary plastic.

De Bruins:  
The company was established in 1992. It collects metals and buys back metal fraction of aluminium, copper and brass from individuals and garages. It also acts as a broker for Collect-A-Can by buying back steel metal cans. It is located in Mogoditshane, one of the peri-urban villages about 15 kilometres from Gaborone city centre. All the scrap metal collected is exported to South Africa.

Pyramid Holdings:  
Pyramid Holdings was established in 1982 to collect and process all forms of secondary paper. The company currently focuses its operations on collecting and bailing cardboard from commercial areas. It estimates that it currently collects and processes 13 tonnes of paper per day. Pyramid Holdings operates from Gaborone South industrials sites, about 7 kilometres from city centre. The paper collected and bailed is exported to paper mills in South Africa and Zimbabwe.

Boswa Recycling:  
Established in 2000, the company collects printing paper from institutions and commercial sector. The company is located in Mogoditshane. The paper is bailed and exported to South Africa.

Botswana Tissue:  
The Company was established in 1990 to collect and process paper and plastic. It has currently started manufacturing toilet tissue from printing paper. It collects paper from commercial areas and institutions. It has also hired people to recover cardboard at the Gaborone landfill. The company currently collects and processes 10 tonnes of paper daily and 1 ton of plastic daily. The company is located in Gaborone Commerce Park, about 8 kilometres from Gaborone city centre. Except that manufactured into tissue paper,
the majority of the collected paper is bailed and exported to paper mills in South Africa and Mauritius. The collected plastic is also bailed and exported to South Africa.

Collect-A-Can: Collect-A-Can Botswana was established in 1993 as an initiative of the South African steel industry to collect steel metal cans used for packaging beverages. The company pays cash for cans collected and delivered to its depot by individuals, private collectors, schools and Kgalagadi Breweries. The company operates from Gaborone West industrial sites about 5 kilometres from Gaborone city centre. The company estimates that it currently recovers 320 tonnes of cans per month. The cans collected are bailed and exported to Collect-A-Can, South Africa.

Power Metals: The Company was established in 1991 to collect metal scrap of copper, steel, brass and aluminium. The company obtains the materials from waste dumps and garages. It also buys scrap metals from individuals. The company is located in Tlokweng, a peri-urban village about 10 kilometres from Gaborone city centre. The recovered materials are exported to South Africa.

Alman Metals: Alman Metals was established in 1995 to recover secondary materials of all types of paper, all types of plastic and all forms of scrap metals. But the company currently collects and bails 40 tonnes of newsprint monthly, and cuts and shapes 18 tonnes of metals. The newsprint is obtained from Mmegi newspaper and Somarelang Tikologo. Metals are obtained from garages and welding companies. The plastic collection has not taken-off because of lack of reliable sources. The company is located in Pilane, a village 30 kilometres from Gaborone city centre. The materials collected and processed are exported to South Africa.

Somarelang Tikologo: The NGO also known as Environmental Watch was established in 1991 to raise awareness on general environmental issues including the potential benefits of waste recycling. In addition to their
educational role, the NGO is also operating a bring system at its premises in central Gaborone for materials such as glass, paper, plastics, metal cans and other. They act as a broker for collectors of the respective materials. In particular, all corporate members of the organisation such as recyclers can collect the materials that are brought to their premises. They however, manually crush glass they recover for export to South Africa.

Segwana is a subsidiary of Kgalagadi Breweries Limited the main brewer in Gaborone. It operates a deposit refund scheme for refillable beer and soft drink beverage bottles that are bottled locally by the company. The bottles can be returned to Segwana depot or to commercial outlets where the beverages were bought for the deposit to be refunded. The bottles recovered are cleaned and reused.