COMMERCIAL ORGANIC COMPOSTING: A CASE STUDY OF THE PANORAMA COMPOSTING PLANT, CITY OF JOHANNESBURG, SOUTH AFRICA

By

RETHABILE SEHLABI

SHORT DISSERTATION

Submitted in partial fulfilment of the requirements for the degree of

MASTER OF SCIENCE

in

ENVIRONMENTAL MANAGEMENT

in the

FACULTY OF SCIENCE

at the

UNIVERSITY OF JOHANNESBURG

Supervisor: Tracey McKay

Co-supervisor: Dr L.G.C Scheepers

May 2010

UNIVERSITY OF JOHANNESBURG

AFFIDAVIT: MASTER'S AND DOCTORAL STUDENTS
TO WHOM IT MAY CONCERN

This serves to confirm that I Rethabile Sehlabi
Full Name(s) and Surname

ID Number 7908010398086

Student number 200514269 enrolled for the

Qualification Msc: Environmental Management

Faculty __ Science

Herewith declare that my academic work is in line with the Plagiarism Policy of the University of Johannesburg which I am familiar.

I further declare that the work presented in the Commercial organic compost (minor dissertation/dissertation/thesis) is authentic and original unless clearly indicated otherwise and in such instances full reference to the source is acknowledged and I do not pretend to receive any credit for such acknowledged quotations, and that there is no copyright infringement in my work. I declare that no unethical research practices were used or material gained through dishonesty. I understand that plagiarism is a serious offence and that should I contravene the Plagiarism Policy notwithstanding signing this affidavit, I may be found guilty of a serious criminal offence (perjury) that would amongst other consequences compel the UJ to inform all other tertiary institutions of the offence and to issue a corresponding certificate of reprehensible academic conduct to whomever request such a certificate from the institution.

Signed at Johannesburg _____ **on this** 26 **of** May **2010**

Signature _____ **Print name** Rethabile Sehlabi

STAMP COMMISSIONER OF OATHS
Affidavit certified by a Commissioner of Oaths
This affidavit conforms with the requirements of the JUSTICES OF THE PEACE AND COMMISSIONERS OF OATHS ACT 16 OF 1963 and the applicable Regulations published in the GG GNR 1258 of 21 July 1972; GN 903 of 10 July 1998; GN 109 of 2 February 2001 as amended.

Declaration

I declare that this Dissertation is my own, unaided work. It is being submitted for the Degree of Master of Science in the University of Johannesburg. It has not been submitted before for any degree or examination in any other University.

UNIVERSITY OF JOHANNESBURG

Signature

ACKNOWLEDGEMENTS

I would like to thank the following people:

- Tracey McKay for her dedication, continued support guidance during the preparation of this mini dissertation.
- Dr L.G.C Scheepers for his valuable and informative inputs.
- Christa Venter and Gina Shoemaker (Pikitup) for their valuable suggestions and input to the study.
- Derrick Kgwale, Francois Marais (Golder Associates Africa), Jarrod Ball and Hazel Fiehn (Zitholele Consulting) for pointing me in the direction at the beginning of this study.
- John des Ligneris for offering me with valuable insight on the composting projects in City of Johannesburg
- Werner Voight for general guidance at the start of this research.
- To my husband Lundi Mbokodi for his support and encouragement during the research.
- Last but not least to my dad, Vincent Matabataba Sehlabi, for the courage, perseverance, determination you have inspired me with all my life and during this research. May your soul rest in peace.

UNIVERSITY
JOHANNESBURG

TABLE OF CONTENTS

UNIVERSITY OF JOHANNESBURG

UNIVERSITY OF JOHANNESBURG

LIST OF FIGURES

UNIVERSITY OF JOHANNESBURG

LIST OF TABLES

LIST OF ACRONYMS

CoJ	City of Johannesburg
ISWM	Integrated Solid Waste Management
IWMP	Integrated Waste Management Plan
NEMA	National Environmental management Act
USA	United States of America
NGO	Non Governmental organization
NWMS	National Waste Management Strategy
SSWM	Sustainable Solid Waste Management

UNIVERSITY OF JOHANNESBURG

DEFINITIONS

Littering	When a person in possession or in control of an object or matter discards it (Environmental Conservation Act, 1989)
green organic	Plant origin material
Waste	Undesirable or superfluous by-product, emission or residue of any process or activity which has been discarded, accumulated or stored with the purpose of discarding or processing (Department of Water Affairs and Forestry, 1998).
Air space	Airspace describes the permitted height, length and breadth that the landfill may finally occupy and determines the lifespan of a site
Transfer station	A location where refuse from waste collection trucks is compacted and containerised.

UNIVERSITY OF JOHANNESBURG

ABSTRACT

The City of Johannesburg (CoJ), South Africa, faces many waste management challenges. Some of the primary challenges are a general lack of waste management, recycling and composting awareness (City of Johannesburg, 2003a). Within this context, addressing the challenges of composting is complex, time consuming and faced with difficulty. The CoJ has embarked upon a composting initiative that is designed to redirect organic waste from landfills to the compost production plants. Furthermore, this initiative is also aimed at selling bags of compost to Johannesburg consumers (individuals and nurseries). The ultimate aim however is to meet several sustainable development objectives: economic development; social development and environmental protection.

The problem statement investigated by the research is whether the Panorama Composting Plant meets the above mentioned sustainable development objectives. Research was conducted qualitatively and data was obtained using both primary and secondary sources. For example, the sources of data comprised of research reports, magazine articles, journals and interviews with key personnel in the waste management field.

Subsequent to intensive analysis and interpretation, in conclusion, the research has established that Panorama plant contributes to environmental sustainability. It has also been established that the Panorama plant's contribution to social and economic sustainability is limited.

UNIVERSITY
JOHANNESBURG

CHAPTER ONE

1.1 Introduction

Chapter 1 provides background information to the solid waste problem in the City of Johannesburg (CoJ). The second part of the chapter explores solid waste management within environmental management and the concept of Integrated Waste Management. The problems statement, associated sub problems and the rationale behind the study are presented. The study area is also discussed. Lastly, the research framework is described giving direction on how the study will be conducted.

1.2 The solid waste issue in the City of Johannesburg

Solid waste is the waste that is generated by human and animal activities. It is usually solid in nature and is disposed of as it is perceived of as being 'useless' or 'unwanted' (Tchobanoglous *et al*, 1993). Currently, the CoJ is experiencing great challenges with regards to solid waste management. One of which is that solid waste creates pollution problems, for example, rivers become contaminated with litter. Inappropriate solid waste disposal impacts negatively on urban open spaces, urban water courses and, thus, on public health (City of Johannesburg, 2003a).

UNIVERSITY OF JOHANNESBURG

The CoJ is currently faced with a number of specific solid waste management challenges namely: (1) insufficient solid waste management facilities (2) the poor condition of some solid waste management facilities and (3) increased annual solid waste generation rates. Additional problems that the CoJ must deal with include: (a) the illegal dumping of solid waste - by companies and private individuals, (b) a culture of public littering, (c) limited facilities for hazardous solid waste disposal, (d) low levels of recycling, (e) little separation of solid waste at source which has given rise to material recovery facilities such as those shown in Figure 1 and (f) inaccurate and missing data on solid waste production, distribution, source and type (City of Johannesburg, 2003a).

In some South African municipalities such as the CoJ, organic material represents more than 50 percent of the waste flow (Giggey *et al*, 2000), thus a large percentage of solid waste directed to landfills is organic (City of Johannesburg, 2003a).

Figure 1: Material recovery facility (source: City of Johannesburg, 2003a)

UNIVERSITY OF JOHANNESBURG

This organic material consists mainly of green waste from household gardens, lawns, parks and sport fields. Diversion of these organics out of the waste stream could help save the limited landfill space in the CoJ (Giggey *et al*, 2000).

Managing urban landfills and the vast volumes of solid waste that fill them, however, are just some of the challenges facing the CoJ (City of Johannesburg, 2003a). Solid waste in the formal waste stream in the CoJ is disposed of in five general landfill sites. It is projected that all of them will be operating at half capacity by 2010. Landfills in the CoJ are filling up with waste at an alarming rate. The lifetime of each of the landfills is continually shortened as solid waste generation increases in pace over time (City of Johannesburg, 2003a).

Given the difficulties of identifying new landfill sites which do not impinge on new or planned residential developments, as well as, the escalating costs of solid waste transport and the environmental and social problems associated with landfills, it has become necessary for the CoJ to review its solid waste disposal strategy (City of Johannesburg, 2003a). It is, thus imperative to increase the number of recycling initiatives such as organic composting.

Furthermore, many of the residents of Johannesburg are poor (21 percent living in poverty) and job creation has a crucial role to play in bringing people out of poverty (City of Johannesburg, 2008). It is with these challenges in mind, that the commercial composting of the green waste (from garden refuse sites) is explored. The purpose of the study is to investigate the use of composting of organic waste within the municipal boundaries of the CoJ.

1.2.1 Alternative disposal methods

Clearly, one of the ways in which solid waste can, and should, be managed, is to reduce the amount of waste that must be disposed of. This means a change in perception of solid waste from that of "being disposable" to that of having "economic value". One of the ways of doing this is to increase the amount of solid waste that is being recycled by paying more for it. Unfortunately, in the CoJ, current levels of recycling are low – estimated at six to eight percent of the waste stream, and are mainly a result of informal and small scale private sector initiatives (City of Johannesburg, 2003a).

The low percentage of household waste separation is the primary inhibitor of recycling as it pushes up the cost of recycling due to fact that manual waste separation has to be catered for. Due to the lack of separation at source (where the waste is created: households) recycling and waste recovery rates are low. The recycling levels are estimated at six to eight percent (6 - 8%) of the waste stream.This is due to the mixing of waste that results in cross contamination. Contaminated waste is of low economic value, therefore it limits the number of recycling initiatives that create job opportunities. (City of Johannesburg, 2003b).

In the CoJ, the public does not prioritise solid waste management nor know the benefits or importance of waste separation. This lack of commitment from the public to solid waste management is related to lack of education on waste management (City of Johannesburg, 2003b). In its 2010 and 2030 vision statements, the CoJ hopes to increase solid waste separation to foster recycling and composting in order to help achieve sustainable development goals. This lack of short term plans is an indication of inefficient management within CoJ as local government.

To this end, CoJ aims to create a city "in which the integrity of underlying, supportive social and ecological systems is maintained well into the foreseeable future" as well as, a city that

promotes a high quality of life for its residents "a city in which the surrounding environment is conducive to its citizens' health and sense of well-being. "Implicit in this notion are the desirable aesthetic, recreational and psychological benefits of living in a clean environment" (City of Johannesburg, 2003b, p.3). However, without measures, targets (dates of implementation), responsibility delineations and audits to review progress the above intentions are not solid or easily attainable.

The CoJ's solid waste management and recycling initiatives are aimed at meeting the requirement of the Polokwane Declaration. The Polokwane Declaration was the first National Waste Summit hosted by the Department of Environmental Affairs and Tourism and was held in Polokwane, September 26-28, 2001. The participants at this summit ranged from representatives of government at national, provincial and local level; civil society and the business community. This summit was held in recognition that solid waste management is a priority for all South Africans, and the need for urgent action to reduce, reuse, and recycle waste in order to protect the environment (DEAT, 2001).

The vision of the Polokwane declaration is to implement a solid waste management system which contributes to sustainable development and a measurable improvement in the quality of life, by harnessing the energy and commitment of all South Africans for the effective reduction of waste. The goals of this declaration are namely to (1) stabilize solid waste generation (2) reduce solid waste disposal by 50 percent by 2012 and (3) develop a plan for ZERO waste by 2020 (DEAT, 2001). In the interim, the CoJ has created a five year plan aimed at reducing illegal dumping by 30 percent as a means to achieve the Polokwane Declaration.

1.3 Solid waste management within environmental management

The term environment is defined as the surroundings within which humans exist that consist of (i) land, water, and atmosphere of the earth, (ii) micro-organisms, plants and animal life, (iii) any part or combination of (i) and (ii) and their inter-relationships among and between them; and (iv) the physical, chemical, aesthetic, and cultural properties and conditions of the foregoing that influence human health and well being (RSA, 1998).

Environmental management is defined as the process of administering, supervising or handling the environment in order to achieve a desired outcome, usually the protection or

conservation of the environment (Fuggle & Rabie, 1992). In this research, environmental management refers more specifically to management of solid waste as means of protecting the environment.

According to City of Johannesburg (2003a), residential waste volumes are expected to increase from 889 665 tons a year to 1 079 055 tons a year by 2010. It is stated that the actual growth is dependent upon levels of disposable income, which are expected to improve as economic development and job creation increase, resulting in higher levels of consumption. Based on the 2003 statistics, the high-income earners generated on average 1.3 to 1.6 kilograms of waste per day, middle-income earners between 0.7 and 1 kilograms per day, and low-income earners between 0.35 and 0.6 kilograms of waste per day. This implies that without efficient waste management measures waste will continue being a problem that is detrimental to the environment.

As mentioned earlier, solid waste creates pollution problems in the CoJ, for example, rivers become contaminated with litter. The improper solid waste disposal has contributed to the degradation and contamination of Jukskei and Klip rivers systems, thus impacting negatively on public health (City of Johannesburg, 2003b). Leachate from poorly designed landfills also contributes to the high level of pollution to the river systems in the CoJ. It is therefore important that effective waste management measures are implemented to control and prevent environmental pollution.

UNIVERSITY OF JOHANNESBURG

According to Farmer (1997), the management of environmental pollution is a key element in achieving sustainable development. Sustainable development is defined as the 'development that meets the needs of the present without compromising the ability of the future generations to meet their own needs' (Brundtland, 1989). Currently, in many countries, sustainable development is an overall framework in which environmental protection (management) activities such as pollution management are undertaken.

From this perspective, it is important to prevent pollution through environmental management measures such as solid waste management.

Fuggle and Rabie (1992) state that waste management is one of the developing multi-disciplinary applied sciences that offer practical, effective and often innovative solutions to many modern waste problems. Solid waste management is further defined as the control of

the generation, storage, collection, transfer and transport, processing and disposal of solid waste in accordance with the best principles of public health, economics, engineering, conservation, aesthetics and other environmental considerations and that is also dependant on public attitudes (Tchobanoglous, *et al*, 1993).

The study will assess whether the diversion of green organics from landfills to composting plants as a solid waste management measure contributes to environmental management.

1.4 Integrated Solid Waste Management

Integrated Solid Waste Management (ISWM) is defined as the selection or implementation of appropriate suitable techniques, technologies and management programs to achieve specific waste management objectives and goals (Tchobanoglous, *et al*, 1993). The concept of Integrated Waste Management has been modified over the years and consists of a hierarchy that is now accepted internationally as the approach to waste management as shown in 1.

Table 1: Integrated Waste Management and the Waste Hierarchy approach (Source:Gertsakis & Lewis, 2003).

Waste Hierarchy	
Cleaner Production	Prevention
	Minimisation
Recycling	1. Re-use
	2. Recovery
	3. Composting
Treatment	4. Physical
	5. Chemical
	6. Biological
	7. Destruction
Disposal	8. Landfill

Waste management hierarchy can be traced back to the 1970s, when the environmental movement started to question the practice of disposal-based waste management. This movement argued that instead of regarding 'rubbish' as a homogenous mass that should be buried; it must be treated differently depending on its composition. The following waste management measures must be considered, prevention, re-using, recycling, composting, burning and burial (Schall, 1992 cited in Gertsakis & Lewis, 2003).

The principles of Waste Hierarchy as shown in Table 1 mean the following:

- **Cleaner production:** The use of cleaner technologies and the use of fewer raw materials needs to be encouraged. The main aim of this principle is to prevent, or at least, minimise solid waste production where and when possible. Waste reduction can start at households. Households can reduce the amount of waste they produce by making informed choices by opting to re use their packaging.

- **Recycling:** If solid waste is produced it should be re used, which involves treatment of waste as a resource. In the NWMS, the term recycling covers a wide spectrum of issues, such as the related processes of resource recovery, waste re-use and the processing of recyclable materials recovered from both the general and hazardous waste streams (City of Johannesburg, 2003b). This study supports the recycling principle. A large percentage of the waste directed to landfills in the CoJ is organics. Diversion of these organics out of the waste stream to commercial composting plants like Panorama where it gets recycled can help save the limited landfill space or improve its lifespan (Giggey *et al*, 2000).

- **Treatment:** Should solid waste not be recycled, it must be treated. Waste treatment refers to the activities required to ensure that waste has the least practicable impact on the environment. Treatment options include physical, chemical and, biological processes. Waste treatment technologies (such as incinerators) are limited currently in the CoJ. It is, therefore, recommended that investment must be made to increase their number (City of Johannesburg, 2003a).

- **Disposal:** The last option is disposal by means of landfilling. Landfills are sites for the disposal of waste materials by burial. This principle states that before land filling is practised other disposal measures such as waste recycling must be explored. The diversion of organic material to Panaroma composting plant is the CoJ's initiative to discourage landfilling of green organics.

This research will assess how organic composting supports the notion of integrated solid waste management.

UNIVERSITY OF JOHANNESBURG

1.5 Problem statement, sub problems (research questions) and rationale

The initial study purpose took a generic approach, the investigation of waste management in the CoJ. It was only after an initial interview with one of the key personnel in the waste industry (Venter, 2006; Personal Communication), that the current study focus was followed.

The problem under investigation is whether the Panorama Composting Plant meets the sustainable development objectives, namely: environmental, social and economic sustainability. In order to investigate the main problem, the sustainable development objectives, regarded as sub-problems in this study need to be investigated as well:

1.5.1 Environmental sustainability

- Does the diversion of organics to the Panorama pilot composting plant prolong use of available landfill space?
- Does the Panorama pilot composting plant contribute to environmental sustainability within the spatial limits of the CoJ, namely by assisting the CoJ to partially fulfil requirements of the Polokwane Declaration? This declaration emphasises that solid waste management is a priority for all South Africans, and the need for urgent action to reduce, reuse, and recycle waste in order to protect the environment (DEAT, 2001).

UNIVERSITY OF JOHANNESBURG

1.5.2 Social sustainability

- Can the Panorama pilot composting plant generate employment?

1.5.3 Economic sustainability

- Is the plant financially sustainable, in terms of meeting operational costs and generating a profit?
- Are suitable long term markets for commercial organic compost produced by the pilot site secured?

Commercial composting of green domestic garden waste is a new initiative in the CoJ, and in South Africa. Thus, an investigation of the pilot plant at the Panorama Landfill site will be of interest to municipal managers, environmental managers, academics, as well as, the general public. The potential benefits of the pilot plant are multiple. The composting plant has potential to be economically sustainable as jobs and profits can be generated (Zurbrugg *et al*,

2004a). The composting plant also has potential of contributing to social sustainability. When employment is created, society becomes more stable, crime is often reduced and jobs give people a sense of purpose and a rhythm to their life (McKay & Prangley, 2005).

It could help to achieve environmental sustainability, as landfill space will be conserved and waste would be recycled back (reducing the use of raw materials) into the natural system as compost and return as nutrients (Hawkin *et al*, 1999). This, in turn, can promote biodiversity within the city limits. Therefore, this case study will assess the economic, social and environmental impacts of the Panorama Plant, through the lens of sustainable development and make recommendations for future composting plants.

1.6 Study area

This research studies the organic composting of green organic waste within the municipal boundaries of CoJ. Figure 2 shows the location of the CoJ within the boundaries of Gauteng province. Subsequent to the local government elections of December 2000, the CoJ became a Unicity. The former Northern, Southern, Eastern and Western Metropolitan Local Councils, as well as Midrand and Modderfontein were included into the city. The administration of the city has been decentralized into 11 regions with the aim of making the city's administration more accessible to local communities (City of Johannesburg, 2003b).

UNIVERSITY
JOHANNESBURG

Based on economics and population, Johannesburg is the largest city in the Gauteng Province and South Africa. Given its magnitude, economic activities and population size, the solid waste generation is increasing at alarming rate. CoJ is faced with solid waste challenges such as littering and low levels of recycling. Given its current waste management status and challenges, the CoJ was chosen as ideal for this research in order to establish concrete conclusions and recommendations on organic composting as a waste management initiative.

Figure 2: Map of Gauteng showing the City of Johannesburg (City of Johannesburg, 2003b)

As mentioned earlier, in order to address the waste management challenges, the CoJ embarked upon a composting initiative that is designed to redirect organic waste from landfills to the Panorama plant. The plant is located on Jim Fouche Road, Panorama as shown in Figure 3.

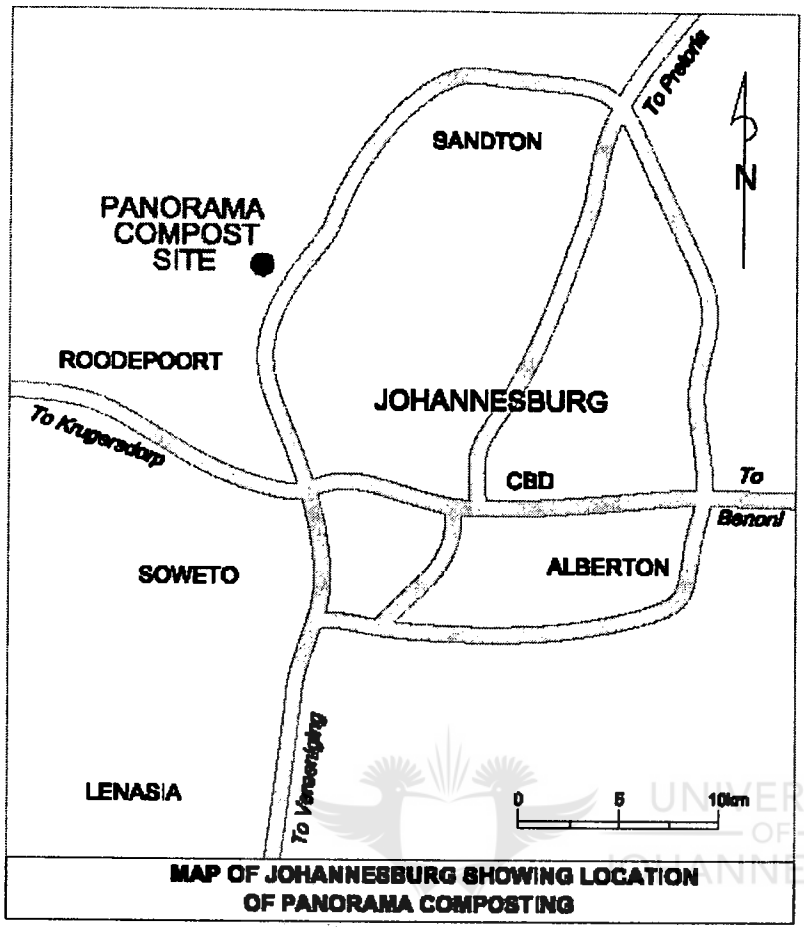


Figure 3: Map of Johannesburg showing the location of the Panorama composting plant

1.7 Research Framework

The research framework will adopt a three pronged approach in an attempt to solve the main research problem and associated sub problems as depicted in Figure 4. The sub problems will be defined and discussed and correlated into the main research problem.

The research will be conducted qualitatively and data will be obtained using both primary and secondary sources. The sources of data will comprise of articles from research reports, books, journals and interviews with key personnel from Pikitup, a waste management service provider in the CoJ. This data will be collated, analyzed and interpreted. The results/outcome

from analysis will be further subjected to interpretation and scrutiny to establish a comprehensive summary of conclusions.

Lastly, a synthesis exercise will critically assess data analysis techniques. An attempt will be made to arrive at conclusive answers and recommendations to the research. Also, the discussions will determine how the study contributes to the field of environmental management.

1.7.1 Research design and methodology

The design and methodology used in this research is explained below:

Research design

Any research project needs a design. A research design is a blueprint of research. It deals with at least four problems, namely, what questions to study, what data are relevant, what data to collect and how to analyse the results. Maxwell (1996) refers to research design as the underlying structure and interconnection of components of the study. The five components being namely:

UNIVERSITY OF JOHANNESBURG

- **Purposes**: The ultimate goal of the study, or purpose, is the investigation into the economic, social and environmental viability of organic composting within the municipal boundaries of the CoJ.
- **Conceptual context**: With regards to this study, research and evidence are drawn from the existing Panorama composting plant and other case studies in international literature. The study is rooted in the theory of sustainable development.
- **Research questions**: In relation to this study, the main question is whether the existing Panorama plant meets sustainable development objectives or not? The aspects of sustainable development investigated are those relating to social, economic and environmental sustainability.
- **Methods**: As mentioned above qualitative method was used to collect data for the study topic. This involved interviews with key role players and the investigation of policy documents.

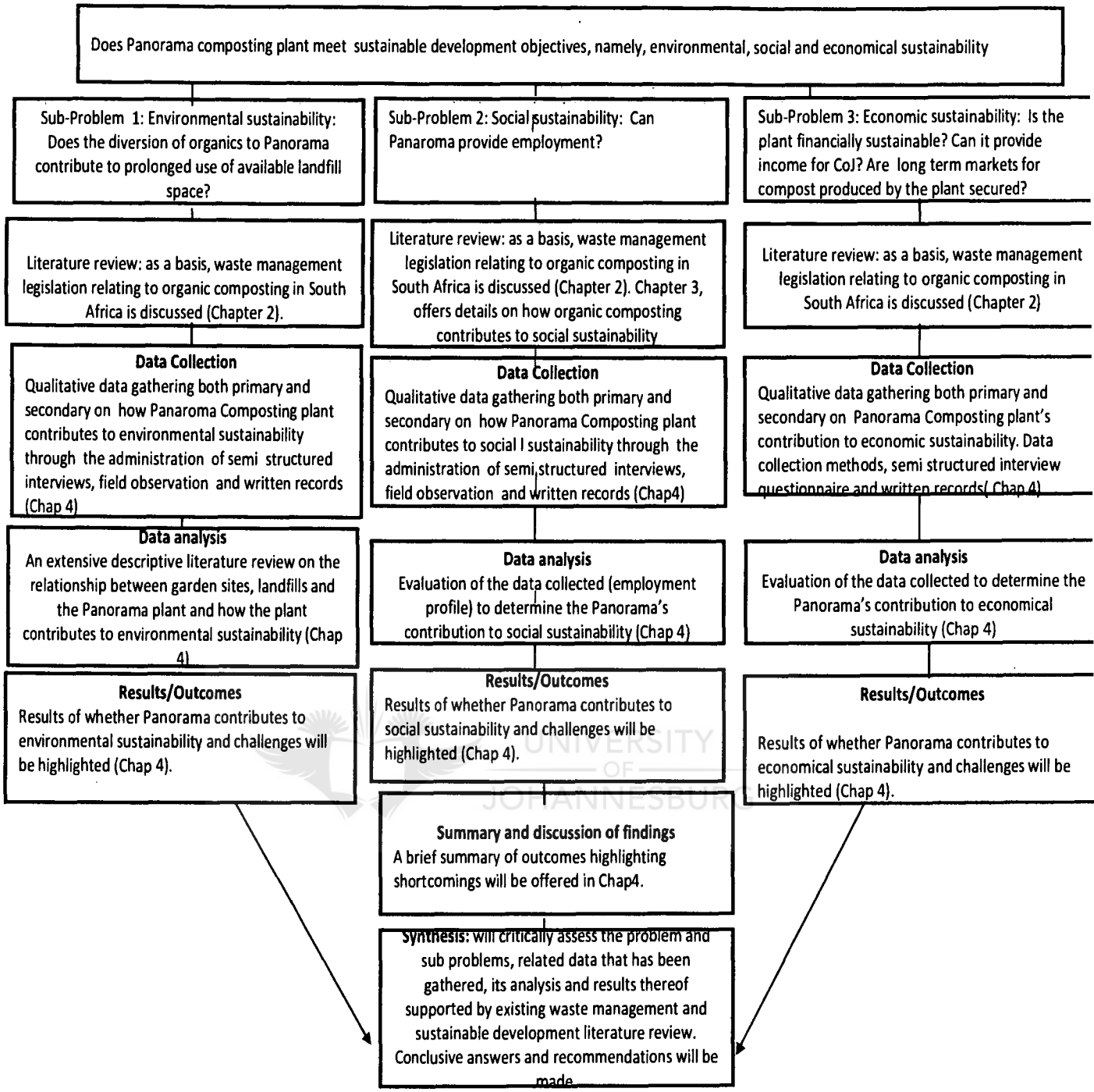


Figure 4: Research Framework

- **Validity**: To ensure validity of the research, multiple data sources were explored to reach conclusions and recommendations.

In order to focus and bound the data collection during the qualitative research, research design was formulated upfront before the study was conducted. It is of importance also to determine the focus area of the study and data collection and analytical methods upfront (Miles & Huberman, 1994). The same tactics were applied in this study; it was determined upfront which case study and what aspects of the Panorama pilot plant would be explored. For example, the Panorama composting plant was chosen as a case study and the angle of study was sustainability. In addition, data collection methods to be used were established.

It is important to note that the entire design for a qualitative project cannot be planned all in advance. For example, one can begin with a rough and tentative design that can be amended accordingly as the research is underway and new ideas unfold. Qualitative interviewing designs are a good example of how designs can change as the research progresses. The design takes shape gradually as more information is revealed and learned. Doing the design is, therefore, a continuous process as one has to redesign the work (basic initial design) at different points in the research as new information gets discovered (Rubin & Rubin, 1995). As mentioned earlier, for this research, it was only after an initial interview with one of the key personnel in the waste industry (Venter, 2006; Personal Communication), that the current study focus was followed. The research design and questions changed, the purpose was more focused on organic composting and a case study was determined.

Methodology used

The study was conducted qualitatively. Qualitative research is a generic term for investigative methodologies described as ethnographic, naturalistic, anthropological, field, or participant observer research. Variables are looked at in their natural setting. Detailed data is gathered through open ended questions that provide direct quotations. The interviewer is an integral part of the investigation in qualitative research (Merriam, 1998). This differs from quantitative research which attempts to gather data by objective methods to provide

information about relations, comparisons, and predictions and attempts to remove the investigator from the investigation.

The qualitative research for this study used case studies. Case studies are the preferred strategy when 'how' or 'why' questions are being posed (Yin, 1994). For example, this study addresses questions on the current state of organic composting in CoJ. In addition, case studies are more appropriate when the boundaries between phenomenon and context are not clearly evident (COLMR, undated).

Furthermore, case studies emphasize detailed contextual analysis of a limited number of events or conditions and their relationships. "Case study research method is an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used" (Yin, 1984, 23 cited in Soy,1997).

The advantages of the case study method are that it is applicable to real-life, contemporary, human situations and it is also accessible to public through written reports (Soy, 1997). With regards to the Panorama case study, written documents were few. Data was collected through interviews with various personnel in the waste management field. Field observations also boosted the context of this study.

UNIVERSITY OF JOHANNESBURG

Sources of data

Evidence was derived from the following sources: (1) direct observations that aided in generating detailed descriptions; (2) analysis of primary and secondary source materials. During a direct observation, the direct observer strives to be as unobtrusive as possible so as not to bias the observations (Soy, 1997).

Primary sources

Primary sources are documents written by someone who experienced or witnessed the event in question. Primary sources used for this study comprise of site photos, businesses annual reports, magazine articles and research reports. Photos in their own right can be an instrument and object of research and be used as second observation (Scrimshaw & Gleason, 1992). Interviews constitute as primary sources of data.

Interviews are a common means of collecting qualitative data to understand the phenomenon under study (Merriam, 1998). In depth semi-structured interviews were conducted. "The semi structured interview is itself quite valuable as a pilot study that is a short, preliminary, investigative study designed to reveal issues which can be explored in more depth later by means of a variety of techniques" (Hitchcock & Hughes, 1989, 83). These interviews also have systematic approach to data collection.

The primary aim of a qualitative research interview is to understand the world from the subject's point of view, to uncover their lived world prior to scientific explanations (Kvale, 1996). With regards to this study, interviews were conducted with key personnel in the waste management field. These personnel are the management of Pikitup, Christa Venter and Gina Shoemaker (compost sales consultant at Panorama). An interview questionnaire indicating the type of questions asked is attached in Appendix 1.

Secondary sources

The function of secondary sources on the other hand is to interpret primary sources, and so can be described as at least one step removed from the event or phenomenon under review. Secondary source materials, interpret, give values to and make conclusions about the events reported in primary sources (Merriam, 2002). In this research, secondary sources used consist of journal articles or books, and conference proceedings. For example, a number of articles were derived from, the Wastecon International Waste management biennial conferences.

Documents help to uncover meaning, develop understanding and generate insight. "The strength of documents, as a data source, lies with the fact that they already exist in the situation, they do not intrude upon or alter the setting in ways that the presence of the investigator might" (Merriam, 2002, 13). This implies that documents play a vital role in establishing the validity of the research. Furthermore, unlike interviews or observations they are not dependant on human cooperation. The collection of information from secondary sources was conducted prior to, during and after, the initiation of actual fieldwork.

Overall the strengths of qualitative research include the ability to gain a deeper understanding of what is being evaluated, flexibility in evaluation design and implementation. For example study design can be amended during the research process as evidence gets uncovered. The components of research design such as the study purpose can be revised accordingly during

the research period. In addition, it is relatively inexpensive to conduct the study qualitatively (Guion & Flowers, 2001).

1.8 Conclusion

This chapter has given brief background information to the solid waste problem in the CoJ. Solid waste management has been placed within the field of environmental management. The research statement problem, associated sub problems and study area are explained.

In conclusion, it has been established that the CoJ is faced with waste management challenges. The CoJ's composting initiative, the Panorama plant is a means of addressing the waste management challenges. Based on the research framework shown in Figure 4, Chapter 2 will analyse the collected data relating to waste management legislation in relation to organic composting.

UNIVERSITY OF JOHANNESBURG

2 CHAPTER 2: WASTE MANAGEMENT LEGISLATION BACKROUND

In line with the research framework, Chapter 2 offers a brief overview of waste management legislation associated with organic composting practise in South Africa (CoJ). The discussion will also elaborate on the CoJ's role and responsibilities in waste management as a government body.

2.1 Related legislation and plans: waste management

Solid waste management in the CoJ is regulated by various sections of legislation, policies and plans, such as the Constitution, which highlights the relationship between waste management and sustainable development. Other legislation includes: The National Environmental Management Act (NEMA) of 1998, NEMA; Waste Act, 2008 and the Municipal Systems Act. Policies include the Waste Management Policy, while plans include, National Waste Management Strategy and Action Plans.

2.1.1 Legislation

Overarching legislation

Constitution Act No. 108 of 1996

UNIVERSITY OF JOHANNESBURG

The Constitution is the supreme law of the land. No other law or government action can supersede the provisions of the Constitution. Chapter 2, Bill of Rights, Section 24 (Environment) states that everyone has the right to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation (RSA, 1996). It is therefore important that effective waste management measures are implemented to control and prevent environmental pollution. The CoJ's initiative, the Panorama composting plant therefore serves this purpose.

National Environmental Management Act (NEMA), 1998 (act No. 107 of 1998)

Since July 2006, the regulations tied to The Environment Conservation Act No. 73 of 1989 have been repealed by the NEMA regulations. Thus, all solid waste related regulations governing solid waste management in South Africa now fall under NEMA. NEMA's solid waste related regulations set requirements for the disposal of solid waste and the operation of solid waste disposal facilities. Also described in these regulations are the requirements for handling and treating solid waste, both general and hazardous (RSA, 1998).

NEMA sets parameters for environmental governance that includes establishing solid waste related principles which apply to all levels of government. These principles are those relating to: (a) avoidance and minimisation of waste, (b) remediation of pollution, (c) *reduction, re-use and recycling*, (d) proper disposal of waste, (e) cradle-to-grave and (f) polluter pays. Of most importance in relation to this study are principles (a) and (c), as they state that government is compelled to support recycling of solid waste (RSA, 1998). NEMA therefore encourages municipal bodies such as the CoJ to initiate waste management initiatives. It is from this perspective that the CoJ has constructed the organic composting scheme such as Panorama plant.

National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)

This act emphasises that a municipality must exercise its executive authority to offer waste management services such as waste removal, storage and disposal. In relation to the organic composting, the act further compels the local municipality such as the CoJ to set standards and requirements for re-use and recycling of waste (RSA, 2008). Like the Constitution and NEMA, the Waste Act aims at promoting sustainable development.

Municipal Systems Act No.32 of 2000

UNIVERSITY OF JOHANNESBURG

The principles, mechanisms and processes for local government, including planning, monitoring and standard setting are established in Chapter 2 of the Municipal Systems Act No.32 of 2000 (RSA, 2000). This act (Chapter 3) also regulates the management of powers and functions allocated to local government. As stated in the act, one of the duties of municipal administrations is to 'be responsive to the needs of the local people' (RSA, 2000, 22). This statement reinforces the requirements of NEMA that firmly asserts that the duty of municipalities such as the CoJ is to ensure that the local communities are provided with solid waste management services. CoJ is obliged to make certain that waste is successfully managed including reduction and recycling (composting).

Specific national legislation

Health Act No. 63 of 1977

The Health Act requires local authorities to reduce nuisances, including any accumulation of refuse or other matter which is dangerous to health. The act also empowers the Minster to

make regulations which could directly impact on solid waste management. In addition the act obliges local authorities to terminate and reduce nuisances, including any accumulation of refuse or other matter which is dangerous to health (City of Johannesburg, 2003a). It is, therefore, the duty of the CoJ to manage solid waste in order to avoid and reduce potential threats to the environment. As organic composting recycles waste and reduces nuisances it plays a critical role in waste management and sustainable development.

2.1.2 Policies

White Paper on Integrated Pollution and Waste Management, 2000 & The National Waste Management Strategy (NWMS) and Action Plans for South Africa

The promulgation of this White Paper allowed for a policy shift towards an integrated approach to pollution and solid waste management and focuses on pollution prevention, solid waste minimisation, impact control and remediation. The Strategy and corresponding Action Plans (which must abide to the existing laws) were drawn up to implement those elements of the White Paper which addresses waste. One requirement of these plans is that the local authorities must draw up plans relating to general solid waste. In response to the Waste Management Policy and waste management by-laws, the NWMS and Action Plans and the National Integrated Pollution and Waste Management Policy, the CoJ has formulated the Integrated Waste Management Plan (IWMP) (Otieno & Venter, 2004).

The IWMP is founded on the principles of Integrated Waste Management and the waste hierarchy as shown in Table 1.

Objectives of the Waste Management Plan

Waste management planning comprises of public participation, environmental impact assessment processes, data collection, waste collection, recycling, treatment and disposal methods records. The Plan also includes feasibility studies on the technical, financial and administrative aspects of waste management systems, and the monitoring and evaluation thereof (City of Johannesburg, 2003b).

The Waste Management Plan has a number of objectives such as the provision of an integrated waste management strategy combining all methods of waste management with regard to the waste hierarchy. Other objectives include progressive reduction of waste

disposed at landfills and increase of waste minimization and recycling. With regards to CoJ, the Waste Management Plan aims at treating and disposing all waste within the CoJ. Also, the Waste Management Plan aims to minimize adverse social and environmental impacts related to waste management and thereby improving the quality of life for all the citizens in Johannesburg (Otieno & Venter, 2004).

Key issues addressed by the Waste Management Plan

The plan covers issues and gaps in the current waste management practices and provides strategies and action plans for the future waste management of waste within CoJ. It has been identified that garden waste and composting are strategic issues that need to be enhanced. With regards to the analysis of the gaps identified for garden waste and composting in the Waste Status Quo Report for the City, 2003, it is believed that the following need to be enhanced: (1) collection services for garden waste (2) treatment and disposal facilities for garden waste in landfills and (3) composting facilities (Otieno & Venter, 2004).

In addition, as part of the Integrated Waste Management system for the city, it was identified that recovery and recycling had to be prioritized. For example, reduction and resource recovery were identified as a strategy, the objective being to reduce the amount of waste generated and disposed off at landfills. Therefore, recycling and composting are strategic priorities. Within the framework of core strategies, strategic priorities (issues), goals objectives and targets have been developed. With regards to this study, garden waste and composting are identified in the plan as strategic issues with associated goals and objectives. The goal is to divert green and garden waste from the general waste stream to composting facilities (Otieno & Venter, 2004). To this end, the pilot plant at Panorama (The Panorama Composting Plant) was initiated.

The objectives of this goal are to develop an incentive based integrated garden waste and composting strategy to achieve the proposed goal of 25 percent diversion of garden waste from landfill sites. Also to develop partnerships with the private sector so as to optimize the management, quality and marketability of the garden waste sites and the final compost product. Other objectives are to encourage the participation of the public in achieving the goal and the key objectives, through education and awareness and also by creating an incentive-based composting strategy (Otieno & Venter, 2004).

2.2 Conclusion

The most important aspect highlighted in this chapter is that the CoJ as local municipality is legally required to be responsible for waste management services and pollution prevention in the city. It has also being established that the waste related legislation aims at promoting sustainable development. Proper waste management and pollution prevention contribute to sustainable development. This study (in later chapters) will establish whether the CoJ's initiative of waste recycling through Panorama plant is contributing to sustainable development. Based on the research framework, Figure 4, Chapter 3 will analyse the concept of organic green commercial composting in relation to sustainable development.

UNIVERSITY OF JOHANNESBURG

3 CHAPTER 3: OVERVIEW OF ORGANIC GREEN COMMERCIAL COMPOSTING

Based on the research framework (Figure 4), the information for Chapter 3 was obtained from journal articles, books, and conference proceedings. This chapter covers the analysis of organic green commercial composting in relation to sustainable development. The composting process and the various kinds of composting are described. A brief discussion on why some commercial composting plants fail is offered. The chapter also examines how international developing countries practice commercial organic composting. Lastly, organic composting is discussed as an initiative that has the potential to minimise waste management challenges.

3.1 Definition of composting

Composting is the biological decomposition of organic materials by micro-organisms. Decomposition occurs naturally. However, in the commercial composting process, human intervention can accelerate and improve natural decomposition (Marr, 1995). During composting, raw organic waste materials are transformed into biologically stable, humic substances that make excellent soil modifications (Cooperband, 2002). In order for the composting process to be effective, however, there has to be appropriate environmental conditions within the composting system, for example, oxygen, temperature and moisture.

UNIVERSITY OF JOHANNESBURG

3.1.1 Micro-organisms and their role in the decomposition process

Micro-organisms and invertebrates carry out the decomposition of organic waste. They use garden and food wastes as a source of energy and need oxygen and water to survive. The decomposition process results in the production of carbon dioxide, heat, water and soil enriching compost (partially decomposed organic materials). The heat produced in the composting process ranges from 66° to 71° C. Due to the increased temperature, increased water evaporation occurs. It is, therefore, vital to monitor the temperature of the pile to determine the success of the composting process. Subsequent to the decomposition process, the temperature of the pile gradually lowers to the ambient temperature (Marr, 1995). In addition, the weight and volume of the compost pile is reduced. This is also another way of measuring the effectiveness of the composting process.

Micro-organisms that decompose the organics in the composting process comprise of a wide range of naturally occurring organisms including bacteria, fungi, moulds, actinomycetes, and

protozoa. Other small invertebrate animals such as mites, millipedes, insects, earthworms, and other similar organisms can also be involved (at Panorama, the micro-organisms breed naturally). A wide range of different organisms increases the chances of a complete composting process. Aerobic bacteria are, however, the primary organisms that cause decomposition of materials in a compost pile (Marr, 1995).

3.1.2 Aerobic versus anaerobic decomposition

The majority of organisms preferred for the composting process are aerobic since they provide rapid, complete composting. Some other organisms are anaerobic, implying they function in conditions without oxygen. This process is also referred to as fermentation and is slower than the aerobic process. The greatest limitation associated with anaerobic organisms is that it generates odours, acids and alcohols that may be harmful to some plants (Marr, 1995). The Panorama plant uses the aerobic composting process.

3.1.3 The role of temperature in the composting process

Aerobic bacteria survive at different temperatures. For example, thermophilic bacteria prefer temperatures of 60° to 66° C. When the composting process commences, bacterial species that thrive at lower temperatures predominate. As temperatures increase, however, they die off. As this occurs, thermophilic bacteria increase in number and eventually dominate. Eventually, the ever-increasing temperatures of the compost pile, kills the thermophilic bacteria as well. With the demise of the thermophilic bacteria, heat is no longer generated so intensely and the temperature of the pile slowly decreases and the lower temperature bacteria begin to dominate again. In the end, when most of the material has been composted and the bacteria no longer have an energy source, they die and the composting process is complete (Giggey *et al,* 2000).

3.1.4 Environmental effects of composting

Potential negative impacts of composting on the environment are the lowering of water quality (leaching of compost to water resource) and air resources (dust and odours) and the compromising of public health and well being by attracting flies and mice (Diaz *et al,* 1993). These potential impacts occur only when the following exist: (1) inadequate technology, (2) poor management of composting process or (3) lack of preventative/corrective measures.

UNIVERSITY OF JOHANNESBURG

Some of the elements produced during composting are carbon dioxide and heat (Cooperband, 2002). Given that CoJ is a large city faced with climate change challenges, the carbon dioxide and heat released into the atmosphere may create or enhance an urban heat island.

3.2 Composting technologies

Composting systems can be broadly classified as "reactor or non-reactor processes" (Giggey *et al,* 2000, 258). Reactor processes are usually known as 'in-vessel' or 'enclosed' processes and make use of some form of containment to control the composting environment. Non-reactor processes consist of windrows and static piles, and these two classes can be further classified according to whether natural or forced aeration is used. Forced aeration is not a natural process of composting, but it is more rapid as it expedites the aerobic decomposition process, thus reducing the composting period.

3.2.1 Reactor (in vessel) processes

Reactor or 'in vessel' composting processes range from agitated solids, packed bed (silo), rotary drums or kilns, agitated bins, static beds and compost boxes (Giggey *et al*, 2000). Bin composting involves forced aeration in the bin floor; little turning of the composting material; and movement of material from one bin to another. These processes are specially designed commercial systems, with potential advantages like reduced labour, weatherproofing, effective process control, faster composting, reduced land requirement, and quality output. (Marr, 1995).

The agitated bed system combines controlled aeration and periodic turning. Composting takes place between walls that form long, narrow channels, referred to as beds. Each wall has a rail or channel on top that supports and guides a compost-turning machine (Marr, 1995).

Another in-vessel method resembles a bottom-unloading silo. The material composted in this system is vertically stacked, therefore, minimizing the area needed for composting. However, the stacking can also present challenges such as compaction, temperature control, and airflow that must be overcome (Marr, 1995).

Rotary drums are another reactor system that uses a horizontal rotary drum to mix, aerate, and move the material through the system. The drum is partially filled with compost and, as organic material is added to the drum, the drum is rotated to mix the ingredients and aerate

the mixture, adding the required oxygen. This results in a faster composting process in comparison to other methods. The composting process starts quickly; and the highly degradable, oxygen-demanding materials are decomposed (Marr, 1995).

However, reactor operations are costly as operational and maintenance costs are high. They are commonly used by countries such as the United States of America (USA), where labour costs would outweigh these inherent operational and maintenance costs. However, due to the inherently high fixed operational and maintenance costs, reactor operations are less than ideal for developing countries or organisations that are not economically stable (Marr, 1995).

3.2.2 Non-reactor processes

A popular non-reactor method is the Bangalore process, which is "a modern version of the Sir Albert Howard's Indore method that packs alternate layers of refuse, manure and straw (or woody matter) to a depth of 5 feet" (Giggey *et al,* 2000, 258). Modern windrows can either be triangular or rectangular in shape depending on the machinery available for turning. The windrows are periodically turned using a bucket loader or special turning machine.

During the turning process, composting materials are mixed, enhancing passive aeration and aerobic decomposition (Marr, 1995). Composting operations may take up to eight weeks to complete. Windrows are flexible, in that they can be used to compost a wide variety of materials. They also have low capital requirements. Thus, the windrow process is popular internationally, where countries such as India, Bangladesh and Brazil all make use of it (Zurbrugg *et al*, 2004a).

Another kind of windrow method, Passively Aerated Windrows, do not require turning, as air is supplied via pipes that serve as air ducts. However, Passively Aerated Windrows are more costly than traditional windrow methods and so usually predominate in wealthier countries such as the USA. In this case the active composting period ranges from ten to twelve weeks. In the Static Bed Processes (including the Beltsville, Brikollari and Daneco processes) the substrates remain essentially undisturbed throughout the composting period. This allows for higher, broader piles which have less space requirements in comparison to 'Windrow' or 'Passively Aerated Windrow' methods (Giggey *et al,* 2000).

Given the CoJ's economic status (poverty and unemployment challenges) and lack of experience in organic compost production, the use of a non reactor vessel process that needed low capital outlays was opted for. As mentioned, the cost of operating and maintaining reactor plants is high, therefore they are not ideal in developing countries or institutions that are not economically stable (Marr, 1995).

3.3 Community and private sector involvement in municipal solid waste management in developing countries

3.3.1 Background to the problem of municipal solid waste management in developing countries

In many developing countries, managing the solid waste stream is a growing environmental and financial problem. Despite significant efforts to manage solid waste better, most municipalities in developing countries fail to cope with the ever increasing volumes of waste produced in their cities (van de Klundert & Lardinois, 1995). The difficulties in managing urban solid waste is linked to inadequate services, inadequate financing and inadequate environmental controls. In most urban areas, solid waste management is not a priority, thus, limited finances are set aside for it. Furthermore, poor institutional structure, inadequate understanding of complex urban management systems and poor sanitation also impact negatively on solid waste management. For example, often those employed to manage solid waste services lack the required skills and understanding of solid waste management (van de Klundert & Lardinois, 1995).

Solid waste management teams normally consist of municipal workers who have little or no specialized solid waste management training or applied skills. In many cases, municipal governments are characterized by little trained manpower and limited equipment (Onu, 2000). Additionally, a general lack of awareness for solid waste management by the public results in the mixing of solid waste types and littering. Since most people in developing countries are not aware of correct solid waste disposal mechanisms and/or the benefits of recycling and composting (there is also lack of incentives, no regulations or policies), the result is the disposal of solid waste in inappropriate areas, such as rivers and vacant land, causing land, surface water and groundwater pollution (Onu, 2000).

3.3.2 Sustainable Solid Waste Management (SSWM) systems

Sustainable Solid Waste Management (SSWM) implies the efficient and effective management of solid wastes (Onu, 2000). Generally, it is accepted that inter-sectoral partnerships are a means of achieving SSWM systems. A partnership between municipal governments, formal private (commercial sector) companies, the informal sector (individuals and small entrepreneurial firms) and Community Based Organizations (CBOs) is required (van de Klundert & Lardinois, 1995).

In general, the role of municipal governments is to protect the rights of the citizens, to provide urban services and to serve the common good. With regards to sustainable solid waste management, their role is to implement by-laws, local regulations and offer solid waste services. For example, it is the municipal government's duty to ensure that commercial composting plants are run according to legal regulations and are environmentally friendly (Gidman *et al* 1995 cited in van de Klundert & Lardinois, 1995).

In some countries, the formal private sector's role in solid waste management systems is associated with activities such as solid waste collection, resource recovery, incineration and landfilling. The reason for private sector involvement is that in developing countries, local governments are inefficient in providing their services. However, in some countries such activities are still carried out by municipal governments. If the formal sector is involved, it is via formal, legal contracts and its participation is motivated by profit. The role of the private sector can be beneficial to solid waste management. For example, the Indian government has elected to increase levels of private sector participation in commercial organic waste composting. To this end, new solid waste legislation has been developed to encourage private sector participation in the funding and marketing of the end product (Zurbrugg *et al*, 2004a).

The informal private sector usually consists of unregistered and unregulated activities carried out either by community enterprises, families or individuals. International trends have shown that those who participate in solid waste activities are marginal, vulnerable people or groups, such as the urban poor, ethnic minorities or newly arrived rural immigrants. In most cases only a subsistence income is generated (van de Klundert & Lardinois, 1995). In the CoJ, landfill salvaging is a major challenge even though legislation and minimum requirements for waste disposal by landfill discourage this practise (see further details in Chapter 4).

Community Based Organizations can play a significant role in solid waste management. Some of these entities are created by groups of citizens from middle and/or high income areas. Their aim is to improve their neighbourhood. For example, across India, decentralized organic composting plants are run by Community Based Organizations, non- governmental organizations (NGOs) or motivated single individuals. All are characterised by high degrees of public participation and small scale operations. Thus, there is potential for success if various local stakeholders are involved (van de Klundert & Lardinois, 1995).

3.4 Reasons why many municipal commercial composting projects fail

Many composting projects are a failure due to the following constraints namely, inadequate attention to the biological process requirements, inappropriate use of technology, lack of vision and marketing plans for the final compost product.

3.4.1 Inadequate attention to the biological process requirements

Often those who wish to implement commercial composting lack understanding of, or do not put sufficient attention to, the favourable biological conditions required. For example, composting requires a constant supply of oxygen, adequate moisture, and a blend of material that meets a specific carbon-to-nitrogen (C:N) ratio. If these parameters are met, carbon dioxide and water will be the primary gas emissions from the process (Hoornweg *et al,* 1999). Figure 5 shows how the composting process has to occur.

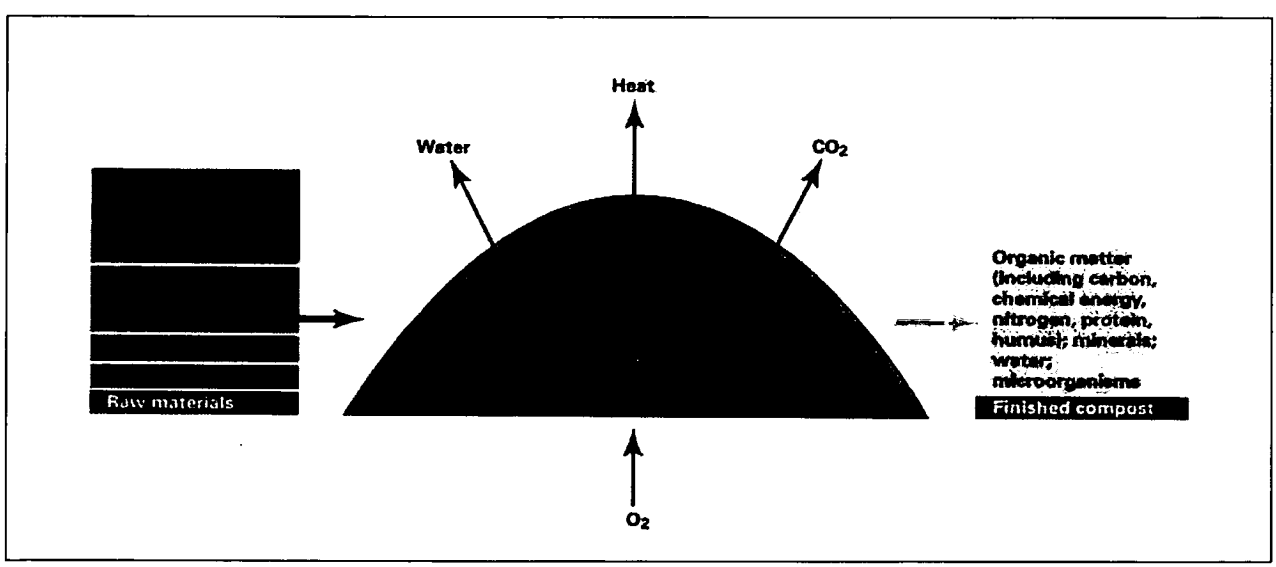


Figure 5: Composting process (source: Cooperband, 2002: www.region18.com/composting.htm)

3.4.2 Over-emphasis placed on mechanized processes rather than labour intensive operations.

Mechanized plants have proven to be unsuited to the conditions (unemployment) that prevail in labour-rich, money-poor countries. High machinery maintenance and running costs become a significant burden for such developing countries. Furthermore, mechanized plants hinder job creation for unskilled individuals in these countries. The shift to mechanised plants creates skilled jobs, which poses a problem as in many developing cities where there is shortage of individuals of this calibre and a shortage of funds to compensate them (Zurbrugg, 2004a).

Karachi, Pakistan is one such urban area that experienced a composting plant failure due to investment in a mechanized process. The Farooq Compost Fertiliser Corporation Plant, was a large composting plant established in North Karachi in the early 1980s. However it failed to operate successfully and is no longer in operation. The Farooq Compost Fertiliser Corporation Plant was not profitable and it failed due to reasons such as a lack of sufficient machinery at the plant (Ahmed & Zurbrugg, 2002).

3.4.3 Lack of vision and marketing plans for the final compost product

The success of a composting project also depends on the quality of the end product, as well as the manner in which it is marketed. Contamination, with heavy metals, for example, results in a poor quality end product (Hoornweg *et al,* 1999). The failure of the Farooq Compost Fertiliser Corporation Plant, in North Karachi, Pakistan has also been attributed to the low quality of end product. Due to lack of source separation, the organic waste composted was contaminated with other substances, resulting in a poor quality end product that could not be sold (Zurbrugg, 2004a).

Poor marketing plans are frequently a cause of failure for composting projects. For example, management of the Farooq plant, in Pakistan adopted an unrealistic marketing assumption, namely that compost could be exported to the Middle East. In addition, few composting plants link up with agricultural stakeholders, thus, animal or commercial fertilizers remain the preferred fertilizer for this sector of the market (Hoornweg *et al,* 1999).

Therefore, it can be concluded that if commercial composting is not well researched, it is unlikely to make a profit, nor will it solve urban solid waste management problems.

Commercial composting, therefore, needs to be part of an integrated solid waste management strategy. Cost effective and sustainable composting is possible within the context of an integrated solid waste management strategy.

In addition, it is vital that appropriate processing technologies be selected based on market opportunities, economic feasibility, and social acceptance. To ensure sustainability participation and cooperation from many stakeholders is required, including national governments, municipalities, local communities, waste generators, and the private sector (Hoornweg *et al,* 1999). For example, without government's buy in and support, specifically in third world cities such as CoJ, the composting initiatives are unlikely to succeed.

3.5 How municipal composting can be improved

Hoornweg *et al* (1999) are of the opinion that in order to enhance municipal composting projects, various issues have to be addressed. These include: improved waste management policies, capacity building (at the technical and managerial level), increased public education (solid waste management and composting) and comprehensive cost accounting. Other important aspects that need to be considered are: integration with agricultural and horticultural activities and a strong focus on implementation and day-to-day operations (Hoornweg *et al,* 1999).

UNIVERSITY OF JOHANNESBURG

The role of national government in composting plants is crucial. National governments need to support and encourage community based, private sector, and municipal composting initiatives. This can be done by providing technical assistance on composting techniques and developing guidelines for the implementation of low-cost facilities. National governments can also evaluate, establish and enforce compost quality standards, as well as, regulate and monitor the performance of compost operations. Promoting the use of compost through public awareness campaigns, can enhance its marketability (Hoornweg *et al,* 1999). National government can also conduct research on the best compost practise that is locally suitable.

3.6 Commercial composting - the international perspective

Composting can be practised through a centralised or decentralised manner. In the former, the organic material is collected in bulk and taken to a central composting plant from where it is passed on to a landfill after biological stabilisation. Unlike centralised composting, decentralised processes do not only reduce and stabilise the composting material, but they

totally divert them from landfills. Global experience has shown that landfills are eternal receivers of waste that simply grow. As stated by Fehr 2007, a society that is unable to control or minimise the size of its landfills is not sustainable. In recent years due to increased environmental consciousness and waste management challenges such as limited landfill space, decentralised composting is becoming common.

In a developing country like Cuba, composting is already considered as an appropriate waste management solution. There is a proposal that decentralised composting of organic municipal waste be integrated into the waste management system. Cuba's economic problems not only hinder the application of modern waste techniques such as incineration, but also inhibit the implementation of centralised waste treatment options. The main challenges facing Cuba are the short fuel supply and the serious deterioration of the equipment used for waste collection and transport (Korner *et al,* 2008).

The proposed integration takes cognisance of the current problems that exist in Cuba such as transport crises, as well as the limited food supply, partly caused by the lack of fertilisers. The proposal takes advantage of the existing urban agricultural plots, which are distributed throughout the cities. These plots could be used as decentralised composting plants that would assist in reducing transport costs. With the cut of transport costs, investment can be made into producing more compost that will boost soil quality essential for increasing food supply (Korner *et al,* 2008).

In other developing countries, such as Brazil, Bangladesh and India, decentralised commercial composting has been established and is becoming a common recycling practice.

3.6.1 Bangladesh's Dhaka

The city of Dhaka, in Bangladesh, has illustrated the success of a decentralized collection and composting scheme (the Indonesian windrow technique). Dhaka, like many developing cities, is faced with many urban environmental problems that cause serious environmental impacts. One of the problems was the need to deal with organic waste. The city realized that waste recovery through recycling and composting were viable options for dealing with the large volume of organic waste that was generated (Zurbrugg *et al.* 2004b).

The national government supported the project, as composting would enhance soil quality. Dhaka was also undergoing an expansion, with an increased population and a spread of the urban limits. With this in mind, city officials realized that landfill space would soon be at a premium. Transporting the waste to other localities would be expensive due to haulage costs. Through the project, huge quantities of organic waste were recovered from the waste stream, generating jobs and incomes, savings on transportation costs and disposal costs. Composting contributed positively to the city's management of waste and job creation (Zurbrugg *et al.* 2004b).

Commercial organic composting was launched in Bangladesh in 1998 by a local Non Governmental Government Organisation (NGO) called '*Waste Concern*'. The initial aim of this initiative was to use solid waste for the production of compost, which, in turn, would be used to improve the rapidly depleting fertility of Bangladesh's topsoil. The initiative's key strength is in a partnership between the city government, the NGO and the private sector. The state provides free land for the processing of the waste and *Waste Concern* collects, separates and converts (composting process) the solid waste into organic compost. Community members pay a nominal fee (based on their ability to pay) to *Waste Concern* for the collection of their solid waste (Zurbrugg *et al.* 2004b).

UNIVERSITY OF JOHANNESBURG

The communities manage the solid waste collection process, but the marketing and sale of the compost is done by private sector organizations, who also add nutrients to the product to enhance sales. There is a well established market for the compost, as majority of the land use in greater Dhaka and adjoining areas is agricultural. The composting initiative is successful because of the public-private partnership and the role that community plays in the collection of the waste, specifically by keeping collection costs to a minimum and collecting composting service payments to achieve cost recovery. The initiative is successful as it addresses community needs (the need to get solid waste collected) (Zurbrugg *et al*, 2004b). A partnership based on meeting the needs of all the stakeholders, is, therefore, essential for success. In this case, the partnership ensures a closed benefit loop.

3.6.2 Brazil's Curitiba

Curitiba is favoured by environmentalists and is considered to be a model for the rest of the developing world, notably for its waste management programmes, as well as for other environmental initiatives. In terms of waste management, all waste in Curitiba has to be

separated into organic and inorganic categories. The long history of military dictatorship in Brazil helped to ensure that such municipal bylaws were enforced and became standard routine for the citizens of Curitiba (Meadows, 1994).

However, the crucial role that waste recycling plays in the local economy has greatly assisted levels of local buy-in. For instance, as there is no formal waste collection service in the squatter settlements, residents were driven into the waste collection process by exchanging bags of waste for bus tickets or food parcels. Inorganic waste is sorted in waste sorting plants that specifically employ highly disadvantaged people such as immigrants and the disabled. Waste sorting is not an ideal job and does not pay well, but for many individuals in developing countries, such as Brazil and South Africa it is a better alternative than being unemployed. The provision of jobs further enhances levels of local support for the programme. In addition, proceeds from recycling are used to fund local social services (Meadows, 1994).

Local school children have been educated in recycling and these children have helped to convince their parents to participate in recycling programmes. Perhaps the most significant lesson that can be learnt from Curitiba is that using manual sorting methods, jobs can be created and in developing nations, jobs are highly valued and sought after (Lerner, 1995 and EFL, 2003).

UNIVERSITY OF JOHANNESBURG

3.6.3 India

As is the case with many developing countries, organic waste makes up between 40 and 85 percent of the solid waste stream in India (Zurbrugg *et al*, 2004). Composting was identified as one way of reducing the disposal of these organics. Fortunately, composting has a long tradition in rural India. Building on this tradition, developmental organizations in the 1970s created centralized, large-scale composting plants. However, they proved to be uneconomical (Dulac, 2000 cited in Zurbrugg *et al,* 2004a). Currently, only a small number of these large installations are still operational. Their failure was primarily due to: (1) high operating costs (2) high transport costs and (3) poorly developed compost markets. Marketing the product proved to be especially difficult, as cross contamination of the compost made the material unacceptable to the farmers.

A new trend evolved in India in the 1990's when small, manually operated, composting plants started up. These new composting plants were often the result of spontaneous citizen's initiatives or non-governmental organizations' initiatives. For some of the plants, international funds helped ensure their survival, as trends in international funding changed focus to a decentralized approach to development. These new small, community based schemes receive their bulk green organic waste from neighbouring communities (Zurbrugg *et al,* 2004a). This decentralized approach has many advantages over the large scale, central plants of the 1970s. For example, operational costs are much lower (there are no large machines to buy and maintain) and they have generated jobs for the underprivileged. Also, as organic waste is reused close to where it is generated, transport costs are minimal.

However, despite these successes, the composting plants of India still face serious marketing challenges. Compost sales are lower than that of similar products produced by chemical means, due to the heavy subsidization of these industries by the Indian government. Furthermore, the product battles to compete with much lower priced traditional cow dung and poultry manure (Zurbrugg *et al,* 2004a). Price is not the only problem, perception is another. Few farmers trust the product, preferring their tried and tested traditional products. Therefore, in order for the compost market to be robust, Indian government needs to assist in marketing strategies.

UNIVERSITY OF JOHANNESBURG

Despite the marketing challenges in the Indian composting industry, like Curitiba, the Indian experiences show that manually operated plants are more suitable to third world countries as they provide jobs for unskilled, impoverished people and operate cheaper.

3.7 Organic composting: solution to solid (organics) waste management

As discussed above, through organic waste composting, organic solid wastes are diverted from landfills to composting plants, thus saving limited landfill space. There are more benefits of organic composting in comparison to disadvantages. In addition, the disadvantages are manageable. For example, an organic composting initiative can be highly successful if the market plan for the business is well researched and detailed. Therefore, one can draw a conclusion that this process is one of the solutions to solid waste challenges in cities such as the CoJ.

CoJ is faced with landfill space limits yet organic waste is still being dumped at landfills. Due to lack of data, the accurate estimates of the amount organic waste dumped at landfills cannot be established. Despite this limitation, it is however obvious that at landfills, organics constitute a large percentage of the waste component. The diversion of organic waste from landfills can, therefore, save the limited landfill space. Other spin-offs include job creation. In addition, organic composting limits the generation of landfill related pollutants such as leachate and methane (City of Johannesburg, 2003a).

3.8 Conclusion

For successful commercial composting schemes, there has to be, first and foremost, appropriate environmental conditions within the composting system itself. Then there are various composting technologies that can be implemented, but their success is dependent on the link between the technology and the socio-economic conditions that prevail in the urban area. For example, due to high cost, mechanized composting systems are not suitable for developing world cities.

The three international case studies have shown that community participation is crucial in the success of a composting initiative. Despite the compost marketing challenges that face countries like India, overall, the decentralised composting plants cater for job creation and robust recycling as the waste is locally composted. As shown by the case studies, community involvement increases the success of the decentralised plants. The decentralised composting, therefore have potential to increase social sustainability through strengthening of social networks and job creation.

As per Figure 4, this chapter has shown that composting has potential to contribute to sustainable development (social sustainability). In chapter 4, the Panorama plant as a case study is discussed and the research problem, (whether the plant meets sustainable development objectives) and associated sub problems will be jointly addressed and results will be given.

4 CHAPTER 4: THE PANORAMA COMPOSTING PLANT

As stipulated in the research framework, Figure 4, this chapter offers data on the Panorama composting plant, garden refuse sites and landfills (Sections 4.1-4.4). Section 4.5 explores the concept of commercial composting in the context of sustainable development and Millennium Development Goals. The other third world cities's composting initiatives are explored to determine their application to the CoJ. It is in this section that the research problem (whether the plant meets sustainable development objectives) is addressed and results are given. Lastly, the conclusions are drawn in Section 4.7.

4.1 Panorama: background and current status

The Panorama Garden Waste Composting Plant was first commissioned in 1995, and is currently owned and operated by PIKITUP (City of Johannesburg, 2003a). As mentioned in Chapter 1, the plant is located on Jim Fouche Road, Panorama. PIKITUP was founded in January 2001 and the CoJ is its main shareholder. PIKITUP is the city's official waste management service provider that collects solid waste in the CoJ. The duty of PIKITUP is to ensure that the CoJ is provided with waste management services.

A staff compliment of 18 operates the machines and manages the plant. The employees consist of 5 plant operators, 12 labourers and 1 driver. All of these employees are black African males. Due to maintenance of machinery, staff costs and transportation of the raw material, the Panorama composting plant has high operational costs (Venter, 2006: personal communication). Diversifying the compost products and finding more customers has been identified as one of the ways in which income can be increased to meet these costs.

It is at this plant that organic material is processed into compost. The organics such as grass are sourced from garden refuse sites within the municipal boundaries of the CoJ. This diversion of garden waste from garden refuse sites to the Panorama composting site is reducing waste haulage to landfills (the Panorama plant receives approximately 1 000 tonnes of green waste per month). Even though the amount of garden waste reaching the Panorama plant is limited, this transfer contributes to saving landfill space. Therefore helping the CoJ work towards meeting the requirements of the Polokwane Declaration that aims at reducing and recycling waste (DEAT, 2001).

With only 1 000 tonnes of organic material reaching the Panorama, this indicates that CoJ does not have a fully thought out Integrated Solid Waste Management Plan. In order to increase waste quantities at the Panorama plant, additional organic material will, in future be diverted from other garden refuse sites in the CoJ. PIKITUP plans to install waste transfer stations at these garden refuse sites to further boost material flow to the composting facility. CoJ is also investigating ways in which park waste, from city parks can be diverted to Panorama. Lastly, PIKITUP wants to open additional composting plants within existing landfill sites, such as Linbro Park (Venter 2006; personal communication).

4.2 Composting process and plant machinery

The overall composting process implemented at Panorama is displayed in Figure 6. As shown in Figure 6, the composting process is categorised into three sections namely input, the technical composting process and product. The inputs refer to the garden waste that is utilised to generate compost. The composting process comprises of milling, windrow formation and screening phases.

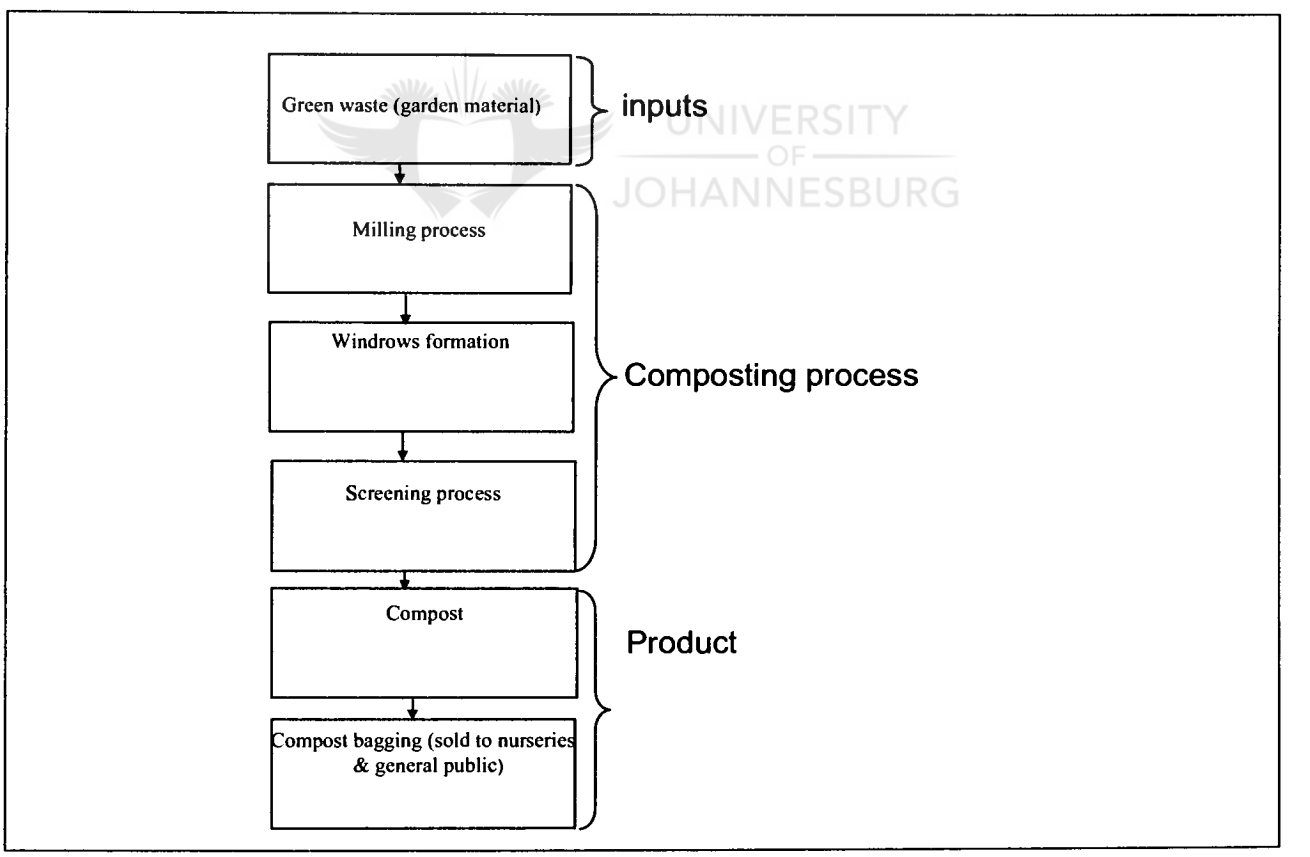


Figure 6: The composting process used at Panorama plant

During the above mentioned composting process, the plant makes use of the following equipment: a milling machine; a loader; a 1800 compo-screen; a Rhino SP4 Windrow Turner and a Compost Shredder MZA – 2500 to produce the compost (see Figures 8-10).

The various functions of these machines are described below.

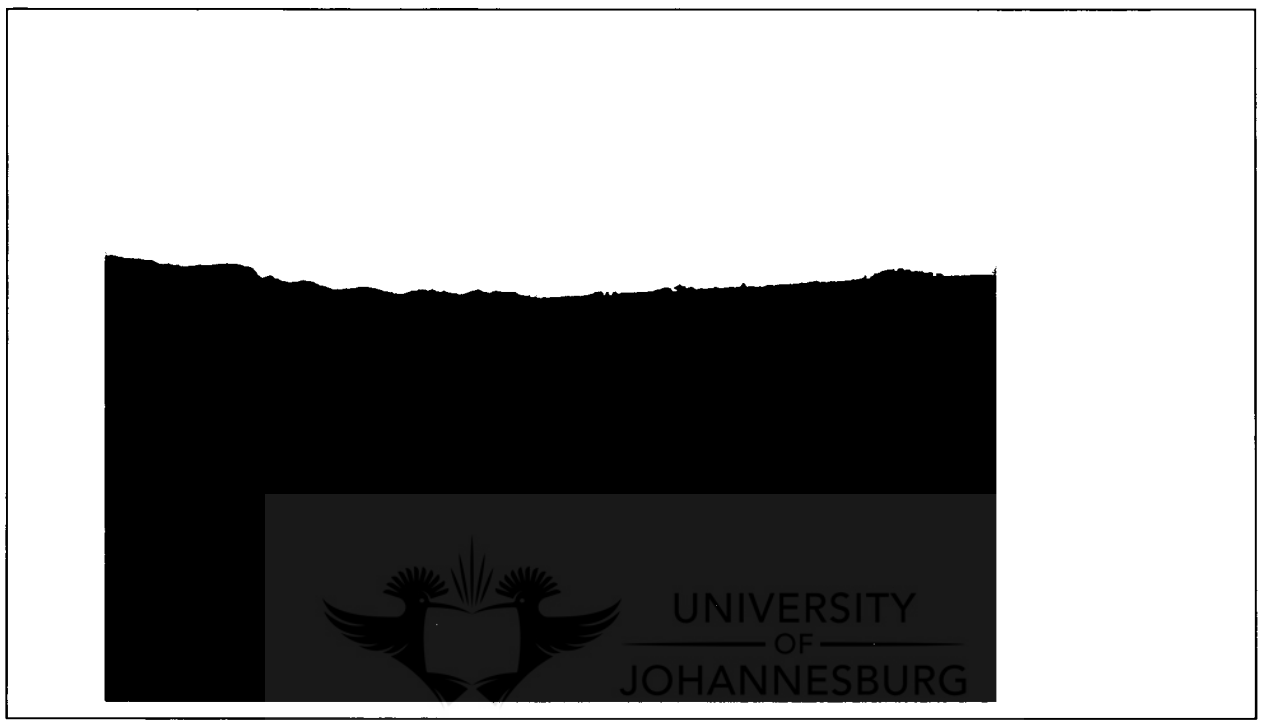

UNIVERSITY OF JOHANNESBURG

Figure 7: Windrows (Photo: Author: 2/3/2006)

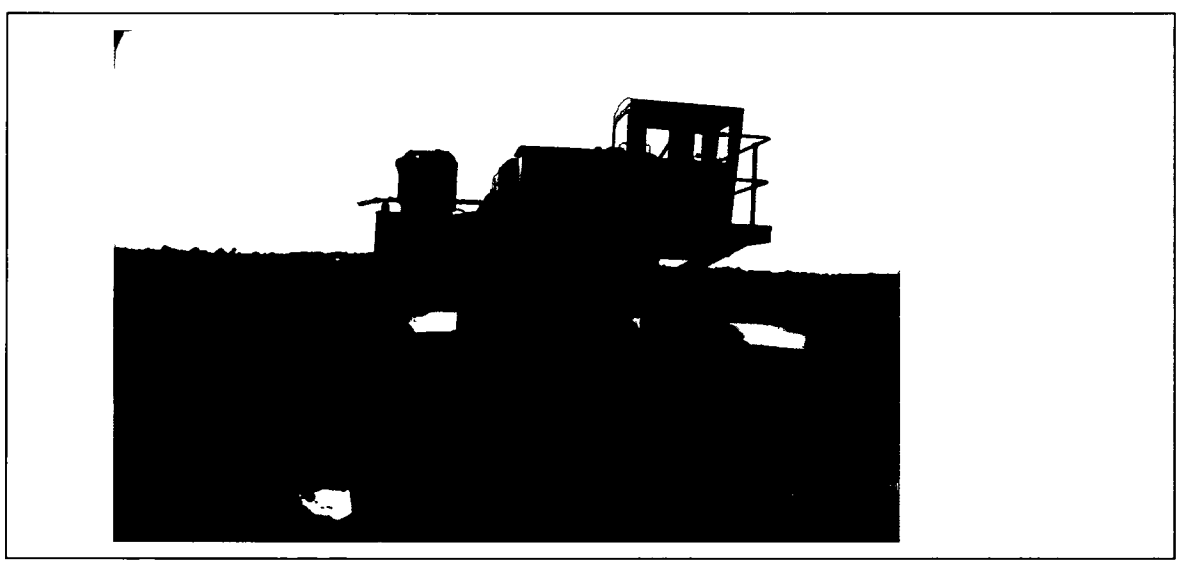


Figure 8: Windrow Turner (Photo: Author: 2/3/2006)

4.2.1 Windrow turner

Windrows (see Figure 7) are turned by the windrow turner (Figure 8) during composting to combine the composting mix, introduce fresh air, and release trapped heat, moisture and stale air (Swan *et al*, 2002). Windrow composting is an aerobic process that needs large quantities of oxygen. This oxygen helps to speed up the composting process and increase temperature (thermophilic temperatures are ideal for bacteria, if thermophilic temperatures are maintained, the composting process kills pathogen and enteric parasites). The frequency of turnings impact on the temperature in the windrow and, therefore, the rate of pathogen suppression (Duluc, 2001).

In addition, it is important that the carbon/nitrogen ratios are correct when the organics are mixed (leaves and wood chips) are mixed together. In addition to the correct carbon/nitrogen ratio, the inoculation of the correct amount of water and that it's evenly spread across the length of the windrow is crucial.

4.2.2 Milling machine

The milling machine as shown in Figure 9 breaks down the compost material into fine powder like particles. This fine compost can be used as mulch or for top dressing by both gardeners and landscapers.

UNIVERSITY OF JOHANNESBURG

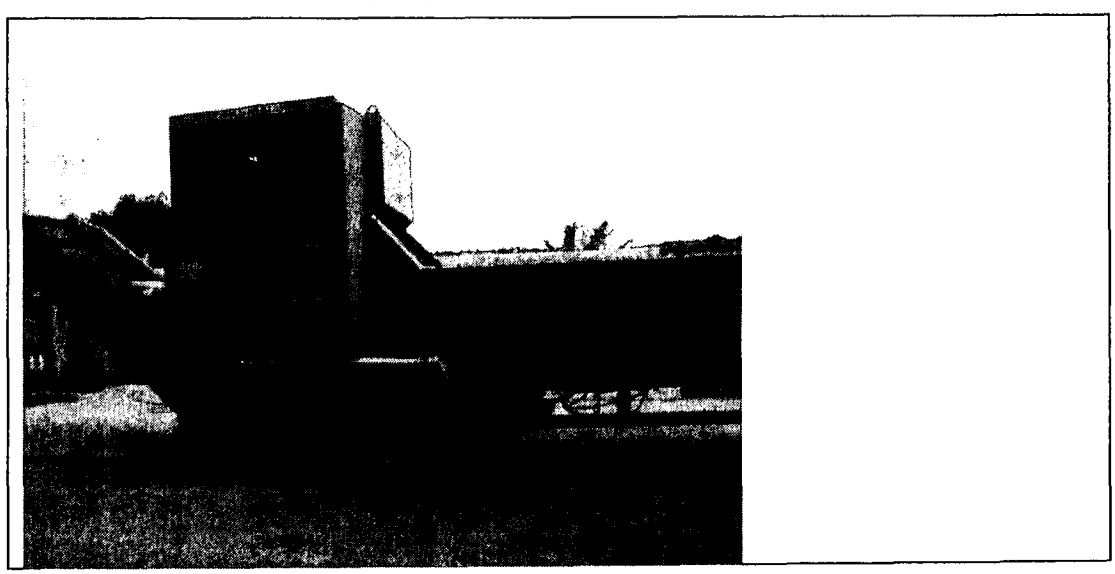


Figure 9: Milling machine (Photo: Author: 2/3/2006)

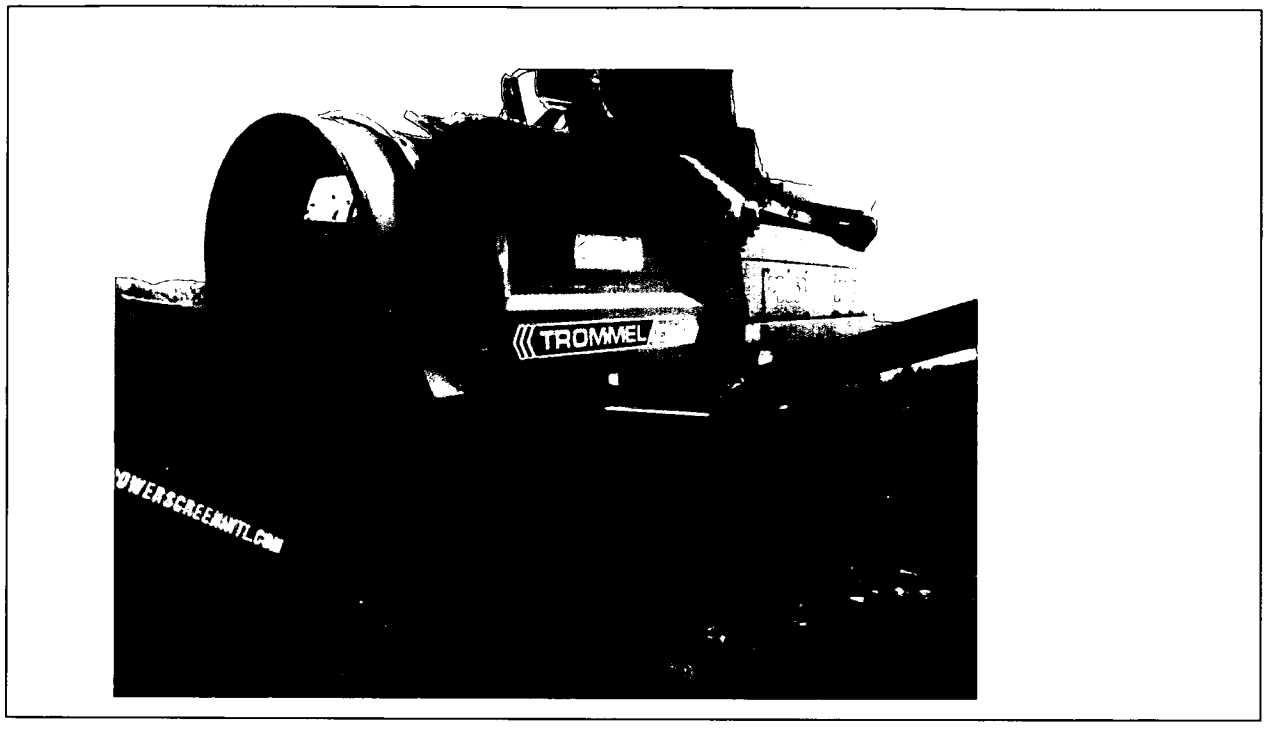


Figure 10: Screening machine (Photo: Author: 2/3/2006)

4.2.3 Screening Machine

During organic composting (subsequent to the milling process), the role of a screening machine (Figure 10) is to separate out the fine grains of compost from the unprocessed materials that are likely to contaminate the final compost product. Screening is beneficial as it makes compost more uniform and easier to use. The type of screen and particle size is determined by the needs of the compost target market, such as farmers, landscapers or gardeners. (Duluc, 2001).

4.3 The state of Garden Refuse sites in the City of Johannesburg

The garden refuse sites are a source of organic material that the Panorama plant uses. It is, therefore, important to examine the state of these garden refuse sites as their condition influences on the quality of compost produced at the Panorama plant. For example, if the organics from the garden refuse sites are contaminated and not properly sorted (at the garden refuse site), the likelihood of producing poor quality compost is high.

UNIVERSITY OF JOHANNESBURG

The flow of organic waste from households to garden refuse sites, landfills and Panorama composting plant is shown in Figure 11).

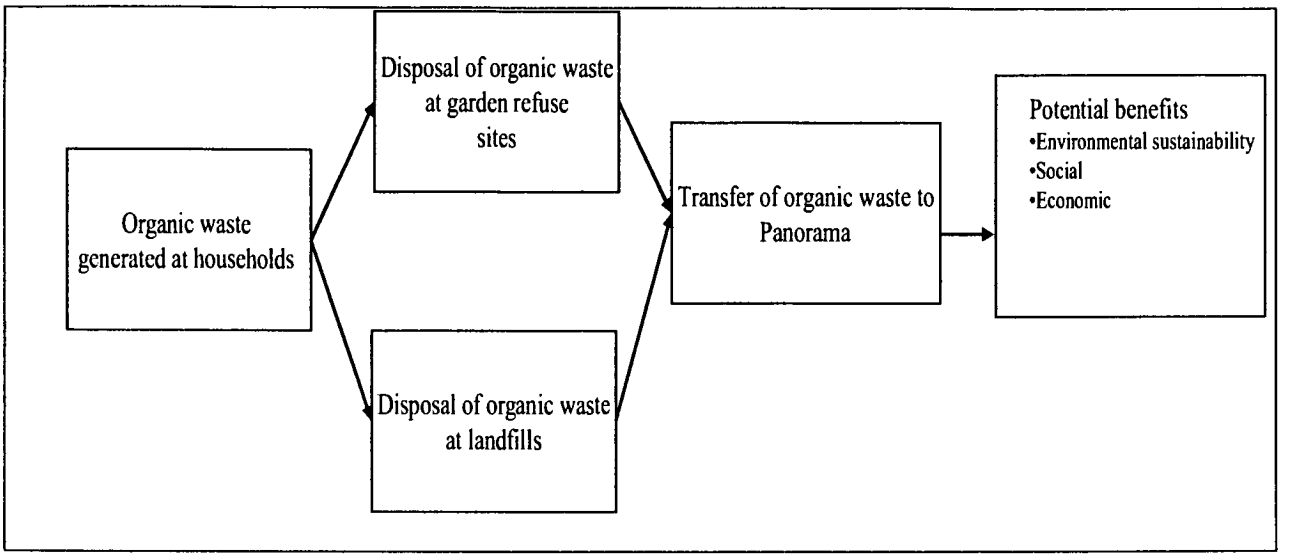


Figure 11:The flow of organic waste from households to garden refuse sites, landfills and Panorama Composting Plant

As shown in Figure 11, the organic waste generated by households is disposed at either the garden refuse sites or landfills. It is from these disposal sites that the organic waste is transferred to the Panorama plant.

UNIVERSITY OF JOHANNESBURG

There are currently 51 garden refuse sites in the City of Johannesburg (see Figure 12). The initial purpose of these garden refuse sites was to assist local residents to dispose of their garden waste. Convenience, in terms of locality, was the overriding factor in the location of these sites, as most suburban residents do not want to travel long distances to dispose of their waste (City of Johannesburg, 2003a). The garden refuse sites are also conveniently located in close proximity of the Panorama plant. This therefore promotes easier transfer of the garden waste from garden refuse sites to the Panorama plant. Initially these garden refuse sites fell under the responsibility of the "Regional Cleansing Depots". However, over time, the care, maintenance and status of the garden refuse sites declined, partly due to the Regional Cleansing Depots having to allocate time and funds to other priority areas and functions (City of Johannesburg, 2003a).

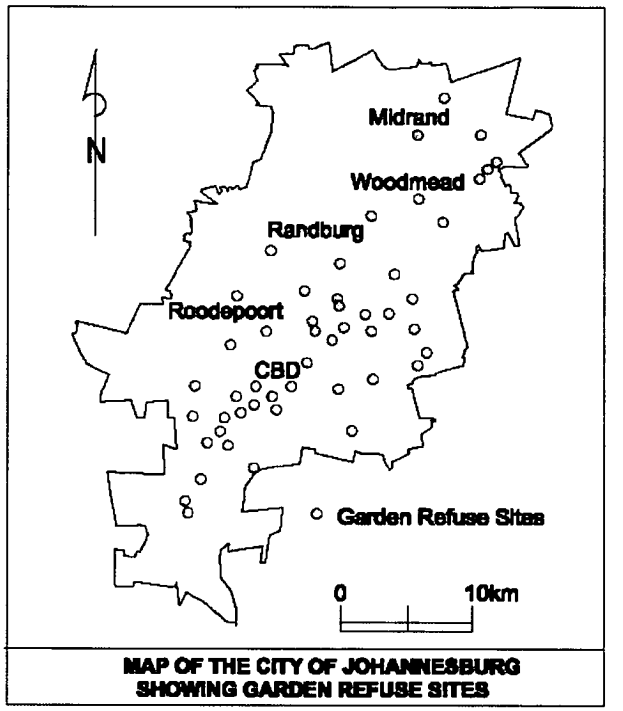


Figure 12: Map of the City of Johannesburg showing the garden refuse sites (source: City of Johannesburg, 2003b)

Many of the garden refuse sites in Johannesburg have similar problems (as explained below) that need to be addressed. The garden refuse sites were established for disposal of garden waste only. But many inadvertently take in building rubble, due to the inability of garden refuse site staff to manage the intake of waste material. Another common problem is the illegal dumping of domestic waste, due to public ignorance. This illegal dumping, in turn, causes other social ills, such as salvagers who comb through the dumpsters trying to find salvageable material (City of Johannesburg, 2003a). Both garden refuse staff and the suburban residents who use the garden refuse sites have found the sites to be high safety risk areas. The lack of fencing, harassment by salvagers and infiltration of criminal elements has left the sites in a poor condition.

UNIVERSITY OF JOHANNESBURG

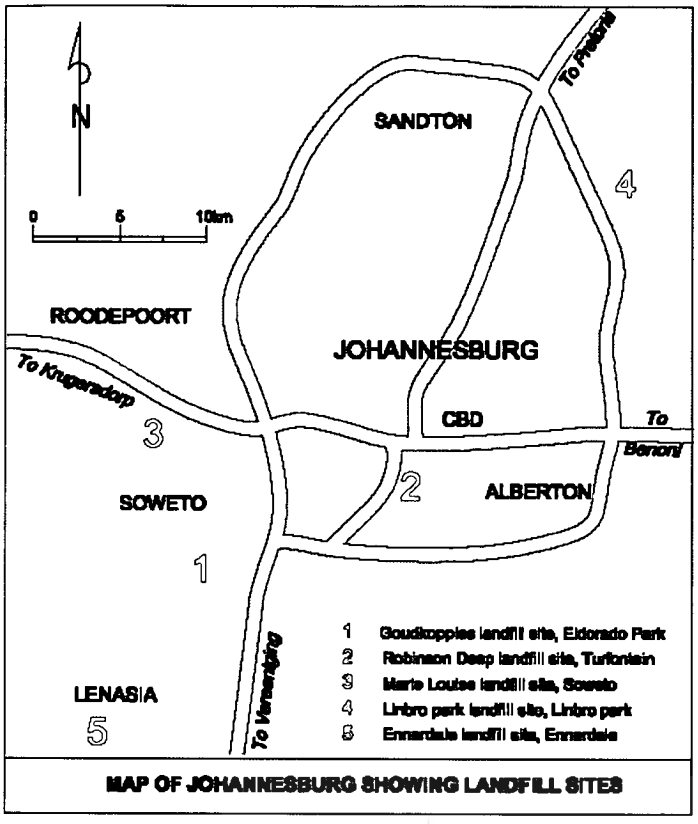
The CoJ has stated that the garden refuse sites need stricter access control (to prevent the illegal dumping and salvaging) and their infrastructure needs upgrading (City of Johannesburg, 2003a). Furthermore, environmental impact studies conducted by the CoJ have revealed that the garden refuse sites also generate environmental problems, such as smoke and water pollution. During the rainy season, water collects on site due to poor drainage, generating water pollution and creating odour problems (City of Johannesburg, 2003a).

It is not all garden refuse sites that are in poor conditions, the more recently developed ones are of a much higher standard and are relatively well managed. In order to improve the conditions of older sites, PIKITUP has employed a central garden site manager to take overall responsibility for all the sites (City of Johannesburg, 2003a). The purpose is to improve conditions on the older sites and develop a long-term strategy to rationalize the number of garden refuse sites and bring in the composting of the organic green waste (City of Johannesburg, 2003b).

4.4 Landfills in the City of Johannesburg

Due to CoJ's poor implementation of integrated solid Waste Management, green organic waste still get disposed at landfills. The need to divert organics from landfills to composting plants is pressing as landfill space is limited in the CoJ. General waste in CoJ is disposed of in five operational landfill sites as shown in Figure 13. Four of these landfills which fall within the CoJ's boundaries belong to PIKITUP, including Robinson Deep, Goudkoppies, Ennerdale and Marie Louise. The fifth landfill, Chloorkop, is privately operated and owned by Enviroserv, (City of Johannesburg, 2003a).

There is no available open space zoned for additional landfills in the city, thus it is of high importance that the pace at which the existing and operating landfills is slowed. It is estimated that by the year 2010, taking into account waste generation growth estimates based on the population growth estimate of approximately 0.2% per year the remaining airspace would be equated to 5 800 000 m^3 provided no new landfills are constructed. (City of Johannesburg, 2003a).



UNIVERSITY OF JOHANNESBURG

Figure 13: Map of Johannesburg showing landfill sites (Source: City of Johannesburg, 2003b).

Apart from the airspace being limited, almost all the operating landfills in the CoJ are faced with design problems, such as inadequate access control (no fencing), insufficient drainage, no liner design, inadequate capping of completed portions of the landfills, and in some cases inadequate water quality monitoring systems (City of Johannesburg, 2003a). PIKITUP is in the process of addressing most of these problems in its upgrading program for all the landfill sites. The general public complaints made are related to poor operational practices. The poor operational practices are complicated by issues such as landfill scavenging. Records of weigh bridges are usually inaccurate due to lack of proper recording of information, computer down time and trained staff members on site (City of Johannesburg, 2003a).

PIKITUP landfills have weighbridge systems with recording systems which documents every load entering the landfill for disposal. CoJ landfills accept building rubble free of charge as it is used as cover material. As disposal of this rubble at landfills is against the landfill requirements for waste disposal by landfill, it is normally not weighed and recorded. As some

waste material such as building rubble is not weighed (failing to meet legal requirements) the CoJ is faced with a challenging task of monitoring the amount of waste in landfills and to determine the remaining landfill space. Another challenge at landfill sites is that they are faced with theft of computer equipment, telephone lines and electrical lines. Due to the theft, recording of information gets hindered and often valuable information lost (City of Johannesburg, 2003a). Therefore, implying that there lack accurate records of all material that is disposed at these landfills.

Another challenge facing CoJ's landfills is that of salvaging. As a means of survival, some poor community members resort to salvaging which involves the reclamation of recycling materials at landfills to sell and generate income. Landfill salvaging is discouraged by the Minimum Requirements for Waste Disposal by Landfill (Department of Water Affairs and Forestry, 1998), and by the National Waste Management Strategy (Department of Environmental Affairs and Tourism, 1998) as it interrupts the landfill operations and poses health and safety risk to the salvagers (as mentioned, salvagers are also a problem at garden refuse sites).

4.5 Commercial composting in the context of sustainable development and millennium development goals

Sustainable waste management has to be a key urban priority, as the UN Development of Economic and Social Affairs, Division for Sustainable Development has noted that "environmentally sound management of waste is among the environmental issues of major concern in maintaining the quality of the earth's environment and especially in achieving environmentally sound and sustainable development in all countries" (Wates *et al.* 2005, 1).

However, Wates *et al* (2005) notes that any sustainable development initiative needs to be monitored and defined within context in order to be sure that it makes a positive and valuable contribution. Commercial composting certainly has the potential to contribute positively to sustainable development. Hoornweg *et al* (1999) are of the opinion that composting is a cornerstone of sustainable development, yet it is often neglected within integrated municipal solid waste management programmes. Thus, commercial composting should become more widespread, especially in developing countries, as it is a way of achieving a balance between diverging economic, social and biophysical (ecological) forces.

Successful commercial composting could contribute to sustainable development and, thus, to two of the eight Millennium Development Goals (gender equality and environmental sustainability). Economically, the composting initiative can create jobs (a vital and scarce commodity in all Third World cities) and be financially self-sustaining. Socially, the initiative can build collaborative links between community members; the Local Metropolitan Government and customers, therefore contributing to sustainable development by enhancing social relations.

The initiative could also contribute to environmental sustainability: with garden waste redirected from landfills to composting plants (producing more organic material that can be composted) and the product (compost) ending up in domestic and commercial gardens (thus, enriching the soil and promoting biodiversity within the newly created or enhanced organic layer within the soil). The diversion of organic waste out of the waste stream could help prolong the lifespan of landfill sites.

Past experiences have shown that compost provides a source of plant nutrients and improves soil fertility. Compost results in significant cost savings for gardeners, horticulturalists, farmers and ground management by reducing water requirements, pesticide, fungicide and herbicide applications. Compost keeps plants healthy by controlling weeds, providing a slow release of nutrients, and preventing soil loss (Chen & Wu, 2005).

UNIVERSITY OF JOHANNESBURG

In addition, nematodes are controlled. Compost also makes an excellent potting mix. It can also serve as mulch for trees, bushes and shrubs. Placed over the roots of plants, compost conserves water (by reducing evaporation) and stabilizes soil temperatures (as temperature ranges are controlled). With the addition of compost to soil, soil fertility is increased and artificial fertilizer requirements are reduced by up to 50 percent (Cooperband, 2002).The result is that "waste" products will be returned to the earth in a natural, self-sustaining manner (des Ligneris, 2000a).

Should CoJ elect to donate compost to disadvantaged communities, especially those who dwell in informal settlements, these communities could use it in their vegetable (food) gardens to increase yields. This additional crop could be used to reduce levels of household poverty, therefore such an initiative would have to be well thought out and planned, and most likely, involve the CoJ working collaboratively with non-governmental organizations (NGOs) such as Food and Trees for Africa or The Food Garden Foundation (http://www.trees.co.za/).

Thus, there is a possibility that commercial compost making can open doors to other poverty alleviation projects such as urban agriculture (Visser, 2004). Urban agriculture consists of the production, processing and distribution of various foods such as vegetables and animal products within (intra-urban) or at the fringe (peri-urban) of an urban area (Baumgartner & Belevi, 2001).

Baumgartner & Belevi (2001) are of the opinion that urban agriculture is of importance as it could assist in reducing two of the most challenging problems facing third world cities, poverty and waste management. Urban agriculture, when successfully practiced can contribute to job creation.

In addition to the mentioned Millennium Development Goal (ensuring environmental sustainability), commercial composting can also contribute to another goal, namely promoting gender equality and empowering women.

4.6 Application of the Bangladesh (Dhaka) and Brazil (Curitiba) and India models to Johannesburg

Although Johannesburg's specific socio economic conditions must be taken into consideration, the models do offer some suggestions for a way forward for the Panorama plant. Firstly, the composting plant in Dhaka, Bangladesh is managed within the specific context of the community that it services (Zurbrugg *et al*, 2004b). In particular, the Dhaka and Indian plants encourage the CoJ to shift away from technologically based solutions to socio-economic ones. Alternatively, CoJ can still construct technological plants that are also socio-economic and take the needs of the communities into consideration.

As earlier mentioned, seventy percent of the employees of the Dhaka composting project are women. These women manually sort and pile organic waste. They also package the final compost product. By using labour intensive methods such as these, jobs, have been created. Furthermore, there is a shift away from large centralized plants to smaller decentralised ones. This was because centralized plants proved to be economically unviable and not fit for the socio-economic conditions that prevail in the third world (Zurbrugg *et al*, 2004b).

However, Johannesburg's socio economic conditions must be taken into consideration as one model cannot be simply transferred from one locality to another. This is due to variation in social and economic status of each place. For example, poverty levels in CoJ vary from those

of Dhaka. In the case of the CoJ, stakeholders such as locals need to be involved in either management or operations of the plant. Education on waste management practices and the value of organic composting are vital to the success of the Panorama plant. The local media, street theatre and local government regulations can be used to promote community participation (Deshmukh *et al,* 2002).

The experience of the Dhaka scheme can help the CoJ implement sustainable commercial composting facilities. In addition, private commercial composting plants need to be partnered in order to share the machinery that CoJ has already bought, in order to reduce costs and improve throughput (des Ligneris, 2000b). As discussed, most importantly, however, is the need to conduct detailed research into the market for compost to improve the current status.

Furthermore, Giggey *et al.* (2000) are of the opinion that other South African experiences should be examined to assess whether it's feasible to implement technologies similar to those currently used or if more labour intensive strategies are more appropriate and can, as is the case of Curitiba be used to support the poorest of the poor. Unlike developed cities, who battle to find people to work in the solid waste field, and so make use of automated machines, cities like Johannesburg, where jobs are scarce, will find labour intensive strategies more appropriate.

UNIVERSITY OF JOHANNESBURG

4.7 Conclusion

As discussed in this chapter, the poor flow of organic material to the composting site, indicates that the CoJ is failing to implement its Integrated Solid Waste Management Plan efficiently. However, 1 000 tonnes of organic waste is received at the Panorama plant each month. This diversion of garden waste from garden refuse sites to the Panorama composting site has reduced waste haulage to landfills. Therefore, it can be concluded that Panorama plant contributes to environmental sustainability. The plant partially fulfils the requirements of Polokwane Declaration by contributing to environmental protection. But, the Panorama's contribution to social and economic sustainability is limited. The limitations are contributed by the low employee numbers and high operational costs.

Based on the results above, conclusive answers and recommendations will be given in the synthesis in Chapter 5 as per research framework shown in Figure 4.

5 CHAPTER 5: SYNTHESIS

5.1 Introduction

As discussed in earlier chapters, the CoJ is faced with many waste management challenges. Some of the primary challenges are a general lack of waste management, recycling and composting awareness (City of Johannesburg, 2003b). In the CoJ, organic material represents more than 50 percent of the waste flow (Giggey *et al*, 2000), thus a large percentage of solid waste directed to landfills is organic (City of Johannesburg, 2003a). The CoJ has therefore embarked upon a composting initiative that is designed to redirect organic waste from landfills to compost plant. The ultimate aim however is to meet several sustainable development objectives: economic development; social development and environmental protection.

Chapter 1 presented the waste management challenges that the CoJ is faced with. Composting waste explored as a waste minimisation initiative. A question was raised whether the diversion of organic waste from landfills to Panorama plant contributes to environmental management field. The answer to this question will be given in this current chapter (Chapter 5). Chapter 1 also discussed the problems statement, sub problems, research framework and methodology.

UNIVERSITY OF JOHANNESBURG

In Chapter 2, waste management legislation associated with organic composting was discussed. Chapter 3 offered an overview on commercial organic composting. In Chapter 4, the Panorama plant, as the research case study was discussed in detail. The application of international composting models to CoJ was explored.

As per research framework, Chapter 5 provides a critical assessment of research problem, sub problems, data and data analysis techniques used. An attempt will be made to arrive at conclusive answers and recommendations.

5.2 Problem Statement and sub problems

As stated in the beginning, the problem statement under investigation was whether the Panorama composting plant meets certain sustainable development objectives, namely environmental, social and economic sustainability. In order to investigate the main problem,

the sustainable development objectives, regarded as sub-problems in this study were investigated. The details were as follows:

5.2.1 Environmental sustainability

With regards to environmental sustainability, the following questions were raised:

- Does the diversion of organics to the Panorama pilot composting plant prolong use of available landfill space?
- Does the Panorama pilot composting plant contribute to environmental sustainability within the spatial limits of City of Johannesburg, namely by assisting the CoJ to partially fulfil requirements of the Polokwane Declaration? This declaration emphasises that solid waste management is a priority for all South Africans, and the need for urgent action to reduce, reuse, and recycle waste in order to protect the environment (DEAT, 2001).

5.2.2 Social sustainability

In terms of social sustainability, the question poised was whether the Panorama pilot composting plant generates employment?

UNIVERSITY OF JOHANNESBURG

5.2.3 Economic sustainability

With regards to economic sustainability, the following questions were raised:

- Is the plant financially sustainable, in terms of meeting operational costs and generating a profit?
- Are suitable long term markets for commercial organic compost produced by the pilot site secured?

5.3 Data

The research data was collected qualitatively using both primary and secondary sources (Chapters 1-4). Sources of data comprised of research reports, magazine articles, published journals and interviews with key personnel in the waste management field (Chapter 4). During the data collection process a number of challenges emerged. For example, there were a limited number of published documents of commercial organic composting in South Africa. Data relating to waste management was also insufficient, for example, due to poor

management quantities of organic waste that lands at landfills is unknown. Therefore the research could not establish by how much the diversion of organic to Panorama plant is saving landfill space. But as indicated in Chapter 4, 1 000 tonnes of organic waste is received at the Panorama plant each month.

5.4 Results

The results are as follows as discussed in Chapter 4.

5.4.1 Environmental sustainability

1 000 tonnes of organic waste is received at the Panorama plant each month. This diversion of garden waste from garden refuse sites to the Panorama plant has reduced waste haulage to landfills. Therefore, it can be concluded that Panorama plant contributes to environmental sustainability by saving landfill space. The plant partially fulfils the requirements of Polokwane Declaration by contributing to environmental protection. Despite this initiative (the plant) the adoption of the Polokwane Declaration of zero waste by 2020 remains optimistic due to poor management of waste services in the City (City of Johannesburg, 2003b). For example, in some parts of the CoJ such as Soweto, waste management is poor and aiming to reach the zero waste status is unrealistic.

UNIVERSITY OF JOHANNESBURG

Due to poor implementation of the Integrated Solid Waste Management Plan, not all organic material reaches the Panorama plant. Some organic waste from households and parks still gets disposed of at landfills. The CoJ is therefore investigating ways in which park waste, from city parks can be diverted to Panorama plant, thus using the plan to its full capacity. This will decrease the organic waste that goes to landfills, increasing landfill space and life span even further.

5.4.2 Social sustainability

As revealed in this case study, the Panorama Plant does contribute to job creation as it has created employment for 18 individuals. But due to this low number of employees, the plant's contribution to social sustainability is limited. Given that the CoJ is a developing city, the Panorama plant in its mechanised state is not ideal as it limits job creation. The CoJ as third world city is labour rich; therefore, labour intensive plants are more suitable. Recommendations on how to improve social sustainability of the Panorama are given in Section 5.6.

5.4.3 Economic sustainability

Unfortunately, the Panorama Plant faces high operational costs due to maintenance of machinery, staff costs and transportation of the raw material, which means that currently it is not economically sustainable. This means that the current marketing plan requires input from a detailed marketing analysis and perhaps re-branding of the end product is required. Most importantly, long term markets for the organic compost need to be secured.

5.5 Conclusions

In conclusion, the study has established that Panorama plant contributes to environmental sustainability as waste is diverted from waste from landfills to the plant for recycling purposes. But the Panorama's contribution to social and economic sustainability is limited. The recommendations on how to increase the social and economic sustainability of the plant is given in detail in Section 5.6.

5.6 Recommendations

5.6.1 Increasing social sustainability

In order for the Panorama plant to be socially sustainable, the rate of employment could be increased if entrepreneurial opportunities beyond the processing component are taken up. For example, small business enterprises can be established for the collection and transportation of the raw product. New small business enterprises could be created in the packaging industry (to package the end product) and in the delivery of the finished product to end-users. Such an approach could certainly help the Panorama Plant find markets beyond those that are currently known (Giggey *et al.* 2000).

5.6.2 Economic sustainability

Given that the market for Panorama compost is not diverse, a detailed market analysis and marketing strategy for the compost product must be undertaken to improve the current operation. For example, the financial success of Dhaka scheme was due to sourcing of large bulk buyers of compost – fertilizer companies (Zurbrugg *et al.* 2004b).

UNIVERSITY OF JOHANNESBURG

A sustainable marketing plan for the Panorama Composting Plant

Perhaps, more than anything, the Panorama Composting Plant needs a detailed marketing plan to be economically sustainable. Currently the plant is up and running, however, success can only be guaranteed if the plant can sell enough of its product to cover costs, perhaps even generate a profit.

Currently the CoJ is only factoring in the savings generated by reducing the amount of solid waste transported to landfills, savings generated by lowered maintenance costs of smaller landfills and the reduced costs of having to find a new landfill site (City of Johannesburg, 2003a). While all of these savings are significant, they are only one aspect of the business of composting. Furthermore, it is difficult to quantify these savings, as data is not always available and there are many variables. If the plant is to be a commercial success, however, other costs need to be taken into consideration. This will include the sunk costs (money spent on establishing the infrastructure), the fixed running costs (overheads) such as water and electricity and the variable running costs (such as salaries and transport) (Chipp, pers comm., 2006).

Once the true costs have been established, the CoJ can determine the cost per unit of compost[1]. Once a unit cost is established, then the break even cost is known. From this a marketing plan can be developed. At this stage, it would be important to note that in profit orientated businesses, a return on investment would also be factored into the unit price. This return is the percentage return on capital invested that a business would expect to see. The return on investment varies according to sector or industry. In this case, it could be the same as competitors in the market, namely AECI's Modderfontein Plant or other compost producers. The CoJ would have to investigate what the norm for these industries are (Chipp, pers comm., 2006).

Any marketing plan for the Panorama Composting Plant would have to include what marketers call the four Ps:

---

[1] This unit could be per kilogram, for example.

First P: The Product:

Compost from the Panorama plant has huge advantages over its competitors, mostly because of its "green" credentials. Customers will be keen to buy a product that supports environmental sustainability, social justice (job creation) and community development. This is a huge marketing advantage, which the CoJ should fully exploit (Chipp, pers comm., 2006).

Furthermore, to enhance the market of the compost product, research on the end product and its existing and potential markets must be conducted. When possible it is advised that end users and industry trade associations be involved in the research as this can: open doors for field research, demonstration plots and funding (Alexander, 1998). The results of the research can lead to the development of new products, marketing programs and other tools used in market development.

Second P: The Price:

International and national research has indicated that some people are keen to buy green products; they are also willing to pay a premium (up to 10%) for such products. This means that the Panorama plant does not have to compete on a "least cost basis". However, should CoJ make a decision to waive this premium and compete with its competitors on price alone, it should win, because consumers, when faced with two equally priced products, with one "green" and another not, they will select the green one over the rival product in most instances. This is good news for the CoJ. Thus, the strength of their product is its very nature and this must be exploited to the maximum (Chipp, pers comm., 2006).

Third P: Placement:

The sales and distribution of the compost have to be identified in the market research. Within the sales and distribution program, strategies which include pricing policies will be developed for the target markets to be approached. These markets typically include those with the greatest potential with regards to value and volume and those which are the easiest to access over a short period of time (Alexander, 1998).

Distribution manner and patterns have to be established. Consideration has to be made on whether in house or distribution sales are applicable. Should the latter be used, it is important to develop a delivery infrastructure which allows customers to receive product when desired. Continued market research should identify and develop programs for new and potential markets as well as methods to enhance the value of the compost.

Regardless of the price and the green credentials, the product must be available for consumers to purchase it. The best way to reach mass consumer household markets is via the traditional household product supply chain, that is, wholesalers and retailers. So the CoJ needs to ascertain who will be targeted i.e. all the wholesalers and retailers, only the wholesalers, only the retailers or some of the wholesalers and retailers.

It would, however, be recommended a partnership between a large national retailer and the CoJ be established. Such a partnership would provide the CoJ with instant access to the domestic market in Johannesburg and could even serve as a pilot for similar initiatives with other cities later on. A retailer chosen must be the one that serves the middle income market segment and is well known amongst Johannesburg consumers.

Before the CoJ approaches a chosen retailer, it must be clearly established how much product the plant can produce and how much of the product the market can absorb. Research will also have to be conducted into what size bags the compost must be sold in, how the product will be labelled and if the CoJ wants to include more than one retailer in the partnership (Chipp, 2006; personal communication).

Fourth P: Promotion:

The CoJ needs to decide how key decision makers (retailers) come to know about their product. In marketing terms, the CoJ can elect to use a push or pull strategy. A pull strategy involves creating demand at the household level so that these people will demand the product and pull it through the supply chain. Such a strategy is cost intensive. Costs for promotion campaigns in the local media and radio stations will be high (at least half a million) and even adverts in municipal accounts cost money.

Thus, this strategy is not recommended. Rather recommended is the push strategy, whereby the CoJ campaigns with the retailer (this will still involve packaging and signage costs).

Furthermore, most retailers will only pay after 90 days, meaning that the CoJ will have to budget for this type of cash flow (Chipp, 2006; personal communication).

Key characteristics of an effective marketing mix and why CoJ must use it

The 4Ps as mentioned above, form a marketing mix and are the four key decision areas that the CoJ must manage in order to satisfy or exceed customer needs better than the competition (Jobber, 1998). In order to be competitive the marketing mix needs to match customer needs, company resources, and be well blended. Details of these characteristics are given below:

The market mix must match customer needs

'Sensible marketing mix decisions can be made only when the target customer is understood' (Jobber, 1998, p.15). Once target markets are established, then the CoJ will need to understand how customers choose between rival offerings. This means conducting research on whether customers 'choice is determined by price, quality or both. Understanding key customers is vital to any business's success (Jobber, 1998).

Markets mix creates a competitive advantage

If the decisions about the 4Ps are based on good research and made with sound judgment, the CoJ can have a competitive advantage over its rivals. The compost's "green" credentials can make it more marketable. In addition, placement, price and promotion strategies are key to a competitive product. For example, as mentioned earlier, the CoJ and its retailer of choice can jointly promote the end product and strategize on placement (Chipp, pers comm., 2006).

The marketing mix should match cooperate resources

This implies that the choice of marketing mix must suit the financial resources of a company. Therefore, the CoJ should choose a marketing mix that does not exceed their financial capabilities. Furthermore, caution must be taken not to create a marketing mix strategy that may be too ambitious for the limited marketing skills of personnel to implement effectively (Jobber, 1998).

The marketing mix should be well blended

Another characteristic of effective marketing mix is that the 4Ps must be well blended to form a consistent theme. 'If a product gives superior benefits to customers, price which may send cues to customers regarding quality, should reflect those extra benefits' (Jobber, 1998, p.17). In addition, when mixing the 4Ps, an organization, such has to bear in mind the targeted customers' needs.

Branding

The success of any business or consumer product depends partly on the target market's ability to differentiate one product from another. Branding is therefore, the main tool marketers use to distinguish their products from a rival's product (Jobber, 1998). CoJ can, therefore, brand their compost product in order to gain a competitive advantage, such as ensuring product identification, repeat sales and new product sales. Alternatively, CoJ could go into partnership with a retailer, to co-brand the compost products. This means placing two or more names on the compost product. Co-branding can in some instances, give the product more competitive advantage.

Alternatively, to enhance the market of the end product and in order to improve economic sustainability at the Panorama plant and other future plants, the CoJ can target volume markets such as:

Reclamation

The CoJ can promote the use of compost by Road Department for road reclamation or by mines for rehabilitation purposes. With regards to the latter, soils previously mined are usually of a poor quality. These soils are usually extremely low pH, and dry and poor in nutrients due to lack of organic matter. However, the addition of organic compost can transform these disturbed soils to fertile conditions (Alexander, 1998).

Agriculture

Farmers are potentially huge users of compost. Ways of making a farmer choose compost over fertilizer will have to be explored. Should the CoJ establish a well researched and realistic marketing mix, the agricultural field can be penetrated. Firstly, the needs and wants

of farmers will have to be known. Furthermore, means of convincing farmers to choose organic compost will have to be determined. It is recommended that small scale urban farmers are targeted.

Construction contractors

Construction contractors can be another potential volume market as they can use compost to control water erosion on active construction sites and help speed the establishment of lawns and parks (Alexander, 1998). The use of organic compost may help reclaim many soils to a degree to which they can be used for landscaping. This due to compost's stabilized supply of organic matter and biological activity.

Landfill cover

Landfills represent another volume market that can be explored. Compost can be used as daily cover, as it provides bio-filtering effects to reduce emission of odorous gases and methane. Also, compost can be used in landfill closure operations. There is often a lack of topsoil to backfill landfills at closure phase. It has become a common world wide, for compost to be utilized at landfill closure phase when there is soil shortage (Alexander, 1998).

Another potential opportunities that can be explored by the CoJ are:

Golf Courses

Finely-screened compost can be used to top-dress fairways and greens or mixed with sand for the building of new greens. In addition, compost can promote strong turf establishment, reducing the need for irrigation and improving drought-stress tolerance. The success of compost is based of its ability to enhance soil structure, moisture holding capacity, organic content, and porosity (in clayey soils) (Alexander, 1998).

In order for a composting plant to be economically sustainable, long term markets have to be secured (Probert *et al,* 2005). Thus, the Panorama plant should target markets such as the above to achieve economic sustainability.

5.7 Future plants

Should CoJ want to construct new composting plants, a number of marketing issues have to be borne in mind in order to achieve economic sustainability. It is advised that a contingency fund be established in the upfront financial plan for composting facility. This will cater for additional modifications that were originally not planned for. For example, due to legislation and policy changes, additional, unforeseen operational costs may arise. The contingency fund can, therefore, assist in meeting these costs without compromising the plant's daily operations (Antler, 2005).

Research on the compost markets in the area must be conducted prior to finalizing the design of the composting operation. A compost marketing plan needs to be developed as part of the overall facility design so that the collection and processing system will produce the desired compost for existing and high potential new markets. This proactive thinking can help reduce unnecessary costs and changes during compost plant operation (Antler, 2005).

In order to increase education and awareness on composting, it is advised that funds be invested in public outreach and education. Most importantly the strategies to be used in the outreach and education programs have to be compatible with community in which the plant will operate. Building community relations on the outset also helps minimize opportunities for public outrage (and potential facility closure). Past experience has shown that when public is informed and allowed to participate from the onset, its more likely for a project to be accepted (Antler, 2005).

In addition, it is critical to train all workers about all aspects of managing a composting facility. Funds specifically for employee training and education have to set aside from the onset. Upfront and ongoing employee education is critical. It has become apparent that companies that invest in their employees are more likely to succeed than their counterparts.

It is also important to be consistent and diligent with product testing, incorporating both regulatory requirements, which usually relate to environmental health and safety, as well as, end user needs. It also recommended that composting facilities participate in testing programmes that offer independently verified quality standards. In this manner the compost quality will not be compromised.

Furthermore, the CoJ can also establish an ongoing feedback system with compost customers in order to learn from their experiences. If used strategically, customer feedback can open doors to new opportunities, products and services. Feedback can arrive in many channels and forms and without tools to manage it can fail to be beneficial. For example, tools can range from asking questions and conducting surveys (Antler, 2005).

Lastly selling compost in bags requires a different skill set and support structure than selling compost in bulk. It is, therefore, advisable that extensive market research be conducted before making an investment in bagging equipment. For example, research can focus on price difference between bulk and bagged compost, and the advantages and disadvantages of each. Of most importance, is what is acceptable to the target consumer market.

It is further advised that CoJ conduct feasibility studies.

5.8 Solid waste management within environmental management

As mentioned in Chapter 1, residential waste volumes are expected to increase from 889 665 tons a year to 1 079 055 tons a year by 2010 in the CoJ. The improper solid waste disposal has contributed to the degradation and contamination of Jukskei and Klip rivers systems, thus impacting negatively on public health (City of Johannesburg, 2003a). Leachate from landfills also contributes to the high level of pollution to the river systems in the CoJ. It is, therefore, important that effective waste management measures are implemented to control and prevent environmental pollution. This leaves the CoJ with a dilemma. On the one hand more waste needs to be directed to landfills, not rivers or vacant land. On the other hand, the amount of waste reaching the landfills needs to be reduced.

As space for additional landfills in the CoJ is contested, it is of high importance that the airspace of the existing and operating landfills be saved. Organic material represents more than 50 percent of the waste flow (Giggey *et al*, 2000), meaning that a large percentage of solid waste directed to landfills is organic (City of Johannesburg, 2003a). Therefore, the diversion of this organic waste from landfills to the Panorama plant saves landfill airspace.

A reduction in volume of waste limits the likelihood of pollution, therefore contributing to environmental management. While its contribution to environmental management may be small, the Panorama plant initiative is a step in the right direction. With initiatives such as

the Panorama plant, the CoJ is working towards the promotion of sustainable development, waste reduction, pollution prevention legislative & compliance to international standards (ISO 14001).

As stated by Farmer (1997), the management of environmental pollution is a key element in achieving sustainable development. It is from this perspective that it can be concluded that the CoJ's initiative of diverting waste from landfills to the Panorama plant contributes to both sustainable development (environmental sustainability) and environmental management.

UNIVERSITY OF JOHANNESBURG

6 REFERENCES

Ahmed, N., & C. Zurbrugg 2002: Urban organic waste management in Karachi, Pakistan. Kolkata: 28th WEDC Conference. http://www.eawag.ch/organisation/abteilungen/sandec/publikationen/publications_swm/downloads_swm/04WEDC-paper-Karachi.pdf Accessed 2 September 2008.

Alexander, R.1998: Five steps to successful compost marketing. *BioCycle, 63.* www.jgpress.com/BCArticles/1998/980663B.html Accessed 3 September 2008.

Antler, S. 2005: Composting source separated organics-25 top lessons learned. *BioCycle, 46,* 60.

Baker, W.E. 2000: *Achieving Success Through Social Capital: Tapping Hidden Resources in Your Personal and Business Networks.* California: Jossey-Bass inc.

Baumgartner, B., & H. Belevi 2001: *A systematic overview of urban agriculture in developing countries.* Swiss Federal Institute for Environmental Science and Technology

Brundtland G.H. 1989: *Our common future.* The world commission on the environment and development. New York: Oxford University Press.

Chen, J., & J. Wu 2005: Benefits and drawbacks of composting.http://www.agnet.org/library/bc/53002/ Accessed 4 September 2008.

Chipp, K, 2006. (Personal communication). 11th August. School of Business Science, University of the Witwatersrand.

Christoforou, A. 2003: *Social capital and economic growth: the case of Greece.* The 1st PHD symposium on social science research in Greece.

City of Johannesburg, 2003a: *Status quo report on the current waste generation and management in the City of Johannesburg.* Jarrod Ball Consortium

City of Johannesburg, 2003b: *State of the Environment Report.* Environmental Management Framework for the City of Johannesburg.

City of Johannesburg, 2008: Budget speech 2008/2009 http://www.joburg.org.za/content/view/2515/114/ Accessed 4 September 2008

Cohen, L., & L. Manion 1994: *Research methods in education.* London: Routledge.

COLMR., undated: Using Qualitative Research Methods. Centre for Organisation Leadership and Management Research, URL: http://www.colmr.research.va.gov/mgmt_research_in_va/methodology/qualitative_research.cfm#2: Accessed 4 September 2008.

Cooperband, L. 2002: *The art and science of composting, a resource for farmers and compost producers.* University of Wisconsin-Madison.

UNIVERSITY OF JOHANNESBURG

DEAT (2001) *Polokwane Declaration on Waste management.* Department of Environmental Affairs and Tourism (DEAT)

Department of Water Affairs and Forestry, 1998: *Minimum requirements for waste disposal by landfill.* Waste management series, Vol 2, second edition. Department of Water Affairs and Forestry, CTB book printers, Capetown.

Department of Housing, 2005: *City Case Study Report: City of Johannesburg.* Dr. Chris Landsberg.

Deshmukh, S., Gupta R., & Agrawal V S., 2002: *Improving the solid waste management by developing the people's perception.* Wastecon International Waste management biennial conference and exhibition. 30 September- 4 October, Durban, South Africa, proceedings, 1, 368-71.

Des Ligneris, J. 2000a: *Composting.* Wastecon 2000 biennial conference and exhibition. 5-7 September, Somerset West, near Cape Town, South Africa, proceedings, 2, 239-246.

Des Ligneris, J. 2000b: *A new waste management strategy to the South African solid waste industry.* Wastecon 2000 biennial conference and exhibition. 5-7 September, Somerset West, near Cape Town, South Africa, proceedings, 1, 285-292.

Diaz, L.F., G.M. Savage, L.L. Eggerth & C.G. Golueke 1993: *Composting and recycling municipal solid waste.* USA: Lewis Publishers.

Duluc, N. 2001: *The organic waste flow in integrated sustainable waste management.* The Netherlands: WASTE.

EFL. 2003: Curitiba: Parana State, Brazil, Environic Foundation International, URL: www.environicfoundation.org/successstories/curitiba.html Accessed 4 September 2008.

Environmental Conservation Act No 73 of 1989: Pretoria: Government Printer.

Farmer, A. 1997: *Managing environmental pollution.* London: Routledge.

Fehr, M. 2007: Confirming decentralised composting as a definite option in urban waste management. *International Journal Environmental Technology and Management, 7,* 274-285.

Flick, U. 1998: *An introduction to qualitative research.* London: Sage publications.

Foster, D. 2005: Brazilian Literature: Contemporary urban fiction, URL:http://www/public.asu.edi/~atdwf/neh_summer/narrative.html Accessed 5 September 2008.

UNIVERSITY OF JOHANNESBURG

Fuggle, R.F. & M.A. Rabie 1992: *Environmental management in South Africa.* Pretoria: Juta.

Gertsakis, J. & H. Lewis 2003: Sustainability and the Waste Management Hierarchy: a discussion paper for EcoRecycle Victoria. Melbourne: RMIT. http://www.cfd.rmit.edu.au/programs/sustainable_products/sustainability_and_the_waste_management_hierarchy

Giggey, M.D., I.S. Gwebu & T.E. Skoglund 2000: *Composting waste organics to save landfill space.* Wastecon 2000 Biennial conference and exhibition. 5-7 September, Somerset West, near Cape Town, South Africa, proceedings: *2*, 257-264.

Guion, L.A. & L. Flowers 2001: *Using Qualitative Research in Planning and Evaluating Extension Programs1.*

Hawkin, P., A. Lovins & L. Hunter Lovins 1999: *Natural Capitalism: Creating the next industrial revolution.* USA: Little Brown.

Hitchcock, G. & D. Hughes 1998: *Research and the teacher.* London: Routledge.

Hoornweg, D., L. Thomas & L. Otten 1999: Composting and its applicability in developing countries. *Urban waste management,* Washington, DC, USA: Urban Development Division of the World Bank.

Jobber, D. 1998: *Principles and Practice of Marketing.* (2nd ed.). London: McGraw-Hill Publishing.

Korner, I., I. Saborit-Sanchez & Y. Aguilera-Corrales 2008: Proposal for the integration of decentralised composting of municipal solid waste into the waste management system of cuba. *Waste management*,28, 64-72.

Kvale, S. 1996: *Interviews: An Introduction to qualitative research Interviewing.* California: Sage publications.

Lerner, J. 1995: Brazil: Curitiba's "Voluntary Sustainability", URL:www.sustainable.org/casestudies/international/INTL_af_curitiba.html Accessed 10 September 2008.

Lindstrand, A., S. Melen & E. Rovira 2006:*Turning social capital into business? A study of Swedish biotech firms' international expansion.* Denmark.

Marr, C. 1995: Composting process. EP3, URL: www.oznet.ksu.edu/library/slow2/EP3 Accessed 10 September 2008.

Mason, J. 1996: *Qualitative researching.* London: Sage publications.

Maxwell, J.A., 1996: *Qualitative research design: an interactive report.* Thousand Oaks, California: Sage publications.

McKay, T. & A. Prangley 2005: Integrating the Informal Economy. Unpublished report of the Gordon Institute of Business Science, University of Pretoria.

Meadows, D. 1994: The Best City in The World, URL: www.context.org/ICLIB/IC39/Meadows.htm 1994 Accessed 12 September 2008.

Merriam, S.B. 1998: *Qualitative research and case study applications in education.* USA: Jossey-Bass Inc Publishers.

UNIVERSITY OF JOHANNESBURG

Merriam, S. B. 2002: *Qualitative research in practice.* USA: Jossey-Bass Inc Publishers.

Miles, M.B. & A.M. Huberman 1994: *An expanded sourcebook, qualitative data analysis.* California: Sage publications.

Mitlin, D. 1992: *Sustainable Development: A Guide to the Literature.* London: Environment and Urbanization, IIED.

Onu, C. 2000. *Sustainable waste management in developing countries.* Biennial Conference and Exhibition 5-7 Sept. Somerset West, Cape Town South Africa.1, 367-378

Otieno, F.A.O. & C. Venter 2004: *A proposed framework for a sustainable waste management in the City of Johannesburg.* South Africa: Wastecon.

Palcznski, R.J. 2002: *Study on solid waste management options for Africa.* African Development Bank.

Probert, E.J., G. Dawson & A. Cockrill 2005: Evaluating preferences within the composting industry in Wales using a conjoint analysis approach. *Resources, Conservation and Recycling, 45,* 128-141.

Republic of South Africa, 1996 South Africa, The Constitution, no. 108 of 1996, Government Printer, Pretoria.

Republic of South Africa, 2000 South Africa, Municipal Systems Act, (Act No.32 of 2000), Government Printer, Pretoria.

Republic of South Africa, 2000 South Africa, Health Act, (Act No.63 of 1977), Government Printer, Pretoria.

Republic of South Africa, 1998 South Africa, National Environmental Management Act (Act 107 of 1998), Government Printer, Pretoria.

Republic of South Africa, 2008 South Africa, National Environmental Management Act: Waste Act (Act 59 of 2008), Government Printer, Cape Town (2008).

Rubin, J.R. & I.S. Rubin 1995: *Qualitative interviewing, the art of hearing data.* California: Sage publications.

Sachs, J.D. 2005*: Investing in development: A practical plan to achieve the millennium development goals.* UN millennium project. London: Earthscan.

Scrimshaw, N.S. & G.R. Gleason 1992: Rapid Assessment Procedures - Qualitative Methodologies for Planning and Evaluation of Health Related Programmes, URL: http://www.unu.edu/Unupress/food2/UIN08E/uin08e0w.htm Accessed 4 September 2008.

Sobel, J. 2002: Can we trust social capital? *Journal of Economic Literature, XL,* 139-154.

Soy, S.K. 1997: The case study as a research method, unpublished paper, University of Texas at Austin.http://www.gslis.utexas.edu/~ssoy/usesusers/l391d1b.htm Accessed 4 September 2008.

Sutton, S. & L. Knight2006: Beyond the Reading Room: Integrating Primary and Secondary Sources in the Library Classroom. *The Journal of Academic Librarianship,* 32, 3, 320-5

Swan, J.R., B. Crook & E.J. Gilbert 2002: Microbial emissions from composting sites. In Environmental and Health Impact of Solid Waste Management Activities, Issues in Environmental Science and Technology, *the Royal Society of Chemistry, 18,* 73-101.

Tchobanoglous, G., H.Theisen & R. Eliassen 1993. *Solid Wastes: Engineering Principles and Management Issues*. New York: Mc Graw Hill.

Trochim, W. 2006: Qualitative Methods. www.socialresearchmethods.net/kb/qualmeth.htm Accessed on 4 September 2008.

van de Klundert, A. & I. Lardinois 1995: *Community and Private (Formal and Informal) Sector Involvement in Municipal Solid Waste Management in Developing Countries'*. Background Paper (Draft) for Urban Management Programme (UMP) Workshop in Ittingen, April, 1995

Venter, C. 2006: (Personal communication). March. Pikitup Offices, Braamfontein.

Visser, S. 2004: Poverty alleviation: the contribution of urban agriculture. www.capetown.gov.za/encodev/downloads/poverty/pdf Accessed on the 1 October 2008.

Wates, J., R. Parker, M. Snow, F. Belfiore & R. Lopes 2005: *Sustainable development and waste management practices*. Sardinia conference.

Westlund, H. 2003: *Implications of social capital for business in knowledge economy: theoretical considerations*. Tokyo, Japan: International forum on economic implication on social capital.

World Commission on Environment and Development, 1987: *From One Earth to One World*: An Overview. Oxford: Oxford University Press.

World Wide Fund for Nature (WWF) 1997: *Caring for the earth South Africa, a guide to sustainable living*. South Africa: WWF

Yin, R.K. 1994: (2nd ed) *Case study Research:Design and methods*. London: Sage publications.

Zurbrugg, C.S., S. Drescher, A. Patel & H.C. Sharatchandra 2004a: Decentralised composting of urban waste – an overview of community and private initiatives in Indian cities. *Waste Management, 24*, 655-662

Zurbrugg, C. S., S. Drescher, I. Rytz, A.H Md Sinha & I. Enayetullah 2004b:Decentralised composting in Bangladesh, a win-win situation for all stakeholders. *Resources, Conservation and Recycling, 43*, 281-292.

UNIVERSITY OF JOHANNESBURG

APPENDIX 1

Panorama management interview questionnaire

General questions on Panorama

- When and why was the plant commissioned?
- Tell me about the composting process followed here at the plant, how its done?
- Explain the use and the kind of machinery at the plant?

Questions relating to environmental sustainability

- How much green waste does the plant receive monthly?
- How do you plan to get more waste to the plant in future?

Questions relating to social sustainability

- How many people are employed by the plant?
- What is the ratio of men to women?
- How does the plant enhance socio economic status of the local communities?

Questions relating to economical sustainability

- What is the public's perception of your compost product?
- What is your key challenge in running the plant?
- What do you think will help in addressing this challenge?

UNIVERSITY OF JOHANNESBURG

APK

363.728809682221 SEKL

UNIVERSITY OF JOHANNESBURG
UNIVERSITEIT VAN JOHANNESBURG

AUCKLAND PARK KINGSWAY CAMPUS / KAMPUS
PO BOX 524 / POSBUS 524
AUCKLAND PARK
2006
Tel: 011 559-2165

2012 -06- 11		

This item must be returned on or before the last date stamped. A renewal for a further period may be granted provided the book is not in demand. Fines are charged on overdue items.