Municipal Waste Management in Namibia: The Windhoek Case Study

by

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Municipal Waste Management in Namibia: The Windhoek Case Study

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DECLARATION

I, Raili Hasheela hereby declare that this research is my original work which to the best of my knowledge has not been submitted to any other university for the purpose of awarding a degree. Where the work of other authors has been used, it has duly been acknowledged.

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SUMMARY

This research attempted to answer the following question:
How can Namibia maintain a well-managed system for municipal waste management in future?

At the national level, the environment is threatened by unsafe waste disposal, which is detrimental to the environmental integrity and posing health hazards. Waste management is important aspect of environmental management in Namibia, due to the fact that waste is a threat to the integrity of the environment. Waste is among the so called 'brown problems', which strongly affects poor people in urban areas. Challenges for managing waste in Namibia are: lack of institutional capacities in some towns to deal with some of the serious waste problems, limited capacity to manage waste and to control pollution, and financial constraints.

The disposal of solid and liquid wastes is a concern in Namibia, especially that waste has some implications in sustainable development. Therefore waste management has become a concern for the Namibian government. The study presented herein has investigated the current status of municipal waste management in Namibia, using Windhoek as a case study. Namibian towns, especially Windhoek are challenged by the increasing population, the link between waste and socio-economic development, as well as increasing amounts of waste generated which puts pressure on disposal facilities. At the moment, some town management systems seem to be ineffective in addressing waste management for the purpose of preventing and minimizing waste in order to reduce environmental impacts that may result due to increasing waste volumes. It was deemed necessary to develop a waste management system that could be implemented by

all towns. Moreover, sound waste management needs to be encouraged in Namibia.

The overall aim of this research was to investigate how waste is being managed at the municipal level in Namibia, in order to recommend a possible system for handling waste across urban Namibia in future. The methodology employed for this research comprised of: literature survey, use of questionnaire, personal interviews, on-site data gathering and data analysis. The researcher worked closely with various town municipalities in Namibia in order to get an idea of how waste is being managed at the municipal level. The towns where the surveys were conducted are: Lüderitz, Mariental, Oshakati, Ongwediva, Ondangwa, Oranjemund, Otjiwarongo, Swakopmund and Windhoek. The researcher conducted an empirical research that is both qualitative and quantitative, presenting original research findings. As part of the design, a case study research was used as an approach to establish an understanding of the concerned situation (waste management at the municipal level) by being focused on Windhoek instead of generalizing. Primary data were collected for this research; however, secondary data from past studies were also used for the purpose of quantification. For the purpose of selecting the study population, the stratified purposive sampling method was used. Out of 31 towns of Namibia, 11 (35.5%) were selected, of which only 9 (29.03%) actively participated in the research. Such a proportion was deemed valid because it gave an idea of how waste is managed in Namibia in general, particularly because a case study research design was also involved, which presented a broader view on waste management systems. This helped the researcher to achieve the research aim. To analyze the data, the researcher summarized the qualitative data collected from various towns, which helped to understand them better and interpret them. In terms of quantitative data, the researcher gathered numerical data, particularly with respect to waste generation, from which waste indicators were calculated. This information helped the researcher to propose a waste management system for Namibia and to answer the research question.

However, the researcher could not obtain data on industrial and commercial waste, since they are handled by private companies. Such information is not publicly shared. Overall, waste is handled by a wide range of stakeholders i.e. those individuals, authorities, institutions and organizations that have a stake in waste production and management. It is also important to realize that handling of waste is a legal issue as far as waste management is concerned. Therefore policies, laws are regulations are developed to regulate waste management at the national, regional and international levels

The definitions of waste as a single term vary from country to country. In the Namibian context, waste is referred to as *any matter whether gaseous, solid or liquid or any combination thereof, which is from time to time listed by the Minister by notice in the Gazette or by regulation as an undesirable or superfluous by-product, emission, residue or a remainder of any process or activity* (EMA, 2007). The following waste management strategies are implemented in efforts to manage waste and for the purpose of reducing the environmental impacts of waste: 1) prevention of waste generation, 2) waste recovery (recycling, re-use and waste treatment) and 3) disposal of waste in an environmentally safe manner. This is referred to as the waste management hierarchy, and it emphasizes that waste prevention should be an ultimate goal for any approach to waste management; after which the other options (recycling, re-use and treatment) can follow. Waste management being one of the approaches to environmental management should be aiming towards sustainable development, the development that aims to meet the needs of the present without compromising the ability of future generation to meet their own needs through sustainable use of natural resources.

The management of waste is now moving towards a more holistic and sustainable approach, with much emphasis being placed on the environmental impacts of waste materials and products throughout their lifetimes. Sustainable use of

resources as an approach to waste management is promoted by the Namibian Environmental Management Act No. 7 of 2007. As a result of this approach, volumes of waste generated are reduced through improved waste prevention measures, improved resource efficiency and a shift to more sustainable consumption patterns. With responsible waste management stakeholders and legal frameworks in place, implementation of waste management strategies can be a success story.

Municipal waste is the waste collected by municipalities independently of the source of waste. It includes waste originated from households, small businesses, institutions and communities. Knowing the statistics on municipal waste being produced and managed from various sources of origin is therefore essential for the purpose of monitoring, decision-making as well as for the development of waste policies.

In terms of recycling, at least 88.9% of the towns that were surveyed practice recycling of waste materials. Those are mainly the towns that have recycling companies or projects. The towns that do not have recycling companies do a local collection of waste materials that are sent to other towns or abroad for recycling. Although re-use is one of the waste recovery strategies, not all towns use it. Treatment of waste as a waste management principle is practiced in all the towns that were contacted for this study. The common type of waste being treated is wastewater/sewage. Apart from wastewater treatment, medical waste is also treated in Oranjemund and Windhoek through incineration. In Windhoek, incineration of medical waste is done by the Ministry of Health and Social Services, after which the Windhoek Municipality takes care of the residue.

In all the towns that were contacted, there are organized methods of collecting waste from households, which are transported to landfill sites for disposal. Noteworthy, the landfills differ in types, sizes and in potentials to threaten the

environment. Waste materials being disposed of at the disposal sites in various towns include: household waste, building rubbles, garden refuse, industrial waste, hospital waste and general waste. Hazardous waste is disposed of at specially engineered landfill sites. Given the fact that handling of waste is a legal issue, the Environmental Management Act of Namibia has set a law that no waste should be discarded at any waste disposal site that has not been declared or approved by the Minister of Environment and Tourism.

Namibia´s economy depends largely on the wealth and exploitation of natural resources. Thus it is important to promote sound environmental management, which is essential for the protection of resources. South environmental management is also necessary for reducing negative environmental impacts and in fact for economic growth. In terms of the socio-economy, high unemployment, poverty, income inequality, pandemic HIV and AIDS, and lack of skills are the major challenges in Namibia.

In essence, waste should be managed in Namibia in order to reduce waste generation and to avoid negative environmental impacts. This is mainly due to the increasing population and economic activities, which play a role in waste generation. Waste management in Namibia is a responsibility of all residents, local authorities, government ministries, private sector and businesses. This study has identified a number of waste management stakeholders identified in different towns of Namibia. Nevertheless, waste management remains a priority for the government, with different government ministries being involved in formulating policies and strategies for dealing with waste and its management. The municipal waste is handled by town municipalities and councils, with support from private contractors.

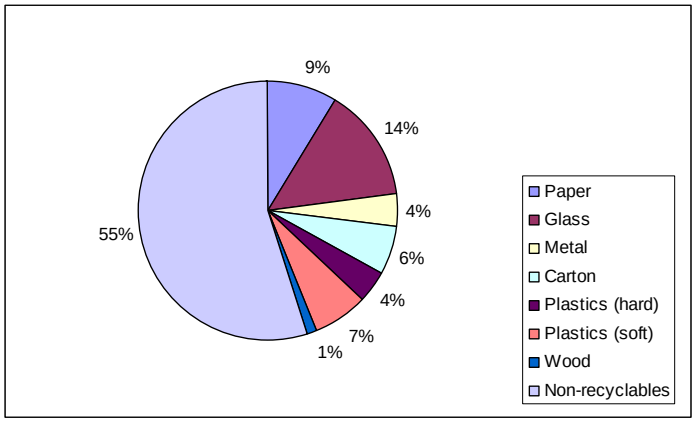
The Division of Solid Waste Management within the City of Windhoek is acknowledged for keeping Windhoek the cleanest town in Africa. It ensures that

all waste generated is collected, transported and disposed of. Waste generated from households is collected by this division. Business waste is collected by both the Solid Waste Management Division and private companies, while the waste generated from industrial areas and from open spaces is specifically collected by individual contractors and private companies.

In terms of waste disposal in Windhoek, there are six general landfill sites that are referred to as 'satellite sites'. Garden refuse and building rubbles are disposed of at those sites. The satellite sites located in various locations within the Windhoek municipal area, namely: Havana, Khomasdal, Pioneerspark, Eros, Olympia and Ludwigsdorf. Approximately 169,915.4 tons (84,957.2 m^3) of building rubbles and 26,442.23 tons (88,170.75 m^3) of garden refuse were disposed of at the satellite sites in 2008. On average approximately 14,159.54 tons (7079.77 m^3) of building rubbles and 2,204.27 tons (7347.56 m^3) of garden refuse were disposed of per month. In addition, approximately 119,916 tons (59,958 m^3) of sand and fill were disposed there in 2008, with an average of 10,970 tons (5,485 m^3) disposed per month.

Apart from the disposal of garden waste and building rubbles, general and hazardous wastes are disposed of at a specially engineered landfill site known as Kupferberg that is located about 11 km from the city centre. At this site, two separate cells are used for the purpose of waste disposal. The general wastes generated from households, commercial and industrial activities are disposed of in the general cell; while the hazardous wastes are disposed of in the hazardous cell. In order to prevent any leakage of leachate from contaminating the soil and ground water, the site is lined with some layers. This study has found that roughly an amount of 229.48 kg of the general waste was disposed per capita per year in 2008, while the amount of hazardous waste disposed per capita per year was 16.8 kg.

Recycling as a waste management strategy is practiced in Windhoek. Various recyclable materials are collected from the landfill sites, including: papers, cartons, plastics, glasses and cans. These are compacted and weighed, then transported to the recycling companies. The recycling companies have to ensure that all recyclable materials are semi-processed, after which they are packaged and send to South Africa for recycling, since there is currently no recycling plant in Namibia. The recyclable materials collected at the Kupferberg landfill site have been divided into fractions as shown in the diagram below. Approximately 55% of the general waste is made up of non-recyclable materials, however, there is a potential for recycling other types of waste, for example, garden refuse that is accidentally disposed there. The diagram below presents the fractions of the recyclable materials being disposed of at Kupferberg, compared with the amount of non-recyclable materials.



Recently a recycling initiative has been started in Windhoek, that is being managed by the private sector. Such an initiative could potentially be replicated in other towns, however challenges associated with costs and transport have been experienced.

Wastewater treatment in Windhoek is essential, particularly because water is a scarce commodity. For this reason, the City of Windhoek has adopted a policy of treating wastewater in order to meet the water demand needs. Currently there are

three water treatment plants in Windhoek, which are used to treat wastewater for consumption. At least 35% of drinking water in Windhoek is reclaimed.

Waste auditing is one of the important practical aspects of waste management. The City of Windhoek conducts waste audits a bi-annual basis. Based on the household waste audits performed in 2004 and 2008, the average amount of waste generated per person per day was 0.37 kg and 0.49 kg respectively. However, according to the waste data collected from Windhoek households between July 2006 and March 2007, the amount of waste generated per person per day ranges between 0.604 – 0.813 kg, which is quite high and is expected to increase. Such an amount needs to be reduced. The audits conducted in 2004 and 2008 were compared, after which not so much difference was found. This led to a recommendation that waste audits should be performed every 5 years.

This study identified some weaknesses concerning waste management in the towns of Namibia. Such weaknesses can be used as opportunities for improvement. In addition, reliable waste data need to be provided, as they play a significant role in waste management. Availability of such data contributes to decision-making processes, as well as to the implementation of waste management strategies. Waste indicators such as waste generated per capita need to be determined, as they are necessary to point out the problematic areas and possibilities of improvement.

This study has come up with a waste indicator model, based on different waste streams in Windhoek in 2008 (see Table below). Based on this model, the amount of waste that was disposed per capita per year in Windhoek was 1,315.51kg. This indicator was used to extrapolate the amounts disposed in other towns, as well as the total amount of waste disposed in overall urban Namibia. Given the high estimates of waste disposed per year, recycling was recommended as the best strategy for reducing such amounts.

Waste indicator	Estimates	Estimated indicators	Units
General waste per year	67,925.52		tonnes
General waste per month	5,660.46		
General waste per capita		230	kg/capita/year
Hazardous waste per year	4,970.58		tonnes
Hazardous waste per month	414.22		
Hazardous waste per capita		17	kg/capita/year
Construction waste per year	169,914		tones
Construction waste per month	14,160.00		tones
Construction waste per capita		574.03	kg/capita/year
Garden refuse per year	26,451.30		tones
Garden refuse per month	2204.4		tones
Garden refuse per capita		89.36	kg/capita/year
Sand & fill per year	119,916		
Sand & fill per month	10,970		tones
Sand & fill per capita		405.12	Kg/capita/year
Capita	296000		
Total waste per capita and year		**1315.51**	**kg/capita/year**

The findings of this study suggest that the waste management system currently being used in Windhoek can be used as a model for the entire Namibia, as it has made it the cleanest city in Africa. Such system still have a potential to be further improved, however, it can still be considered the best-practice waste management system in Namibia.

ACRONYMS AND ABBREVIATIONS

AIDS	Acquired Immuno deficiency Syndrome
BAT	Best Available Techniques
BATNEEC	Best Available Technology Not Entailing Excessive Costs
CBD	Central Business District
CBO	Community Based Organisation
COBA	Cost-Benefit-Analysis
COD	Chemical Oxygen Demand
DEA	Directorate of Environmental Affairs
EEuP	Eco-design of Energy-using Products
EIA	Environmental Impact Assessment
ELVs	End-of-Life Vehicles
EU	European Union
GDP	Gross Domestic Product
GWTP	Gammams Wastewater Treatment Plant
HIV	Human Immuno deficiency Virus
ISWM	Integrated Sustainable Waste Management
ICT	Information Communication Technology
MAWF	Ministry of Agriculture, Water and Forestry
MDG	Millenium Development Goal
MET	Ministry of Environment and Tourism
MFMR	Ministry of Fisheries and Marine Resources
MME	Ministry of Mines and Energy
MOHSS	Ministry of Health and Social Services
MRLGH	Ministry of Regional, Local Government and Housing
MTI	Ministry of Trade and Industry
MWTC	Ministry of Works, Transport and Communication
NBL	Namibia Breweries Limited
NDP	National Development Plan
NEWS	Namibia Environment and Wildlife Society
NGO	Non-Governmental Organisation
NGRP	New Goreangab Reclamation Plant

NMA	Namibia Manufacturing Association
NPC	National Planning Commission
OECD	Organisation for Economic Cooperation and Development
OGRP	Old Goreangab Reclamation Plant
OWTP	Otjomuise Wastewater Treatment Plant
REB	Responsible Environmental Behaviour
RoHS	Restriction of the Use of certain Hazardous Substances in electrical and electronic equipment
UWTP	Ujams Water Treatment Plant
WEEE	Waste Electrical and Electronic Equipment

CHAPTER 1: INTRODUCTION

1.1. Background

Waste management is one of the important aspects of environmental management in Namibia (EMA, 2007). Waste on its own is a threat to the integrity of the environment, as it can have negative environmental impacts which result from environmental threats such as air pollution, illegal dumping of waste, littering, poor sanitation, emission of greenhouse gases, urbanization and poverty (Moningka, 2000; Henry e*t al.*, 2006; Hope & Lerokwe, 1999; UNCHS, 1996a). Negative environmental impacts that may result include groundwater contamination, health hazards, smell nuisance and environmental degradation (Moningka, 2000; WBG, 1998a). In addition, factors such as increasing population and human activities contribute to environmental problems such as poor access to safe water, poor waste management practices, poor health and environmental degradation (Henry *et al.*, 2006; Hope & Lerokwe, 1999; UNCHS, 1996a; Walmsley & Bottem, 1994). Such problems can be a consequence of increasing waste volumes. According to Hope & Lerokwe (1999), the above are referred to as 'brown problems', and are said to be strongly affecting current generations, more especially the poor people living in urban areas. Living in such conditions threaten people's standards of health, security and even life itself (UNCHS, 1996b). Despite the necessity to address the environmental problems, challenges are often experienced, particularly because some towns are lacking institutional capacities to deal with some of the serious problems, for example, controlling of hazardous waste (SoER, 2001; UNCHS, 1996a).

The degree of environmental impacts of waste as a result of increasing populations in urban areas is a matter of concern. Of particular concern is the disposal of solid and liquid wastes, which can have negative environmental impacts such as pollution and diseases (UNCHS, 1996a). Waste products in general have negative effects on natural resources and the environment at large,

and may constitute health hazards (CSA & Smith, 2007; Walmsley & Bottem, 1994).

Consequently, waste has some implications in sustainable development. In terms of development, nations across the globe nowadays are aiming towards sustainability, whereby the concept of sustainable development needs to be applied in all aspects of development, including environmental management. Namibia is not an exception to this (EMA, 2007). In the view of urban development, the concept being promoted is 'urban sustainability', herein defined as the level of urban development reached in an approach to development, whereby the natural and social urban environments are not compromised (Camagni *et al.*, 1998; Hope & Lerokwe, 1999).

Given its high importance and the severity of its need, waste management has become a concern for the Namibian government. For this reason, local authorities are placing increasing efforts in the management of waste across the country. To ensure urban sustainability in the towns of Namibia, various measures need to be in place, in response to the challenges posed by environmental threats, one of which is the increasing waste volumes. In the view of development, the following elements are considered as being of essence in the developmental approaches: use of policies and legal frameworks, stakeholder involvement as well as all relevant principles (Anschützi, 1996; Aziegbe, 2007; Camagni *et al.*, 1998; EMA, 2007; Thomas-Hope, 1995; UNCHS, 1996a). Such elements involve actions needed to reduce the most serious problems, for example the handling of hazardous wastes from dangerous sites. They also contribute to strategies required to promote healthy and safe environments, as well as dealing with specific environmental aspects of concern in general. It is important to note that the environmental problems resulting from specific towns do not only impact those towns alone, they also affect other areas at different levels, for example at the regional and global levels (Camagni *et al.*, 1998).

The study presented herein has investigated the current status of municipal waste management in Namibia, using Windhoek as a case study.

1.2. Problem Statement

Namibia is still in its early stages of development, therefore all its developmental efforts should be considered crucial. As part of environmental management in Namibia, waste management should be placed as a priority in order to reduce negative environmental impacts. However, capacity to manage waste and to control pollution is limited (SoER, 2001). Apart from the management capacity, financial constraints are some of the limiting factors to effective waste management across the country. Namibia is arid to semi-arid, with variable rainfall, and has limited water sources; mainly ground and surface water (Dirkx *et al.*, 2008; Menge, 2006). These sources are at risk of contamination as a result of uncontrolled pollution and poor waste management practices. At the national level, the environment is threatened by unsafe waste disposal, which can be detrimental to the environmental integrity and can pose health hazards (CoW, 2008a; CSA & Smith, 2007; SoER, 2001; UN, 2002). Not only health and environmental damage can result, unattended waste can present poor aesthetic view, causing the environment to be less visually appealing despite the fact that Namibia is a tourist destination. Furthermore, poor waste management is a threat to sustainable development and can have long-term impacts if no improvement is made (SoER, 2001).

The Namibian towns, especially Windhoek are challenged by the increasing population, mostly because of people from rural areas who are searching for better standards of living (CoW, 2008a). Urban population growth in Namibia is also influenced by the migration of people from other countries, for example, the neighbouring countries of Angola and Zimbabwe, and other countries such as China that invest in business. It is clear that there is a link between waste and socio-economic development; therefore as the population increases, the amount of waste generated increases too (Henry *et al.*, 2006; SoER, 2001; SWMD, 2008).

This further puts pressure on the disposal facilities (CSA & Smith, 2007).

There are a number of relevant waste management principles that contribute to reduced waste volumes (Christiansen, 1999; EMA, 2007; Fatta & Moll, 2003; Guiao, 2008; Jacobsen & Kristofferson, 2002; STC, 2008; NEMWA, 2008; SoER, 2001; Vito & Reibstein, 2008; Winchester *et al.*, 2002). However, it is questionable whether their values have been realized. And if so, it is questioned as to whether they are being implemented in Namibia, particularly because some town management systems seem to be ineffective when it comes to addressing waste. Individual towns need to place more efforts in the management of waste in order to prevent and minimize waste for the purpose of reducing environmental impacts that may result due to increasing waste volumes (Jacobsen & Kristoffersen, 2002; WGB, 1998a). If at all possible, a waste management system that could be implemented by all towns needs to be developed. After all, Namibia can only be a better place to live provided that sound waste management is encouraged.

This research attempted to answer the following question:

How can Namibia maintain a well-managed system for municipal waste management in future?

1.3. Research Aim

The overall aim of this research was to investigate how waste is being managed at the municipal level in Namibia, in order to recommend a possible system for handling waste across urban Namibia in future.

1.4. Objectives

The specific objectives were to:

1. identify the principles of waste management being used in Namibia;
2. identify the stakeholders of waste management in Namibia;

3. establish an understanding of the waste management system in Windhoek;
4. identify areas of improvement in terms of waste management in Namibia.

1.6. Methodology

The researcher worked closely with various town municipalities in Namibia in order to get an idea of how waste is being managed at the municipal level. The towns where the surveys were conducted are: Lüderitz, Mariental, Oshakati, Ongwediva, Ondangwa, Oranjemund, Otjiwarongo, Swakopmund and Windhoek.

1.6.1. Research Design

The researcher conducted an empirical research that is both qualitative and quantitative, which presented original research findings (Maree, 2008; Mouton, 2001). It is qualitative in the sense that it aimed to explore the real situation concerning waste management in various towns of Namibia. Two types of qualitative research designs were involved: action research and case study research. Action research is acknowledged as a research method that is collaborative and participatory, focusing on a practical problem experienced by participants for whom a practical solution is sought (Maree, 2008). The action research is qualitative particularly because it strongly focuses on understanding the problem and is explicitly committed to the empowerment of the participants, and will in the end contribute to changing their current situation (Mouton, 2001).

The case study research was used as an approach to establish an understanding of the concerned situation (waste management at the municipal level) by focusing on a specific town instead of being general. Windhoek was selected as a case study for this research. Such an approach aimed to investigate, describe and explain the phenomenon of interest through obtaining different view points as the researcher interacted with various participants (Maree, 2008). This approach helped the researcher to develop an understanding of the dynamics of waste management systems for Windhoek, and in general.

Apart from obtaining the qualitative data, the research also involved an objective process, which aimed to collect numerical data from a focal population (Windhoek), in order to generalize them at a broader scale i.e. for the entire country; hence quantitative. This type of research was non-experimental since it only aimed to describe the situation at hand without being manipulative (Maree, 2008).

1.6.2. Data Collection Strategy

Primary data were collected for this research. These are new/original data collected through the self-administered questionnaire, interviews (face-to-face and telephonically) and through personal observations as described by Maree (2008) and Newman (1999). However, secondary data from past studies were also used for the purpose of quantification.

Each of the surveyed town was provided with a self-administered questionnaire that presented questions concerning the required information. These were shared with respondents electronically. When necessary, follow up questions were asked through emails or over the phone. Prior to the development of the questionnaire, the researcher approached the selected towns with a question: *How is waste being managed in your town*? This question was rather broad, which caused many people to find it difficult to respond. As a result, the researcher rather simplified the main question, by breaking it down to many different questions that were rather straight to the point (see Annex I).

The interviews aimed to obtain rich descriptive data that helped the researcher to get broader inputs based on the participants' knowledge (Maree, 2008). Direct observations also helped the researcher to gain some insight on the issues of interest concerning waste management, for example, how waste is collected, transported, recycled, treated and disposed. This included on-site visits. Such an approach helped to validate the data collected through other methods (Mouton, 2001).

1.6.3. Sampling Design

For the purpose of selecting the study population, the stratified purposive sampling method was used. This method was used because the researcher was interested to work with participants who are knowledgeable about the waste management systems in their respective towns at the municipal level (Maree, 2008). Given their equal selection probabilities, the surveyed towns were randomly selected in order to provide the required data. Out of 31 towns of Namibia, 11 (35.5%) were selected, of which only 9 (29.03%) actively participated in the research. The researcher therefore used a proportion of 29.0% as a representative sample to generalize its results to the entire population. Such a proportion was deemed valid because it gave an idea of how waste is managed in Namibia in general, particularly because a case study research design was also involved, which presented a broader view on waste management systems. This helped the researcher to achieve the research aim.

1.6.4. Data Analysis

The qualitative data collected from various towns were summarized to help the researcher to understand and interpret what could be deduced from them. With such data the researcher was able to get an insight of how waste is being handled as well as to identify the areas that need improvement. In terms of the quantitative data, the researcher gathered numerical data, particularly with respect to waste generation, from which waste indicators were calculated. This information helped the researcher to propose a waste management system for Namibia and to answer the research question.

1.7. Limitations to the Research

Getting an overview of waste data from different sources such as industrial waste, commercial waste and household waste, particularly the quantities of wastes generated, treated, recycled or disposed of would have added value to the findings of this study. However, the researcher could not obtain data on industrial and commercial waste, since they are handled by private companies. Such information is not publicly shared.

1.8. Research Ethics

This research was conducted as response to the current situation of the need to effectively manage waste as an approach to promoting urban sustainability in Namibia. The research attempted to collect all the relevant data regarding waste management in Namibia, and specifically in Windhoek which was used as a case study. The aim was to come up with recommendations on a possible system that can be applied across Namibia in future. In the end, the research findings will be shared with all relevant waste management stakeholders.

The ethical issues of consideration for this research are:

- the identities of the questionnaire respondents have not be revealed;
- the dissertation has not revealed the towns that have demonstrated some weaknesses in terms of waste management practices, instead, statistics were used to present the proportions of those towns;
- most relevant stakeholders were consulted; and
- the use of other people's work has been acknowledged (Maree, 2008; Mouton, 2001).

CHAPTER 2: THEORIES OF WASTE MANAGEMENT

2.1. Introduction

On a global scale, waste management is a serious environmental concern. This is due to the fact that waste is a threat to the environment, as it can have negative impacts when not managed. In fact, most cities in Southern Africa are challenged by the increasing volumes of waste (Hope & Lerokwe, 1999). Waste can cause health hazards, smell nuisance, pests, diseases and other environmental problems if not well managed (Moningka, 2000). Waste from various sources such as sewers, septic tanks, pit latrines and disposal sites can also contaminate surface and groundwater, and this can adversely affect public health (CoW, undated; DWAF, 2004; Henry *et al*., 2006; Winblad & Simpso-Hébert, 2004). Consequently, it has become crucial for waste management to be placed as a priority especially that it is an environmental, social and economic issue (Aziegbe, 2007).

Responsible waste management promotes environmental quality, contributes to sustainability and provides support to economic productions (Henry *et al*., 2006). It involves implementation of measures that afford protection of human health and the environment at large, including: collection, transportation, processing, recycling, disposal, onsite handling, storage, treatment and monitoring of waste (Starkey, 1998). Waste management also involves prevention and minimization of waste (Jacobsen & Kristoffersen, 2002). Furthermore it involves handling of solid, liquid, gaseous or radioactive substances that may originate from domestic, commercial or industrial activities. Overall, waste is handled by a wide range of stakeholders i.e. those individuals, authorities, institutions and organizations that have a stake in waste production and management (Anschützi, 1996; Aziegbe, 2007; Berchtold, 2002; STC, 2008). It is also important to note that handling of waste is a legal issue as far waste management is concerned. Eventually, handling of waste has been placed as a priority by legal frameworks at the national and international levels.

The definitions of waste as a single term vary from country to country. For the European Union (EU), waste is regarded as all items that people deem no longer have any use for them, which they either intend to get rid of or already discarded (Anon a., undated). Waste in the EU also refers to all items which people are required to discard, for example by law because of their hazardous properties. According to the South African Environmental Management Waste Act 59 of 2008, *waste means any substance, whether or not that substance can be reduced, re-used, recycled and recovered that is surplus, unwanted, rejected, discarded, abandoned or disposed of; which the generator has no further use of for the purposes of production; that must be treated or disposed of; or that is identified as a waste by the Minister by notice in the Gazette, and includes waste generated by the mining, medical or other sector, but a by-product is not considered waste; and any portion of waste, once re-used, recycled and recovered, ceases to be waste* (NEMWA, 2008). In the Namibian context, waste is referred to as *any matter whether gaseous, solid or liquid or any combination thereof, which is from time to time listed by the Minister by notice in the Gazette or by regulation as an undesirable or superfluous by-product, emission, residue or a remainder of any process or activity* (EMA, 2007). More other definitions exist in individual countries; however, they are all making a common point, that waste is unwanted, and should therefore be managed.

Different types of wastes are produced by day-to-day human activities. Such waste can be classified as: municipal waste, commercial waste, industrial waste, household waste, hazardous waste, radioactive waste and other wastes. These are all in dire need of effective management. For the purpose of this dissertation, some waste management terminologies have been defined for clarification (see Table 2.1).

Table 2.1. Waste management terminologies definitions

	TERM	DEFINITION
TYPES OF WASTE	Municipal waste	*Waste collected by municipalities independently of the source of waste.*
	Industrial waste	*Type of waste produced by industrial activities.*
	Household waste	*Waste normally generated from houses.*
	Commercial waste	*Waste generated by commercial activities.*
	Hazardous waste	*Waste that could be an immediate threat to either human health or the environment.*
	Radioactive waste	*Waste containing radioactive elements.*
	Other wastes	*Unclassified discarded materials that have no value to the user.*
WASTE MANAGEMENT PRACTICES	Waste reduction	*Reducing waste in terms of quantity.*
	Waste minimization	*Reducing waste at its source, before it is even generated and through environmentally sound management practices.*
	Waste prevention	*Measures aiming at reducing the quantity and the harmfulness of wastes to the environment.*
	Waste treatment	*Processes (physical, thermal, chemical or biological) that change the characteristics of waste in order to reduce its volume or hazardous nature, facilitate its handling or enhance recovery.*
	Waste disposal	*Any waste management operation serving or carrying out the final treatment and disposal of waste without any intention to negatively impact the environment.*
	Recycling	*Reprocessing of waste materials for the original purpose or for other purposes.*
	Re-use	*Any operation by which products are used on more than one occasions for the same purpose for which they were conceived or for other purposes, without the need for reprocessing.*

2.2. Fundamental Principles of Waste Management

In order to avoid adverse impacts of waste in the environment, various waste management strategies that afford the protection of human health and the environment are implemented. Such strategies present the waste managers with challenges and opportunities of handling waste, as each strategy is applied based on the nature and amount of waste being handled (Christiansen, 1999). Waste management strategies are prioritized by individual choices, and this contributes to

achieving other priorities such as issues related to health, urban governance, employment, tourism development and resource recovery (RMG, undated; Soni, 2005). Moreover, responsible waste management requires a development of legal frameworks that set out laws and regulations specifically geared towards responsible implementation of the waste management strategies. The following waste management strategies are implemented in efforts to manage waste and for the purpose of reducing the environmental impacts of waste: 1) prevention of waste generation, 2) waste recovery (recycling, re-use and waste treatment) and 3) disposal of waste in an environmentally safe manner. In fact, this is the waste management hierarchy.

In essence, the principles of waste management aim to promote sound environmental management. Consequently, if applied appropriately, important issues of concern such as protection of human health, protection of the environment at large, protection of resources for future generations as well as reduction of burdens for future generations will be addressed (Christiansen, 1999; Fatta & Moll, 2003; Jacobsen & Kristoffersen, 2002; STC, 2008) . Apart from the waste management strategies highlighted above, more other principles for responsible waste management have been developed, including: 1) the “polluter pays principle”, which requires the waste producers to pay for the waste generated or the damage caused; 2) the “user pays principle”, which requires the user of resources to pay the service providers for services offered on the management of the resources; 3) the “product-stewardship principle”, which requires the waste producer or importer of a waste product to take responsible steps towards the minimization of environmental impacts of the product; 4) awareness raising principle, which alerts the public of the consequences of irresponsible waste management and promotes the reduction of waste; and 5) the sustainable use of resources principle, which contributes to the reduction of waste in the environment (Vito & Reibstein, 2008; EMA, 2007; Guiao, 2008; NEMWA, 2008; SoER, 2001; Winchester *et al*., 2002). Such principles, along with the waste management

hierarchy are implemented as efforts to fight the increasing waste volumes, wasting of resources and the negative environmental impacts.

2.2.1. Waste Management Hierarchy

The waste management hierarchy (as shown in Figure 2.1) emphasizes that waste prevention should be an ultimate goal for any approach to waste management; after which the other options (recycling, re-use and treatment) can follow (STC, 2008). Thus if the hierarchy is effectively implemented, the waste to be disposed of after the first three hierarchical levels will be minimal.

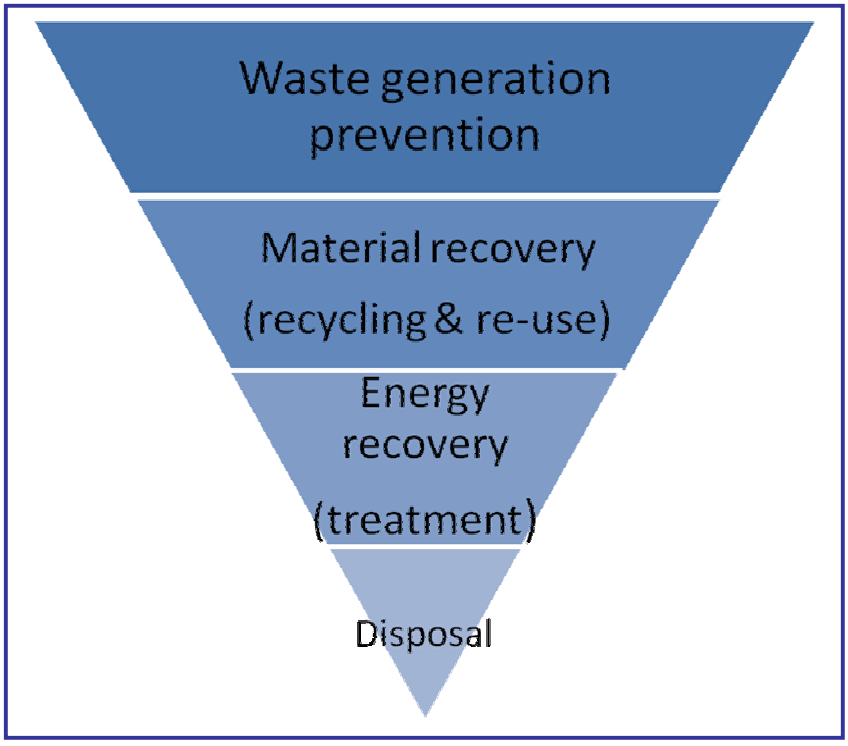


Figure 2.1. Waste management hierarchy

The waste management strategies presented in Figure 2.1 should be viewed as being interconnected. Ultimately their hierarchy can be compared to the web of life where the members of species communities are interconnected within ecosystems (Capra, 1996; Capra, 1999). Communities operate as networks and are well organized. According to

Capra's interpretation, ecosystems do not generate any waste. One species' waste is another species' food. This relationship can be related to the hierarchy of waste management, in which waste is passed between different hierarchy levels. What is discarded as waste in the first level is regarded as a resource in the second hierarchy level, while what is produced as waste from material recovery is fed into the third level for treatment; whereas the residue resulting from waste treatment is finally disposed of in the fourth level. Waste that cannot be treated or recycled can as well be disposed (Rousta, 2008).

2.2.1.1. Waste Prevention

In general, good waste management should start with preventing waste from being generated (Jacobsen & Kristoffersen, 2002). This waste management strategy is a crucial aspect of sustainable urban management, as it reduces the amount of waste being produced, while at the same time providing environmental protection. Reduction of waste is essential, given the fact that waste causes some pressure on the environment, including; leaching of nutrients, use of land for landfills, emission of greenhouse gases, air pollution, water pollution and secondary waste streams (Christiansen, 1999; STC, 2008; SWMD, 2008). According to Jacobsen & Kristoffersen (2002), waste prevention should be placed as a high priority in waste management, particularly because it is the best way to stop the accumulation of waste and to reduce loss of resources. Preventing waste can be made possible through implementation of legal frameworks. However, forecasting the accuracy of such frameworks, for example policies is not possible (Christiansen, 1999). It is advisable that waste prevention should start at the source; which includes changing the mindset of handling waste, for example, shifting to cleaner production processes, using fewer resources in products and influencing consumer choice and demand in the market place in favor of less wasteful products and services (CEC, 2001). Berchtold (1995) has demonstrated proven profits from clean technologies for production industries. Responsibility over this waste management strategy lies in the hands of governments, local authorities and businesses (Botten & Walmsley, 1994).

2. 2.1.2. Recycling and Re-use of Waste Materials

Waste materials can be recovered through recycling and re-use processes. Recycling is a strategy used to recover value from waste for consumption (Starkey, 1998). Re-use refers to making use of discarded waste material products. These are waste minimization strategies that are implemented in order to reduce the amount of waste being generated (Jacobsen & Kristoffersen, 2002). They are essential, particularly for the fact that they reduce the impact of waste in the environment. Even so, they are not 100% efficient. Recycling for example causes negative impacts on the environment through emissions as a result of waste material processing (Christiansen, 1999). As a strategy to reduce the life-cycle impacts of products, the use of materials that can easily be recycled is practiced (STC, 2008). Practically, recycling benefits the environment by reducing the use of virgin materials as well as toxicity in some instances (Rousta, 2008). In addition, recycling recovers a lot of waste while causing less waste to be disposed (Lorek *et al.*, 2001).

In the view of re-using waste materials, discarding of materials to the waste stream is avoided, as this strategy does not require processing. As a result, re-use of waste materials can be of environmental benefit. Nevertheless, in any case the re-use of non-hazardous waste should consider the potential risk to human health and the environment at large (Townsend & Carlson, 1997).

2.2.1.3. Waste Treatment

Third ranking in the waste management hierarchy, waste treatment is considered for the purpose of reducing the waste volume or its hazardous nature (Jacobsen & Kristoffersen, 2002; Menge, 2009; WIP, 2009). Such a waste management strategy enhances energy recovery from waste through physical, chemical, biological or thermal processes. Any waste management method or technique that has been designed to change the physical, biological or chemical character of waste composition or recover/reduce the toxicity of waste in order to minimize the impacts of waste in the environment plays a role in waste treatment (WIP, 2009).

Treatment of waste is made possible through the use of various technologies, one of which is incineration. In this technique, waste is converted to gases or residues by thermal means. Incineration has been acknowledged as a useful way of recovering energy, while at the same time reducing the negative environmental impacts components, for example methane (Farah, 2002). According to Farah, approximately 70% of waste mass can be reduced, while about 90% of waste volume can be reduced through incineration. Despite its positive impacts, incineration can have negative environmental impacts, which can result from the emissions and solid residues produced and through the utilization of solid residues (Lorek *et al*., 2001). Apart from incineration, other waste treatment means can also have negative impacts on the environment for example soil pollution, which can cause groundwater pollution in the end.

In situations where water is scarce, wastewater can be treated and re-used to meet the water shortage and increasing needs (du Pisani, 2006; FAO, 2003; Menge, 2006). Wastewater treatment is a process through which contaminants are removed from wastewater and household sewage. Such a process may involve physical, chemical and biological processes to remove physical, chemical and biological contaminants (Menge, 2006; Wikipedia, 2009a). Through various stages of treatment, floating materials such as grease and oil are skimmed off; while the biological contents, for example, those derived from human waste, food waste, soaps and detergent are degraded. The organic materials and suspended solids are also removed. In the end, a liquid sludge is produced, which is further treated before the final disposal (Oaeb *pers. comm*., 2009). So far there is no process that completely eliminates the need to dispose of solid residues/biosolids. In fact, wastewater treatment without residues would break the web of life, as described earlier, based on Capra's interpretation of the web of life. Biosolids can be of advantage because they can be used for other purposes, such as fertilizer or as energy carrier for incineration. Some wastewater treatment plants also use biogas from anaerobic treatment for plant operations or electricity production or both (Berchtold *pers. comm*., 2009).

Treated water can then be used for some purposes such as domestic consumption or for irrigation (du Pisani, 2006; FAO, 2003; Menge, 2009). If well managed, wastewater can have positive impacts on the environment and health. All the same, waste water can also have adverse effects on the environment and can have negative effects on soil, ground water, surface water bodies, crops and animal health (Mara & Cairncross, 1989).

2.2.1.4. Waste Disposal

The least prioritized strategy of waste management is waste disposal. In this method, waste is buried, deposited, discharged, dumped or released in places where they remain for the long-term. In many cases, urban solid or hazardous wastes are deposited or dumped in specially engineered landfills (DWAF, 1998). This method is used as a final step to dispose the waste that cannot be recycled or treated, together with the residue that comes from the collection, separation and other waste management activities (Rousta, 2008). Landfills are designed in such a way that they protect the environment. For this reason, landfill constructions include elements which control undesirable results, for example landfill leachate and greenhouse gas emissions (DWAF, 1998; McCreanor & Reinhart, 1997). The landfill method can however have negative impacts, given its potential to result in leaching of toxic substances and nutrients if practiced without proper environmental protection (Lorek *et al.*, 2001). Furthermore, dumping of waste in open spaces is said to be a poor waste management approach especially that it can have harmful effect to the water, land and air resources. Although disposal can be successful, it is only a temporary solution to the problem because when the lifespan of the landfill´s barriers against leaking of hazardous waste comes to an end, disastrous results are likely (Rousta, 2008). In order to enhance proper disposal, appropriate regulations need to be in place and implemented (Townsend & Carlson, 1997).

2.2.2. Waste Management Priorities

Priorities of waste management differ from country to country. This is due to the fact that every country does its things differently, has its own goal for waste management and has its own capacities of managing waste (Bogucka *et al.*, 2008; Brunner & Fellna, 2007). In this dissertation, four issues have been considered as priorities of waste management in general.

Waste management being one of the approaches to environmental management should be aiming towards sustainable development. According to Namibia's Environmental Management Act No. 7 of 2007, "*sustainable development means human use of a natural resource, whether renewable or non-renewable, or the environment, in such a manner that it may equitably yield the greatest benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations including the maintenance and improvement of the capacity of the environment to produce renewable resources and the natural capacity for regeneration of such resources*" (EMA, 2007). In fact, this Act has emphasized that all aspects related to the environment should promote sustainable development. Therefore, sustainable development should be seen as the number one priority of waste management.

Considering the integrity and the fragility of the environment, environmental protection is indispensable. As a result, establishing common policies along with standard implementation systems to promote a harmonious, balanced and sustainable development of economic (including waste management) activities contributing to a high level of protection and improving the quality of the environment should be placed as one of the top priorities; herein referred to as the second priority (EC, 2002). Most importantly, the environmental protection requirements must be integrated in the definition and implementation of such frameworks. Essentially this is what is being promoted by the legal frameworks currently in place and waste management principles, along with the waste

management hierarchy. It is important to note that waste management efforts are linked to the economy. Therefore, any waste management framework or system must take into account the status of the economy, since the quantity and composition of waste generated can impact on the costs involved in the management of waste (SoER, 2001; Mbande, 2003; Urio & Brent, 2006). Evidence is available, which proves that developed countries produce more waste than the developing countries, estimated at 1.5kg/person/day compared to 0.3 - 0.8kg/person/day in the developing countries (SoER, 2001). However, one needs to be careful when it comes to the waste statistics because they are uncertain. This is due to the fact that every country analyses the waste generated differently. Furthermore, promotion of sustainable development of waste management activities must consider stakeholder involvement in the process of identifying the priorities that are worthy of consideration in the implementation processes (WBG, 1998). In fact the stakeholders have a crucial role in the implementation of the political frameworks.

On the other hand, it becomes a challenge that in attempts to manage waste, some environmental problems such as pollution, emission of green house gases and health related problems are experienced (Christiansen, 1999). Consequently, taking into consideration the environmental impacts of any approach to waste management and that of the waste management systems is essential. Therefore, conducting environmental impact assessments of any waste management system is considered as a priority. Environmental Impact Assessment (EIA) is a process by which the effects of any operation on the environment are identified, assessed and taken into account (Jacobsen & Kristoffersen, 2002). Here, EIA is referred to as the third priority. Selection of landfill sites for disposal for example is one of the issues to be considered for EIA processes (Chipashvili, 2009). This should be done to eliminate or mitigate the possible impacts in the long-term.

Noteworthy, successes of the waste management systems in the long-term is not guaranteed. Therefore, keeping an eye on the waste management systems is essential, which can be made possible through thorough environmental monitoring processes (DWAF, 1998; Maynard *et al*., 2009). Environmental monitoring includes a collection of environmental data and assessment of the environment itself, which allows one to take note of any change after a certain environmental management approach has been carried out. Of particular importance is the fact that unexpected consequences of implementing waste management strategies in place can be experienced in the environment (Christiansen, 1999). Environmental monitoring in this dissertation is therefore considered as the fourth priority of waste management.

Having the above four priorities in mind, sound management of waste management in the long-term is likely. After all, effective waste management will contribute to sustainable development. Figure 2.2 below shows a connection of the four priorities of waste management considered by this dissertation.

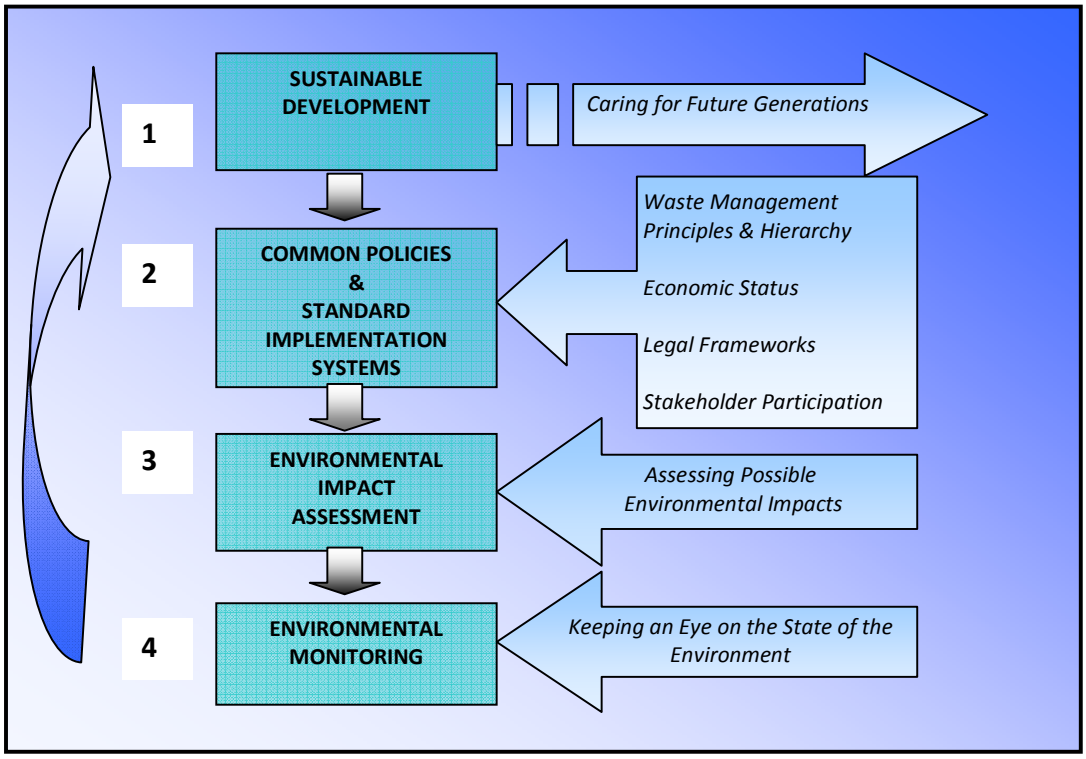


Figure 2.2: Four priorities of waste management

Ensuring sound waste management also demands that the environment should be effectively managed. This may require the use of ISO 14001* standard, which aims to bring about continual improvement over time, as demonstrated in Figure 2.3. below (Starkey, 1998). Such a standard can be used as a benchmark to implement sustainable practices of waste management (STC, 2008).

* ISO 14001 is a standard for environmental management systems that is to be implemented in any business, with an aim to reduce the environmental footprint for that business and to decrease the pollution and waste the business produces (Wikipedia, 2009b).

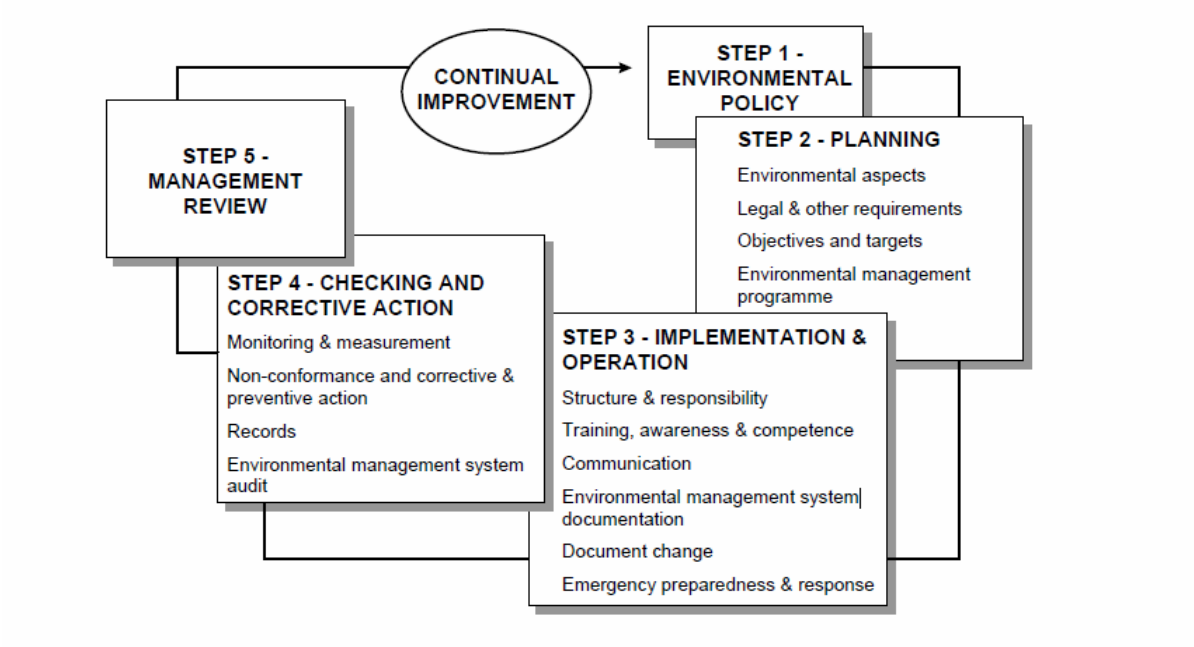


Figure 2.3. Five steps of ISO 14001

(Source: Starkey, 1998)

The five steps in the above diagram can be interpreted as:

Step 1: A policy for the target environmental aspect should be in place.
Step 2: Planning for relevant aspects (as listed) should be considered.
Step 3: Relevant tools for implementing environmental management systems should be in place.
Step 4: Procedures for checking and taking corrective action should be in place.
Step 5: Management reviews should be conducted, which are to address the possible needs for changes in the policies and other environmental management systems.

(Starkey, 1998)

2.3. Responsibilities over Waste

As mentioned earlier, waste management has become an environmental concern particularly due to the fact that waste is an environmental threat. It is worthwhile to note that any environmental concern is the context of everything else, including human lives, business and politics (Capra & Pauli, 1995). Therefore in any approach to environmental management including waste management, it is essential to integrate social, political, economic and environmental issues. Integration of such issues can be achieved through the engagement of various stakeholders in waste management and the use of legal frameworks.

2.3.1. Role Players in Waste Management

Responsible care of the environment should not only lie in the hands of one entity, it should be participatory. In fact, responsible care of the environment can be termed as '*responsible environmental behavior (REB)*'. Agbarachi (2009) has referred REB to as a behavior that is concerned with what is right; meaning that the behavior towards waste management should consider what is right about managing the environment. Participation as part of REB is an approach to development that has been defined as an organized activity of the people concerned (Theron, 2005). Such an approach brings together various stakeholders such as donors, governments, non-governmental organizations (NGOs), popular organizations and communities; while at the same time opening doors for them to learn from each other (Blackburn, 1998). Eventually when considering the issue of waste management, it is crucial to identify the stakeholders in the waste management systems. Stakeholders in waste management should include the waste producers, waste management institutions, environmental management institutions and organizations, donors and policy makers. Examples of waste management stakeholders are: local authorities, city councils, central government, NGOs, CBOs, members of the public, private informal sector, private formal sector, businesses and donor agencies (van de Kludert & Anschiitz, 2000). Such stakeholders contribute to creation, management

and disposal of waste, thus it is essential that they recognize the benefits of waste management and their roles in dealing with waste (STC, 2008).

Having identified the role players in waste management, one can go to the extent of putting into practice the concept of integrated sustainable waste management (ISWM), which refers to a waste management system that best suits the society, economy and the environment in a given location (van de Kludert & Anschiitz, 2000). The ISWM approach takes into account various aspects including technical, environmental, financial, social, institutional and legal; which all have roles to play in the management of waste. Therefore the waste management stakeholders each have a stake within the above aspects, which contributes to achieving meaningful and sustainable ISWM (Henry *et al*., 2006). Stakeholders' roles include: use and waste recovery or disposal, offering financial support through capital investments or granting of loans and insurance services; being part of awareness raising campaigns, participating in consultations, administration, decision-making, management of waste services and development of policies (Anschützi, 1996; Aziegbe, 2007; Berchtold, 2002; Berstein, 2004; EC No. 761, 2001). Waste management primarily lies in the hands of local authorities; however, not all of them meet the needs of businesses (Hope & Lerokwe, 1999; STC, 2008). Thus it is advised that local authorities focus on the coordination and monitoring of the services that they provide, while other stakeholders concerned with collecting, processing, treatment and disposal of waste should collaborate on all aspects of the waste management hierarchy.

The Municipality of Windhoek in Namibia has recognized the importance of involving a wide range of stakeholders. Overall, municipal waste across Windhoek is managed by the Solid Waste Management Division and the Division of Bulk Water and Waste Water within the City of Windhoek. However, the Solid Waste Management Division employs people, contractors and volunteers to work as

custodians for solid waste (CoW, undated). Hazardous waste is handled by private companies as well as concerned government ministries (UN, 2002).

2.3.2. Legal Framework

With the sustainable development concept in mind, plans for future waste management should be included in the political agenda, particularly considering the fact that politics has a big role to play in sustainable development. Today, national policies reflecting waste management systems are developed and adopted to serve as legal frameworks in efforts to contribute to sustainable waste management. In essence, such frameworks should incorporate the waste management hierarchy, while at the same time maximizing social, economic and environmental benefits (RMG, undated). They address issues related to integrated waste management; including all aspects of waste management, waste management systems and the roles of stakeholders. In addition they set long-term aspirations with regard to waste management legislations and activities (EMA, 2007; Fatta & Moll, 2003; NEMWA, 2008; STC, 2008). Overall, legal frameworks are needed to minimize the impacts of waste and waste management in general, as some waste management strategies contribute to waste generation in the implementation process (Christiansen, 1999). Responsibilities over the establishment of regulatory frameworks lie in the hands of the authorities (Jacobsen & Kristoffersen, 2002).

2.3.2.1. Policies, Laws and Regulations

At the national and regional levels, policies, laws and regulations are put in place in an attempt to regulate waste management. Such legal frameworks are developed and implemented in order to promote environmental management in general, as they are concerned with reducing the impacts of waste and waste management on the environment. They provide guidelines on the handling of waste; including the waste service standards, institutional and planning matters, priorities of waste management, waste management measures, dealing with different types of waste, aspects of the waste management hierarchy as well as

penalties pertinent to any damage caused by mishandling of waste (EMA, 2004; EMA, 2007; NEMWA, 2008; KV3, 2006; STC, 2008; Tjela, 2006). It is however argued that policies geared towards reducing waste are meaningless if they are not based upon the waste streams involved (STC, 2008). For this reason, it should be worthwhile to make amendments on the legal frameworks currently in place, in order to base the management of waste on the waste streams involved. Policies specifically are subject to change, based on the conditions of the issues to be addressed (Meyer & Cloete, 2000).

The management of waste is now moving towards a more holistic and sustainable approach, with much emphasis being placed on the environmental impacts of waste materials and products throughout their lifetimes (STC, 2008). Consequently, waste management is being integrated in the legal frameworks that are promoting sound environmental management, including a sustainable management of resources. This is evident in the EU, where waste is increasingly being integrated into the policy field of sustainable resource management. Such an approach is viewed as a shift from an 'end-of-pipe' treatment of the waste towards the front of the waste policy hierarchy i.e. waste being prevented through efficient use of resources (Fatta & Moll, 2003). Sustainable use of resources as an approach to waste management is also promoted by the South African Environmental Management Waste Act 59 of 2008 and the Namibian Environmental Management Act No. 7 of 2007. As a result of this approach, volumes of waste generated are reduced through improved waste prevention measures, improved resource efficiency and a shift to more sustainable consumption patterns (Fatta & Moll, 2003). Given its high priority in the waste management hierarchy, waste prevention is regarded as a key element in the waste management policies; especially due to the fact that waste volumes are ever increasing (CEC, 2001).

Policies, laws and regulations vary from country to country, based on the issues of priority. However, these can be successful if properly implemented. A lesson of a good legal framework can be learned from the EU waste regulations, which are applied by the Member States (see Table 2.2).

Table 2.2: EU regulations related to the prevention and management of waste

Source: STC, 2008

Directive	Description
Waste Framework Directive	*Provides a legislative framework for collection, transport, recovery and disposal of waste for all EU Member States.*
Packaging and Packaging Waste Directive	*Obliges businesses which have a turn over of more than £2 million and handle at least 50 tonnes of packaging in a year to recycle and recover a prescribed proportion of their packaging waste, with minimal environmental impact after disposal.*
End of Life Vehicles (ELVs) Directive	*Requires vehicle manufacturers and importers to set up networks of authorized treatment and facilities to provide free take back schemes for vehicles, so that at the end of a vehicle's life, the vehicle can be re-used, recycled or recovered.*
Waste Electrical and Electronic Equipment (WEEE) Directive	*Require producers of certain categories of electrical and electronic equipment to register with a producer compliance scheme and pay the compliance scheme to dispose of their waste products appropriately, including the treatment, re-use, recovery or recycling of components where necessary.*
Restriction of the Use of certain Hazardous substances in electrical and electronic equipment (RoHS) Directive	*Restrict the use of some hazardous substances (e.g. lead, cadmium, hexavalent chromium, mercury, polybrominated biphenyl ethers) in electrical and electronic products, as they may have negative impacts at the end of their lives.*
Eco-design of Energy-using Products (EuP) Directive	*Allow the setting of requirements for designers to consider the energy efficiency and environmental impacts of their producers at the design stage.*
Batteries and Accumulators and Waste Batteries Accumulators Directive	*Obliges producers to meet the cost of collecting, treating and recycling waste batteries and accumulators, with the aim of reducing their lifetime environmental impacts and promoting the recovery of materials within them.*

Co-operation on legal frameworks such as this can work well between countries if well maintained. The same could potentially work for the countries in the southern African sub-region. Such a co-operation can either be established through a development of regulations on handling common waste or through a harmonization of environmental laws. With such an approach, countries in cooperation can effectively manage waste through the use of standard guidelines. In particular, for those countries that do not have formal means for handling some types of waste, it would be an advantage to be involved in cooperation such as the one being implemented by the EU Member States. Lesotho for example, up to 2006 did not have any formal means of dealing with hazardous waste (Tjela, 2006). It would have been beneficial if there were standard regulations or a standard policy or law for the Southern African countries for dealing with hazardous waste, which Lesotho could adhere to.

2.3.2.2. International Agreements and Conventions

Apart from regulating waste at national and regional levels, international agreements have been put in place to address the issue of waste management at the international level. Such agreements each have a role to play in the management of waste and the environment at large, as they emphasize certain laws, rules and regulations as well as guidelines to be followed by all countries that are signatory to them. Examples of international agreements and conventions that are of relevance to waste management are given in Table 2.3 below.

Table 2.3. Examples of International Conventions of relevance to waste management

Convention	Description
Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal, 1992	*Agreed to ensure environmentally sound management of hazardous waste and other wastes through the reduction of their movements, for the purpose of reducing their impacts on human health and environment.*
London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972	*Agreed to promote the effective control of all sources of marine pollution and to take all practicable steps to prevent pollution of the sea by dumping of wastes and other matter.*
International Convention on Oil Preparedness, Response and Cooperation, 1990	*Agreed to promote the use of precautionary measures for maritime safety and to prevent oil pollution and marine pollution.*
Washington Declaration on Protection of Marine Environment from Land-based Activities, 1995	*Agreed to protect and preserve the marine environment from all land-based activities that may threaten human health and well-being, as well as the integrity of coastal and marine ecosystems and biodiversity.*
UN Convention on the Law of the sea, 1982	*Agreed to protect and preserve the marine environment including the seabed, ocean floor, subsoil and the resources in the environment.*
International Convention on the Prevention of Pollution of the Sea by Oil, 1954	Agreed to prevent sea pollution by oil discharged from ships.
International Convention on the prevention of pollution from ships (MARPOL), 1978	Agreed to prevent pollution of the marine environment by ships from operational and accidental causes
International convention for the Control and Management of Ships' Ballast Water and Sediment, 2004	Agreed to prevent, minimize and eliminate the transfer of harmful aquatic organisms and pathogens through the control and management of ships' ballast water and sediments.

Furthermore, agreements can be strengthened between countries through the use of Treaties to establish Communities (formed by countries in agreement); as practiced by the European countries (EU, 2002). Through such Treaties, the Communities can establish common policies promoting environmental protection and sustainable development, while at the same time incorporating important development matters such as socio-economic issues, for example, poverty reduction, employment creation, social protection, inequality reduction, protection of human health and the wise use of natural resources. In addition such policies should consider the measures that need to be in place to deal with regional and international environmental problems. As part of such policies, the environmental protection requirements must be integrated into the definition and implementation of the Community policies, considering the diversity of situations of among the Member Countries of the Community. The Member Countries should then be expected to cooperate at the community level and internationally, in terms of economic, financial and technical aspects. All agreed policies should be adopted by a selected Council, while the Community and Member Countries should coordinate their policies on development cooperation and must keep consulting each other on any important matters.

2.4. Conclusion

Waste management is a serious environmental concern. There is no standard definition of waste; definitions vary from country to country, and different types of waste are produced by daily human activities. As an approach to waste management, a four level hierarchy is followed when dealing with waste. In the order of priority; waste prevention, material recovery, energy recovery and disposal are the different levels of the waste management hierarchy. The first three levels of the management hierarchy are aiming at reducing the waste volumes, while the fourth level is the final disposal of waste products from the other levels. Further to the hierarchy, other guiding principles are in place to promote sound waste management. In addition, this dissertation has considered four priorities of waste management as: sustainable development, avoidance of

negative environmental impacts, environmental impact assessment, and environmental monitoring. Ensuring sound waste management also requires effective environmental management, which can be made possible though the implementation of the ISO 14001 standard. In actual facts, all waste management strategies are aiming towards contributing to waste reduction and environmental protection. Even so, despite their good intentions, negative impacts are experienced. Nevertheless, with responsible waste management stakeholders and legal frameworks in place, implementation of waste management strategies can be a success story.

CHAPTER 3: NAMIBIA

3.1. Introduction

Namibia is located in southern Africa, sharing boundaries with Angola, Botswana, South Africa and the Atlantic Ocean to the north, east, south and west respectively. Its surface area covers approximately 825 814 km^2, while its population has been estimated at 2.1 million inhabitants (PRB, 2008). Namibia is blessed with abundance of natural resources, both renewable and non-renewable, in which its economy almost entirely depends. It is rich in mineral resources, fisheries resources and has a diversity of terrestrial flora and fauna. Given its prosperity in resources, Namibia is classified as one of the resource-rich countries in southern Africa, and is not classified among the poorest countries in the world (Fosu & O'Connell, 2006; Marope, 2005). According to Gaomab (2005), Namibia is classified as a middle-income country, with per capita income of just over US$2,000.00.

As it is the case elsewhere in the world, environmental management is one of the developmental challenges in Namibia. This is particularly due to the fact that Namibia is faced by many environmental threats, which are in dire need of management. Generally, environmental threats are those factors that impact the environment negatively, in many cases resulting in environmental problems. Such threats include: pollution, food insecurity, population growth, heavy dependence on agriculture, increasing pressure on resources, land-use changes and urbanization (Hope & Lerokwe, 1999; Nyang'oro, 2001; Walmsley & Bottem, 1994). When not managed, such threats pose negative impacts on the environment, resulting in disasters such as: biodiversity loss, deforestation, desertification, species decline and extinction, health problems and diseases, climate change, land degradation and soil degradation (Miller, 2007; Nyang'oro, 2001; Troni, 2008; Walmsley & Bottem, 1994). On top of the above threats, poverty is another environmental threat on its own, as it plays a role in contributing

to environmental problems (Camagni *et al.*, 1998; Nyang'oro, 2001; UNFPA, 2001). This is due to the fact that the livelihoods of people living in poverty mainly depend on the environment.

Consequently, environmental management has been placed as a priority in Namibia. Environmental management is herein defined as the management of those activities that have or can have impacts on the environment (MET, 2008). It is a priority for the government ministries, NGOs, local authorities, private sector and communities. This is in line with what has been stressed by the Namibian Environmental Management Act No. 7 of 2007 that participation of all interested and affected parties in the management of the environmental issues of concern should be encouraged (EMA, 2007). Environmental issues being dealt with include: communal land management, protected area management, land degradation, water resources management, pollution control, waste management, biodiversity conservation, energy use, coastal management and climate change. The environmental issues of concern in Namibia are further addressed using alternative approaches to development i.e. through environmental management programmes and projects. Nonetheless, for the purpose of this dissertation, the focal environmental issue is waste management.

3.2. Socio-economic Situation in Namibia

Namibia is currently faced by the following challenges: high unemployment, poverty, income inequality, health issues and lack of skills (BoN, 2009a). These need to be addressed in order to put the national economy on the path of long-term growth. Namibia's economy depends on three major economic sectors: 1) primary (agriculture & forestry, fishing & fish processing, and mining & quarrying); 2) secondary (manufacturing, electricity & water, and construction) and 3) tertiary (including, wholesale & retail trade, hotels & restaurants, transport & communication, health, and education). In the view of the economic growth status, there has been a fluctuation in the economic growth performance on the economic sectors over the years. This is due to poor performance in the primary and tertiary

sectors, which contributed to the deceleration of growth in the real sector (BoN, 2009a). On top of that, Namibia's economy is affected by changes in the global economy.

In terms of the Gross Domestic Product (GDP), the government is the greatest contributor to GDP in Namibia (BoN, 2001; BoN, 2009a). Looking at the three major economic sectors, the tertiary sector makes great contribution to GDP, followed by the primary and secondary sectors respectively (see Table 3.1). Individual sectors in Namibia that make major contributions to GDP are: mining & quarrying, manufacturing, public administration & defence, education and agriculture & forestry (BoN, 2009b). Of these, mining is the greatest contributor to GDP in the private sector, mainly due to diamond mining. The above mentioned sectors also contribute to employment. The GDP per capita grows over the years. In 2004, the GDP per capita was N$21,328.60 millions, and has grown to N$23,596.30, N$27,117.00, N$30,304.00 and N$34,483.00 millions in 2005, 2006, 2007 and 2008 respectively (BoN, 2009a).

Table 3.1: Gross Domestic Product by Sector: Percentage contribution

Sector	Year				
	2004	2005	2006	2007	2008
Primary	*18.7*	*19.6*	*22.0*	*20.1*	*24.4*
Secondary	*17.3*	*17.5*	*19.7*	*21.8*	*18.9*
Tertiary	*56.9*	*55.6*	*51.9*	*51.8*	*50.8*

Source: BoN, 2009b

In the view of health, Namibia is challenged by the spread of the pandemic HIV and AIDS, reportedly wide-spread across the country. This pandemic is said to have greater implications in the national development, thus its spread has to be reduced, along with its effects (NPC, 2008). The vulnerability of HIV and AIDS is attributed to social factors such as: poverty, migrations, alcohol abuse and the social inequalities between men and women (LeBeau, 2009). Despite this

predicament, the Namibian health system has reportedly made greater progress when it comes to primary health care delivery (Gaomab, 2005).

Poverty in Namibia is more concentrated in the rural areas, mainly among the previously disadvantaged groups (NPC, 2002). As measured using data on the Namibia's household income and expenditure survey of 2003 and 2004, two poverty lines have been established for the "poor" and the "severely poor"; whereby the consumption levels per adults per month are lower than N$262.45 and N$184.56 respectively (CBS, 2008). Based on the above definitions, the household expenditure rate of the "poor" and the "severely poor" households has been estimated at 27.6% and 13.8% respectively. Given the poverty situation, a large number of people have limited access to basic services such as education, health, markets, public transport and schools. Part of this is the fact that poor households are generally further away from a wide range of administrative and infrastructural services; on average 14 km from hospitals and clinics, 7 km from the market, 32 km from the secondary school, 34 km from combined school, 6 km from primary school and 7km from public transport (CBS, 2008). However, major differences are obvious from region to region. Research has found that there is a gap between the rich and poor people in Namibia, and this needs to be closed (Gaomab, 2005; NPC, 2008). High levels of poverty in Namibia are also exacerbated by the high rate of unemployment, which is estimated to be over 30% (Vision 2030, 2004). One of the factors contributing to the high levels of unemployment is the lack of formal education opportunities, which is also attributed to high rates of drop outs in schools as well as poor quality education (Gaomab, 2005). Furthermore, the fact that there are only a few people with secondary education and fewer with tertiary education in the poor households has contributed to the high rate of poverty (CBS, 2008). Eventually, lack of skills leaves the uneducated people unable to be mainstreamed into the employment sector, due to the mismatch of skills with the available jobs (Vision 2030, 2004).

In its effort to develop the national economy, Namibia is now promoting the optimal and sustainable use of resources concept, in order to provide for the needs of its people (NPC, 2008). In terms of environmental management, Namibia is striving to ensure environmental sustainability through strengthening the management of its natural resources.

3.3. Namibia's Efforts towards National Development

Namibia is committed to promoting sustainable development; the development that aims to meet the needs of the present, without compromising the ability of future generation to meet their own needs (Glazewski, 2005). It has been clearly stipulated by the national Environmental Management Act of Namibia that sustainable development must be promoted in all aspects related to the environment. Sustainable development is of high importance in Namibia, especially due to the fact that many people are living in poverty and that the national population is growing. Population increase in Namibia has become a challenge because along with it competition over resources has increased (Ashley, 1994). Socio-economic factors such as slow social development, extreme poverty, environmental degradation and inadequate investment in human resource development also have impacts on sustainable development (NPC, 2008; UNDP, 2008; World Bank, 1990). Consequently, sustainable development will minimize the impacts of the competition over resources and will promote sound environmental management. In general, the sustainable development concept was developed as a result of the increasing human basic needs (food, clothing, shelter and employment), as well as the environmental problems affecting the planet due to human activities (Glazewski, 2005). Noteworthy, sustainable development is more concerned with the future generations (Currie & De Waal, 2005).

It is crucial that sustainable development should contribute to the needs of people, and to the national economy at large. Nonetheless, relying on economic growth solely is not enough to achieve sustainable development; institutional development, social development and natural resource management are also

essential (UNDP, 2008; World Bank, 1990). Furthermore, using policy and legal frameworks as well as stakeholder involvement in environmental management contribute to achieving sustainable development (Camagni *et al*., 1998; UNCHS, 1996; Walmsley & Bottem, 1994).

In its attempt to achieve sustainable development, Namibia has developed some frameworks which serve as guiding steps towards achieving the sustainable development goal. For the purpose of reducing poverty and inequality, a poverty reduction strategy has been developed, whose implementation is being guided by the National Poverty Reduction Action Programme (CBS, 2008; Vision 2030, 2004). Furthermore, Namibia is a global partner to the world's Millenium Development Goals (MDGs), the eight goals that have been agreed world-wide with an aim of responding to the world's main developmental challenges; targeted to be attained by the year 2015. The first of these goals aims to reduce poverty by half by the year 2015 (CBS, 2008).

One of Namibia's development frameworks is the 5 year national development strategy that has invested in developing what is referred to as 'National Development Plans (NDPs)'. Such plans focus on reviving and sustaining the economic growth. They also outline policies that are bringing together different economic sectors and are addressing Namibia's developmental challenges and sustainable development at large (LAC, 2004). The Namibian government has also formulated a long-term development framework called Vision 2030, whose goal is "*that the people of Namibia are well developed, prosperous, healthy and confident in an atmosphere of interpersonal harmony, peace and political stability; and as a sovereign nation, Namibia is a developed country to be reckoned with as a high achiever in the comity of nations. Namibia enjoys: Prosperity, Interpersonal Harmony, Peace and Political Stability"* (LAC, 2004:183). Namibia also has a formalized Constitution, the Supreme Law of Namibia, against which all other laws are tested. Furthermore, in its commitment to the concept of sustainable development, Namibia is a signatory to many international environment

conventions. Such conventions each has a role to play in the management of the environment and they all support the political will and commitment to the implementation of Namibia's obligations with respect to international treaties. Furthermore, Namibia as a global partner to the world's MDGs is aiming towards achieving the seventh goal 'ensuring environmental sustainability' that is aiming at promoting sound environmental management (Karuaihe *et al.*, 2008). Namibia is working towards achieving this goal at the national level through a number of projects and programmes.

When it comes to making decisions on matters related to the environmental management and sustainable development, the government through its ministries (e.g. MET, MAWF, NPC, MFMR, MRLGH, MME & MTI)†, NGOs and UN agencies engage. The Directorate of Environmental Affairs (DEA) under the MET is the leading agency for promoting sustainable development (UN, 2002).

3.4. Waste Management in Namibia

3.4.1. Overview

As much as environmental management has been prioritized in Namibia, the waste management approach has not been left out. Waste in Namibia needs to be managed especially because the national population is increasing, technologies are advancing and because there are many economic activities taking place; which all contribute to the production of waste. Additionally, waste needs to be managed in order to reduce waste production, reduce waste volumes, reduce negative environmental impacts and promote environmental health (CoW, undated; Henry *et al.*, 2006; EMA, 2007; OECD, 2008; UNCHS, 1996). It is also crucial to collect data on waste, as they can be used in planning, decision-making

† MET – Ministry of Environment & Tourism; MAWF – Ministry of Agriculture, Water & Forestry; NPC – National Planning Commission; MFMR – Ministry of Fisheries & Marine Resources; MRLGH – Ministry of Regional, Local Government and Housing, MME – Ministry of Mines & Energy; and MTI – Ministry of Trade & Industry

and to design effective policy measures (ETC/RWM, 2008). Data on waste can also be used in the preparation of the state of environment reports on waste management. Equally important is pollution control. Pollution needs to be controlled in order to reduce negative environmental and human health impacts resulting from the accumulation of waste volumes. Noteworthy, waste reduction by all means is a crucial aspect of sustainable development (Walmsley & Bottem, 1994).

In Namibia, waste management is a responsibility for all residents, local authorities, government ministries, private sector and businesses. As listed in Table 3.2, so far over 30 industries have been identified, that contribute to waste; therefore each having a stake in waste management (Mbendi, 2009).

Table 3.2. Industries that have a stake in waste management in Namibia

Industry	Industry
• Agriculture, Forestry and Fishing • Arts and Crafts • Automotive • Building, Construction and Civil Engineering • Chambers of Commerce • Chemicals • Computers and Communications • Development • Electrical Power • Energy • Engineering • Equipment • Exchanges • Exhibitions, Trade Shows and Conferences • Financial Services • Health Services • Leather • Manufacturing	• Media • Mining • Miscellaneous • Oil and Gas • Packaging • Professional Services • Public Utilities • Pulp and Paper • Real Estate • Security • Textiles and Clothing • Trading • Transport and Storage • Travel, Tourism and Recreation • Wholesale and Retail • Material Handling • Food, Beverages and Tobacco • Government

Source: Mbendi (2009)

To be specific, the stakeholders listed in Table 3.3 below have been identified as having significant roles in waste management (apart from municipalities and town councils), in towns that were contacted for the purpose of this dissertation.

Table 3.3. Identified stakeholders in various towns in Namibia

Town	Stakeholders	
Lüderitz	*Residents*	*Businesses*
	Institutions e.g. schools	*Recycling companies*
	Household owners	*Fishing companies*
	Lüderitz Refuse Management Project	*Commercial companies*
Mariental	*Various Businesses*	
Ondangwa	*Residents*	*Namibian recycling teams*
	Refuse removal contractors	*Vully Cleaning services*
	Cross-country cleaners	*Move-a-Mess*
Ongwediva	*Residents*	
	Businesses	
Oshakati	*Businesses*	*Schools*
	Namibia Beverages	*Financial institutions*
	Namibia Breweries Limited	
Oranjemund	*Enviroserv*	
	Oranjemund Recycling Company	
	Namdeb	
Otjiuarongo	*None was identified*	
Swakopmund	*Enviro-Fill*	
	Refuse Solutions	
	West Coast Recyclers	
	Scrap Metal	
Windhoek	*Schools and high learning institutions*	*Enviro-Fill*
	Rent-a-Drum	*Kleen Bin*
	Namibia Breweries Limited	*METRA*
	4H Namibia Project	*Khomas Recycling*
	Collect-a-Can	*Businesses*
	The Glass Recycling Company, etc.	

Despite the fact that there are many stakeholders for waste management in Namibia, waste management is priority for the government. Consequently, various government ministries (MET, MRLGH, MME, MAWF, MOHSS‡ & MWTC§) have

‡ MOHSS – Ministry of Health and Social Services

responsibilities over the management of waste, and are therefore committed to formulating policies and strategies regarding waste management and pollution control in Namibia (UN, 2002). Nevertheless, the overall responsibility over the management of urban waste lies in the hands of local municipalities and town councils. Such authorities work closely with the private sector and businesses (Schenck, 2009). Given the fact that different types of wastes exist (as defined in Chapter 2), they are dealt with differently by different ministries and organizations. Some of the wastes, such as hazardous wastes that cannot be handled by the local authorities are dealt with by the government and private companies (UN, 2002). Solid waste is primarily dealt with by the MRLGH through town municipalities, village authorities and local authorities. The hazardous waste and solid waste and sanitation are coordinated by MME, MRLGH and the MOHSS. Nevertheless, safe handling and disposal of waste has been identified to be a challenge in Namibia.

Furthermore, the '3R principle' has been placed as a priority in Namibia (see Figure 3.1). This is a principle that promotes the reduction, re-use and recycling of waste; whereby waste reduction is the first priority, followed by re-use and recycling of waste materials (Schenck, 2009; UN, 2002).

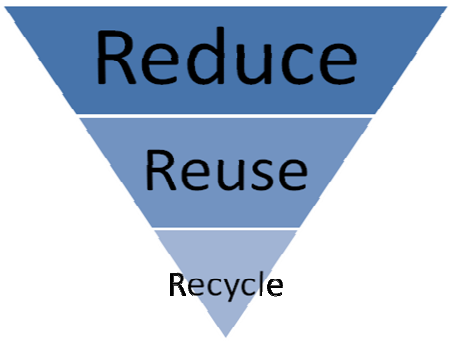


Figure 3.1: The '3R Principle' Hierarchy

§ MWTC – Ministry of Works, Transport and Communication

The government and the private sector use the media and primary schools to promote the concept of the '3R principle' through waste management awareness campaigns (Schenck, 2009; UN, 2002). This concept is essential because it aims to minimize waste volumes and their impacts. Reduce refers to the reduction of waste by all means. Re-use is a preferred waste management strategy since it does not involve processing, while recycling involves processing of waste materials to be used again. For the purpose of promoting recycling, various partners from the private sector, particularly the recycling companies have recently started up an initiative that encourages the use of bins for collecting recyclable products (Schenck, 2009). With such an initiative, recycling stations have been placed infront of various shopping centers, where the following types of waste products: cans, glass, papers and plastics are collected for recycling purposes. Today, this initiative is only operational in Windhoek, where it has been proven to work well. Plans are to spread it across to other towns of Namibia, however, some challenges associated with costs, waste transportation and management of services have been identified. Such challenges still need to be dealt with. The partners to this initiative are: Rent-a-Drum Group of Companies (Rent-a-Drum, METRA, Khomas Recycling and Kleen Bin), 4H Namibia Project, The Glass Recycling Company, Collect-a-Can, Namibia Manufacturing Association (NMA), the Namibia Environment and Wildlife Society (NEWS) and the Namibia Breweries Limited (NBL). This initiative has been acknowledged by the Department of Solid Waste Management within the Windhoek Municipality (Aloe, 2008). Overall, some of the companies dealing with waste in Namibia are presented in Table 3.4. below.

Table 3.4. Some of the waste management companies in Namibia

Company/Project	Role
Collect-a-Can	Recycling
Cross Country Cleaners	Refuse removal
EnviroServ	• Hazardous waste assessments • Refuse removal • Waste minimization and recycling • Landfill site development and operation • Equipment and plant hire • Composting • Container customization for all types of waste • Industrial cleaning
Enviro-Fill	Landfill site operation and monitoring
The Glass Recycling Company	Recycling
4H Namibia	Recycling
Lüderitz Refuse Management Project	Refuse removal
Move-a-Mess	Landfill monitoring
Oranjemund Recycling Company	Recyclable waste management
Refuse Solutions	Refuse removal
Rent-a-Drum Group of Companies (Rent-a-Drum, Kleen Bin, METRA, Khomas Recycling)	• Waste management audits • Recyclable waste management • Waste collection • Shredding of confidential documents • Cleaning and sanitizing containers • Skip removals • Fat trap removal • Medical waste removal • Tank oil & sludge collection • Frame Platform waste collection
Scrap metal	Recycling
Vully Cleaning Services	Refuse removal
West Coast Recyclers	Recycling

3.4.2. Municipal Waste Management

Municipal waste as defined in Chapter 2 is the waste collected by municipalities independently of the source of waste. It can also be defined as the waste collected by or on the order of municipalities (Sheshinski, 2001). Municipal waste includes waste originated from households, small businesses, institutions and communities. Knowing the statistics on municipal waste being produced and managed from various sources of origin is therefore essential for the purpose of monitoring, decision-making as well as for the development of waste policies (SWMD, 2004; SWMD, 2008). In addition, availability of regular and comparable data on recycling, re-use and disposal of waste plays a role in the implementation of waste management policies (SEPA, undated). However, of those towns contacted for the purpose of this dissertation, very few towns in Namibia have reliable waste statistics. At least the Ondangwa town has recorded that approximately 746.4 tons of waste is produced from 3000 households annually. Using the overall amount of waste generated annually in Ondangwa, it can be estimated that at least 0.14kg of waste is generated per person per day. This figure was calculated by dividing the total amount of waste produced per year in kilograms by the estimated population of 15,000[**] people in the town, which was further divided by 365 days. Based on the waste audit conducted in Windhoek in 2004, a total of 24,861 tons of waste was generated by households (SWMD, 2004). On average, the average amount of waste generated per person per day ranged between 0.19kg and 0.7kg, depending on the level of household income Further details on waste statistics in Windhoek are presented in Chapter 4.

In Namibia, the waste prevention principle has been placed as a high priority over recycling, treatment and disposal of waste by almost all towns of Namibia. This is evident through the responses from those towns that were consulted to provide

[**] The total population of Ondangwa residents is estimated at 14,000. However, approximately 15,000 people are engaged on day-to-day activities in town during the day, some of which do not reside in town at night.

information required for this dissertation. As an approach to prevent illegal dumping of waste and littering, town municipalities and contractors provide garbage bins to households, while others are distributed across the central business areas, near shopping centers and in streets; for people to dispose the unwanted materials. Further to that, skip containers are allocated in open areas for use by people in the vicinity, to prevent increasing waste volumes in the environment. Such practices are prioritized by all towns that were contacted, which suggests that most of the Namibian towns if not all are investing in distributing garbage containers. Other principles used to prevent waste and to promote waste reduction are: awareness campaigns on reduction, re-use and recycling of waste materials, clean up campaigns and the law enforcement. These are practiced in many towns of Namibia.

At least 88.9% of the towns that were surveyed practice recycling of waste materials. Those are mainly the towns that have recycling companies or projects. The towns that do not have recycling companies do a local collection of waste materials that are sent to other towns or abroad for recycling. Some towns for example, Lüderitz recycle both locally and abroad. Towns such as Oranjemund and Windhoek collect recyclable materials, semi-process and transport them to South Africa for recycling. The type of waste being recycled in the towns of Namibia include: cartons, cans, papers, plastics, bottles, beverage cans, glass, card boards and scrap metals. Nevertheless, pursuing recycling initiatives in most towns of Namibia is challenged by financial constraints (Benade *pers. comm.*, 2009; Cotzee *pers. comm.*, 2009; Tjaronda *pers. comm.*, 2009).

Although re-use is one of the waste recovery strategies, not all towns use it (perhaps for valid reasons). Of the towns that were contacted, 22.2% do not re-use waste materials. However, others (77.8%) do, re-using materials such as bottles, cans and metals. An interesting case of a re-use strategy has been discovered in Oranjemund, where a certain gentleman re-uses used cooking oil as

fuel for his truck. In addition, the mine in Oranjemund uses used engine oil for machinery operations. Furthermore, several residents in some towns for example Otjiwarongo use waste materials to construct their houses, particularly the informal settlements.

Treatment of waste as a waste management principle is practiced in all the towns that were contacted. The common type of waste being treated is wastewater/sewage. Treated water can be used for domestic purposes as well as for irrigation of parks and sport fields. Windhoek specifically makes use of treated water for drinking and irrigation (du Pisani, 2006; Menge, 2006). Treated wastewater is re-used in the drinking water system of Windhoek particularly because the town Municipality has more advanced treatment facilities compared to other towns i.e. anaerobic digesters, activated sludge plants and bio-filters; which produce high quality water (CSA & Smith, 2007; Menge, 2006). With the exception of Swakopmund, other towns that were contacted only have waste pond systems for treating wastewater that can be only used for irrigation. At least Swakopmund has an activated sewage plant (CSA & Smith, 2007). Having 100% of the surveyed towns practicing sewage treatment suggests that the majority of Namibian towns if not all, treat sewage. In fact the Namibia's Greenhouse Gas Inventory for year 2000 has confirmed that all towns of Namibia practice sewage treatment (see Table 3.5.).

Table 3.5. Sewage treatment types used in the towns of Namibia

Region	Town	Sewage type(s)	Region	Town	Sewage type(s)
Caprivi	Katima Mulilo	Ponds	Kunene	Khorixas	Ponds
Erongo	Walvis Bay	Activated Sludge Plant	Kunene	Outjo	Ponds
Erongo	Swakopmund	Activated Sludge Plant	Kunene	Opuwo	Ponds
Erongo	Omaruru	Ponds	Ohangwena	Eenhana	Ponds
Erongo	Arandis	Ponds	Omaheke	Gobabis	Ponds
Erongo	Karibib	Ponds	Omusati	Outapi	Ponds
Erongo	Henties Bay	Ponds	Oshana	Oshakati	Ponds
Erongo	Usakos	Ponds	Oshana	Ondangwa	Ponds
Hardap	Rehoboth	Ponds	Oshana	Ongwediva	Ponds
Hardap	Mariental	Ponds	Oshikoto	Tsumeb	Biofiltration plant
Karas	Keetmanshoop	Ponds	Otjozondjupa	Otjiwarongo	Ponds
Karas	Luderitz	Ponds	Otjozondjupa	Grootfontein	Ponds
Karas	Oranjemund	Ponds	Otjozondjupa	Okahandja	Ponds, activated sludge plant
Karas	Karasburg	Ponds	Otjozondjupa	Otavi	Ponds
Kavango	Rundu	Ponds	Otjozondjupa	Okakarara	Ponds
Khomas	Windhoek	Anaerobic digesters, activated sludge and bio-filters, industrial waste ponds			

Source: CSA & Smith, 2007

Apart from wastewater treatment, medical waste is also treated in Oranjemund and Windhoek through incineration. In Windhoek, incineration of medical waste is done by the MOHSS, after which the Windhoek Municipality takes care of the residue. Table 3.6. below shows the type of waste being recycled, re-used and treated in different towns of Namibia that were conducted during this study.

Table 3.6. Types of wastes being recycled, re-used and treated in various towns of Namibia

Town	Luderitz	Mariental	Ondangwa	Ongwediva	Oshakati	Oranjemund	Otjiwarongo	Swakopmund	Windhoek
Recyclables	• Cartons • Cans • Papers • Plastics	• Bottles • Scrap metals • Papers • boxes	• Bottles • Tins • Papers • Metals • Bricks • Etc.	• Iron • Tins • Bottles	• Bottles • Plastics • Cans • Card boards • Scrap metals	• Bottles • Papers • Cans • Carton boxes	• None	• Glass • Papers • Plastic • Metal	• Glass • Papers • Metals • Plastics • Carton boxes • Textile • Wood • Bricks • Etc.
Re-used	• None	• Bottles	• Plastics • Bottles • Tins • Papers • Metals • Bricks	• Cans • Bottles • Aluminium (only collected and send to Windhoek)	• Bottles • Cans	• Cooking oil • Engine oil • Treated water	• Cans • Bottles • Recyclables • Corrugated iron • Wood • Treated water	• None (products are only collected to be re-used in other towns) • Treated water	• Cans • Bottles • Scrap metals • Corrugated iron • Bricks • Treated water
Treated	• Sewage	• Sewage	• Sewage	• Sewage	• Sewage	• Sewage • Medical waste	• Sewage	• Sewage	• Sewage • Medical waste

In all the towns that were contacted, there are organized methods of collecting waste from households. On a weekly basis, refuse trucks go from house to house using the '*door-to-door system*' to remove household waste from the provided bins. Most of such trucks belong to contractors; being contracted by town municipalities and councils. Nonetheless, some of the waste generated by households, for example, building rubbles are collected on an *ad hoc* basis, upon request. Additionally, in some towns, for example Swakopmund and Windhoek, individuals and companies also take their wastes to the waste disposal sites. The same will be practiced in Oranjemund in future. Waste generated by businesses is also collected by refuse trucks, at least more than once a week, depending on the volume of waste produced. Such an arrangement prevents people getting to dump their own waste and get exposed to unhealthy environments at the disposal sites.

Using data collected at the regional levels, there are high percentages of garbage collection from household in the Erongo Region, followed by Khomas, Karas and Otjozondjupa Regions respectively (Table 3.7). However, when looking at the proportions of people living in urban areas, high percentages of people living the Khomas Region reside in the urban areas, followed by Erongo, Karas and Otjozondjupa. Despite the fact the data presented in Table 3.7 does not present the actual situation in individual towns, it suggests that the majority of households is not connected to waste collection systems. Nonetheless, for those towns where waste is collected from all households and collection points in neighbourhoods, for example skip containers, there is a match between the percentage of garbage collection from households and the percentage of urban population. Windhoek in the Khomas Region is a good example among others.

Table 3.7. Water, toilet and garbage data by region

Region	Water (m^3)	Water (m^3/head)	Toilet, flush % of households	Toilet, bush% of households	Garbage collected, % of households	No. of households	Population	No. living in main urban areas	% living in main urban areas
Caprivi	2,622,191	33	13.3	83.4	31.5	16,839	78,785	22,134	28.1
Erongo	8,742,045	85	80.3	11.5	87.7	27,496	103,180	86,091	83.4
Hardap	3,160,883	48	49.6	34.0	58.3	15,039	66,028	31,144	47.2
Karas	3,707,581	58	57.8	26.0	76.8	15,481	64,039	37,599	58.7
Kavango	3,331,759	17	7.3	81.3	30.6	30,467	198,963	36,964	18.6
Khomas	13,130,931	54	75.3	20.2	87.3	58,580	243,585	233,529	95.9
Kunene	2,317,043	35	26,2	65.5	45.6	12,489	66,385	17,004	25.6
Ohangwena	360,097	2	3.2	88.8	45.3	35,958	226,416	2,814	1.2
Omaheke	1,092,173	16	32.2	62.2	34.5	12,590	66,779	13,856	20.7
Omusati	781,319	3	3.3	83.0	42.4	38,202	226,337	2,640	1.2
Oshana	3,478,191	22	19.2	49.2	53.3	29,557	158,181	49,897	31.5
Oshikoto	488,767	3	15.9	70.2	43.1	28,419	158,352	14,929	9.5
Otjozondjupa	3,924,677	34	47.8	42.7	64.5	25,338	116,205	55,011	47.3
Total	**47,137,656**	**27**	**34.4**	**54.2**	**42.4**	**346,455**	**1,773,235**	**603,612**	**34.0**

The water data presented in the above Table was obtained from NamWater (for those towns that have their own systems, data from such systems was not included). In addition, the population, garbage, toilet and urban distribution data were based on the 2001 Population and Housing Census

The garbage collection data includes the sum, regular and irregular collection as well as roadside dumping, mainly skip collection (CSA & Smith 2007).

For the purpose of waste disposal, only two of the towns that were contacted dispose waste at open dumping sites, the rest use landfill sites for disposal. However, one of those two towns has considered using a landfill in future, and an EIA for the site has already been contacted. A landfill site can either be a hole in the ground which is filled with waste, or an engineered facility that is designed to dispose waste (DWAF, 1998). Landfills differ in types, sizes and in potentials to threaten the environment. They are covered with a layer of soil at the end of each day's operation by trash compactors. Waste materials being disposed of at the disposal sites in various towns include: household waste, building rubbles, garden refuse, industrial waste, hospital waste and general waste. Hazardous waste is disposed of at specially engineered landfill sites. So far, only Windhoek and Walvis Bay have suitable sites for disposing hazardous waste (SoER, 2001). Some of the towns that have engineered landfill sites for example Windhoek and Oranjemund dispose waste of in different landfill cells, based on their classifications.

Of the towns that were contacted, 33.3% of them considered conducting EIAs upon the selection of disposal sites. However, 33.3% of the respondents were not sure whether EIAs were contacted for their towns or not. The remaining 33.3% did not conduct EIAs upon the selection of their sites at all. However, according to the minimum requirements for waste disposal by landfill for South Africa, EIAs should be conducted for both medium-sized general waste landfills and hazardous waste landfills (DWAF, 1998).

Essentially, waste disposal sites (both the open dumping and landfill sites) should be monitored. Monitoring of waste disposal sites needs to be carried out in order ensure that any environmental impact is identified and rectified (DWAF, 1998). Of the towns that were contacted, at least 77.8% monitor their disposal sites. This gives an impression that disposal sites in most towns of Namibia are monitored. For those towns that do the monitoring, they mostly monitor the type waste being disposed of and basically ensure that the site is in an acceptable condition. A few

of them, for example, Windhoek monitors the amount of waste being disposed of, using the weighbridge method of measuring waste weight; whereby the vehicle carrying waste load is weighed upon entry into the site and after waste disposal. The difference in the truck weight before and after waste disposal is then recorded as the amount of waste being disposed of (Haindongo, *pers. comm.*, 2009). Monitoring of waste at disposal sites is a responsibility of site care takers and contractors such as Enviro-Fill, Move-a-Mess and Rent-a-Drum; done on a regular basis, mostly once a week. However it can be more than once a week. Some towns for example Ongwediva, Ondangwa and Windhoek do the monitoring of waste disposal as often as waste is being disposed of.

In terms of security, most of the disposal sites are fenced off and are guarded. The guards direct people of where to dispose waste. However, some of the disposal sites are being vandalized by scavengers, who survive on collecting and selling waste materials (SoER, 2001). Thus, guarding the disposal sites does not guarantee vandalism prevention.

Overall, the waste management practices for Namibia are summarized in Figure 3.2 below.

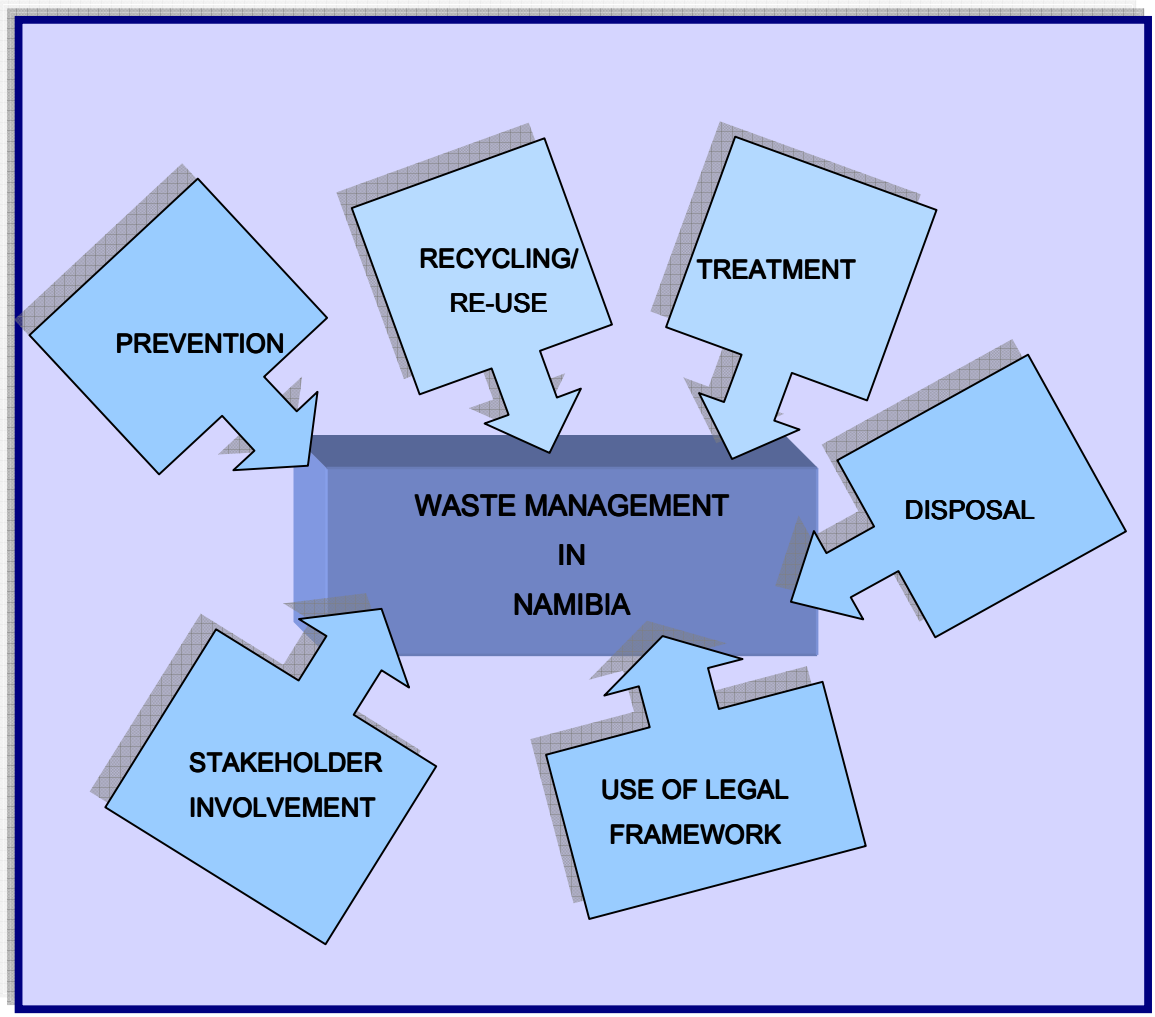


Figure 3.2: Principles of Waste Management in Namibia

3.4.3. Legal Framework

In improving its performance in environmental management, Namibia is continually placing efforts in developing legal frameworks in order to ensure implementation of best environmental management practices to maintain a healthy environment. Article 95 of the Constitution of the Republic of Namibia has clearly pointed out that the state shall actively promote and maintain the welfare of people by adopting *inter alia* policies aimed at maintenance of ecosystems, ecological processes, biological diversity of Namibia and the utilization of living natural

resources on a sustainable basis for the benefit of all Namibians both present and future generations (NC, 1990). This includes a development of policies contributing to improved environmental management practices for the benefit of the present and future generations. Specifically in terms of waste management, Article 95 has made it clear that the state shall provide measures against the dumping and recycling of foreign nuclear and toxic waste on Namibia's territory. The Namibian Constitution should therefore be viewed as the driving force behind the development of the policies and all laws currently in use.

Furthermore, environmental management in Namibia is being promoted by the Environmental Management Act No. 7 of 2007 (EMA, 2007). This Act has set out some principles that must be adhered to when it comes to applying environmental management measures. Many of such principles apply to the management of the environment as a whole; however, there are those that are specifically of relevance to waste management (see Box 3.1 below). In terms of waste management and pollution control, a Bill was passed in 1999 that emphasizes the prevention and regulation of air, water and land pollutants, as well as an establishment of an appropriate framework for integrated pollution prevention and control, regulation of noise, dust and odour (MET, 2006). It has also stressed the need for establishing a system of waste planning and management. The Pollution Control and Waste Management Bill is currently in a process of being promulgated into an Act (Nghitila *pers. comm.*, 2009).

Box 3.1. Environmental Management Principles of Relevance to Waste Management in Namibia (Adapted from EMA, 2007)

- Renewable resources must be used on a sustainable basis for the benefit of present and future generations.
- Assessments must be undertaken for activities which may have significance on the environment or the use of the natural resources.
- Sustainable development must be promoted in all aspects relating to the environment.
- The option that provides the most benefits or causes the least damage to the environment as a whole, at a cost acceptable to the society, in the long-term as well as short-term must be adopted to reduce the generation of waste and polluting substances at source.
- The reduction, re-use, and recycling of waste must be promoted.
- A person who causes damage to the environment must pay the costs associated with rehabilitation of damage to the environment and to human health caused by pollution, including costs for measures as are reasonably required to be implemented to prevent further environmental damage.
- Where there is sufficient evidence which establishes that there are threats or serious or irreversible damage to the environment, lack of scientific certainty may not be used as a reason for postponing cost-effective measures to prevent environmental degradation.
- Damage to the environment must be prevented and activities which cause such damage must be reduced, limited or controlled.

Handling of waste is a legal issue. Consequently, it has become a law in Namibia that no waste should be discarded at any waste disposal site that has not been declared or approved by the Minister of Environment and Tourism (EMA, 2007; MET, 2008). For this reason, it is an offence to discard or to cause waste to be discarded in an unapproved site. Anyone who commits such an offence will therefore be liable of a fine that does not exceed N$500,000.00 or to an imprisonment for a period not exceeding 25 years or to both fine and imprisonment. As an environmental law, it is essential that the 'polluter pay's principle' should be applied to avoid undesirable environmental consequences. With such a principle, individuals, companies and public authorities involved in any polluting activities are held responsible for costs involved in preventing or dealing

with pollution caused by such activities to ensure that the environment is in an 'acceptable state' (Birnie & Boyle, 2002; Glazewski, 2005). This principle is only applied by in a few of the towns (44.4%) that were contacted (see Table 3.8). In addition, there is another principle known as 'user pays principle', which requires the users of waste resources to pay the service providers for the services rendered for the management of such resources. This principle is only applied in a few towns in Namibia, including Lüderitz and Windhoek. Furthermore, another principle known as the 'product-steward principle', a principle that requires the waste producers or importers of waste products to take responsibilities towards the minimization of environmental impacts by the products is not much applied. Of the towns that were contacted, only Mariental and Windhoek apply such a principle.

Table 3.8. Environmental law principles used in various towns of Namibia

Town	Polluter Pays Principle	User Pays Principle	Product-stewardship Principle
Luderitz	No	Yes	No
Mariental	Yes	xx	Yes
Ondangwa	No	No	No
Ongwediva	No	No	No
Oshakati	No and Yes	No	No
Otjiwarongo	xx	xx	xx
Swakopmund	Yes	Yes	No
Windhoek	Yes	Yes	Yes

xx – no information was provided

As far as environmental law is concerned, it is important to have some sorts of guidelines or a legal framework that guides the management of waste (OECD, 2007). At least all the towns that were contacted use some guidelines, policies or regulations for waste management. Based on these results, it is assumed that the majority of towns in Namibia, if not all, use some guiding frameworks to manage waste. Worth mentioning, the Environmental Management Act No. 7 of 2007 has made it clear that no waste and sewage disposal or chemical treatment should be

undertaken without an environmental clearance certificate (EMA, 2007). Anyone who goes beyond this law is charged a fine not exceeding N$500,000.00 or to an imprisonment for a period not exceeding 25 years or to both fine and imprisonment. An environmental clearance certificate is a certificate that may set conditions for carrying out activities that have potential environmental consequences (MET, 2008). Such activities may fall into the following categories: land use and transformation, water use and disposal, removal of resources (including natural living resources), resource renewal, industrial processes, agricultural processes, transportation, waste and sewage disposal, energy generation and distribution, and recreation.

The legal frameworks of relevance to waste management in Namibia are described in Table 3.9 below.

Table 3.9. Some of the relevant legal frameworks to waste management in Namibia

Framework	Emphasis
Atmospheric Pollution Prevention Act No. 45 of 1965	*Prevention of pollution of the atmosphere.*
Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal, 1992	*Environmental sound management of hazardous waste and other wastes through the reduction of their movements, for the purpose of reducing their impacts on human health and environment.*
Hazardous Substances Ordinance No. 14 of 1974	*Control of toxic substances (including manufacture, use, disposal, import and export).*
Pollution Control and Waste Management Bill of 1999	*Prevention and regulation of air, water and land pollutants; establishment of an appropriate framework for integrated pollution prevention and control, regulation of noise, dust and odour, as well as an establishment of a system of waste planning and management.*
Pollution Prevention Ordinance No. 11 of 1976	*Prevention of air pollution.*
Prevention and Combating of Pollution of Sea by Oil Act No. 6 of 1981	*Prohibits the discharge of oil from ships, tanker or off-shore installation and gives the state certain powers to prevent such pollution and deal with removal of oil spills.*
Prevention and combating of pollution of the sea by oil Act 24 of 1991	*Prevention of sea pollution by oil.*
UN Convention on the Law of the sea, 1982	*Protection and preservation of the marine environment including the seabed, ocean floor, subsoil and the resources in the environment.*
Water Resources Management Act No. 24 of 2004	*Prevention of water pollution.*

3.5. Conclusion

Namibia´s economy depends largely on the wealth and exploitation of natural resources. Sound environmental management is essential for the protection of

resources, for reducing negative environmental impacts and in fact for economic growth. Environmental management in Namibia is a priority for the government, NGOs, local authorities, private sector and communities. Stakeholder participation in environmental management is encouraged by the Environmental Management Act of Namibia.

In terms of the socio-economy, high unemployment, poverty, income inequality, pandemic HIV and AIDS, and lack of skills are the major challenges in Namibia. The national economy depends on 3 major sectors: primary, secondary and tertiary; with the tertiary sector being the biggest contributor to GDP. The mining sector under the primary sector is the greatest contributor to GDP in the private sector, due to diamond mining. Over the years, an increase in the GDP per capita has been experienced. Notable in terms of economic development, the national economy is affected by changes in the global economy. For the purpose of developing the national economy, Namibia is promoting the sustainable use of resources while at the same time meeting people's needs. Furthermore, Namibia would like to ensure environmental sustainability through strengthening the management of its natural resources.

Today, Namibia is promoting the concept of sustainable development in all aspects of environmental management. In its effort to achieve sustainable development, it is promoting institutional development, social development and natural resource management. Namibia also makes use legal frameworks both at the local and international levels, and it encourages stakeholder involvement in all aspects striving towards sustainable development. At the national level, Namibia has also developed some frameworks such as the National Poverty Reduction Action Programme, National Development Plans and Vision 2030. It is also a global partner to the MDGs and is a signatory to many environmental conventions. The DEA under MET is the leading agency for promoting sustainable development in Namibia.

Waste management in Namibia is needed to reduce waste generation and to avoid negative environmental impacts. This is of essence particularly due to the increasing population and economic activities, which play a role in waste generation. Waste management in Namibia is a responsibility of all residents, local authorities, government ministries, private sector and businesses. A number of waste management stakeholders have been identified in different towns of Namibia. Even so, waste management is a priority for the government, with different government ministries being involved in formulating policies and strategies for dealing with waste and its management. The municipal waste is handled by town municipalities and councils, with support from private contractors.

The '3R principle' is being promoted in Namibia, whereby reduction is more prioritized, followed by re-use and recycling. Waste is being prevented in all towns of Namibia through the provision of bins and skips to households, in business areas and in streets; as well as through awareness campaigns on waste reduction, re-use and recycling. The recycling principle is being practiced by many towns of Namibia, however not in all. Common waste products being recycled are: bottles, cans, papers, metals and plastics. Although not all, some towns re-use waste products such as bottles, cans and plastics. When it comes to the treatment of waste, sewage treatment is a common aspect in all towns that do waste treatment, in fact all towns of Namibia. Medicinal waste is treated in some towns.

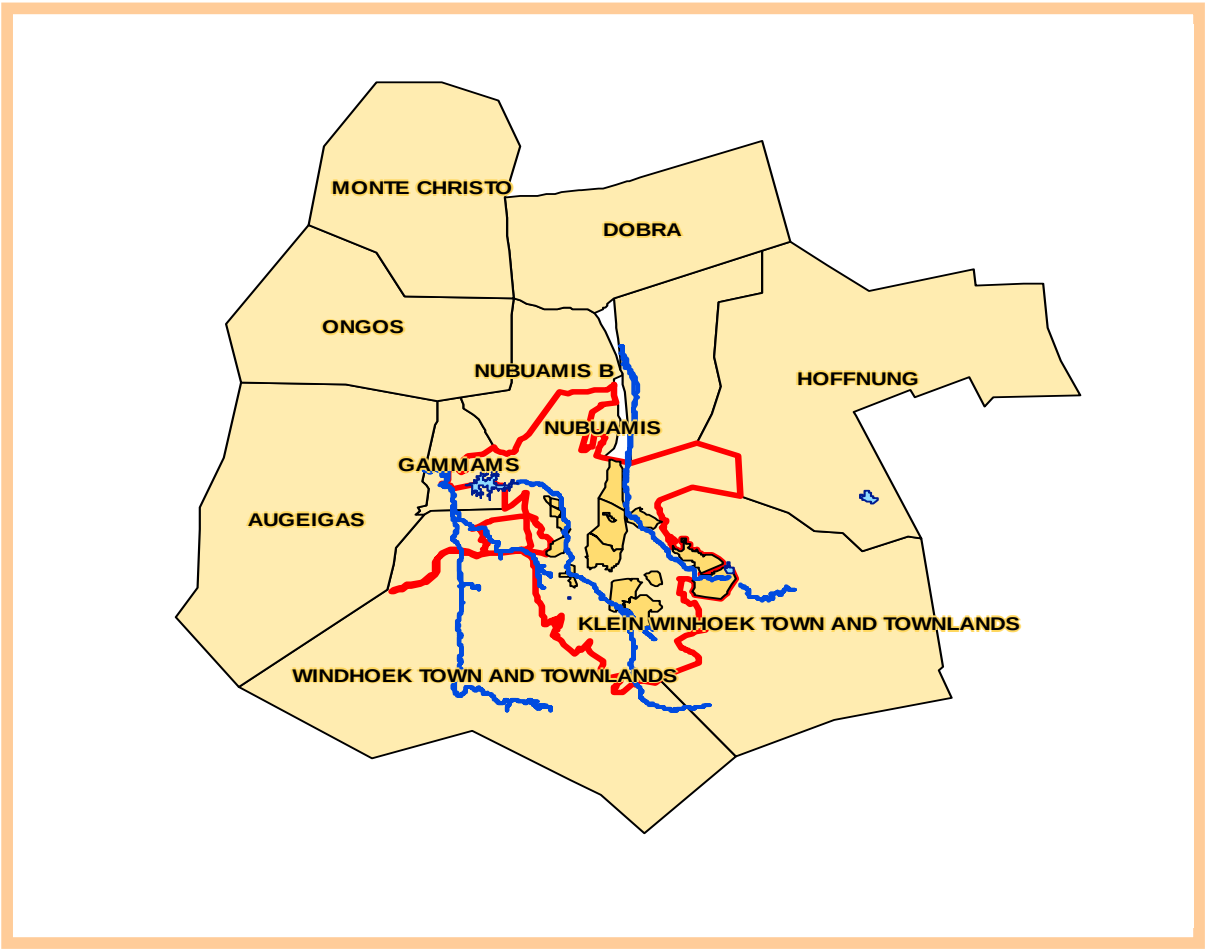
Waste is collected on a regular basis by refuse trucks from households and business areas. However, some wastes such as building rubbles are collected on an *ad hoc* basis, upon request. Waste disposal is done at open dumping and landfill sites, with more landfill sites than open dumping sites in different towns. Most of these are being monitored and most are fenced off and guarded, however many are being vandalized by the scavengers.

In terms of legal frameworks, the National Constitution of Namibia is promoting sound environmental management as well as a development of policies. Further to that, the Environmental Management Act of Namibia is promoting sound environmental management and has set out some laws regarding the handling of waste, including charging of fines and imprisonment of waste producers. Despite its importance, the ‘polluter pays principle’ is only applied in a few towns in Namibia. Most importantly, there are many legal frameworks of relevance to waste management that are used in Namibia, including international conventions. Legal frameworks are essential to ensure sound management of waste as well as reduction of negative environmental impacts.

CHAPTER 4: MUNICIPAL WASTE MANAGEMENT IN WINDHOEK

4.1. Introduction

Windhoek the capital city of Namibia is located between Khomas Highland, Auas and Eros Mountains (Map 4.1). With a population of approximately 296,000 people; Windhoek is home to various traditional groups: Hereros, Owambos, Damaras, Namas, Caprivians, Kavangos, Sans, Tswanas, Basters; and the western groups comprising Germans, Afrikaner, English and Portuguese (CoW, undated; SWMD, 2008). Windhoek offers a range of unique experiences that do attract tourists. Features such as national monuments, historical buildings, museums and the general environment have made Windhoek a tourism destination. Today, Windhoek is said to be the cleanest city in Africa.



Map 4.1. Map of Windhoek (Source: City of Windhoek)

The Windhoek Municipality, csommonly known as ‘City of Windhoek’, is committed to the management of the environment through making use of the principles of sound environmental management in all development efforts and in the promotion of improved quality of life for all residents of Windhoek (CoW, 2008a). It renders environmental practices that aim to ensure a healthy, clean and secure environment for all residents; while at the same time creating an environment for socio-economic and sustainable development. In the view of environmental management at large, the Department of Planning, Urbanization and Environment within the City of Windhoek plays a major role. Specifically in terms of waste management, the Department of Infrastructure, Water and Waste Management plays a significant role.

Environmental management in Windhoek is however challenged by the flocking of people from rural areas in search of better standards of living. Consequently, problems such as unemployment, low-incomes, poverty, resource exploitation, poor quality of life and urbanization are experienced (CoW, 2008a). Generally, factors such as increasing population, urbanization and industrialization are known to contribute to waste production and pollution, which further threatens the environment (UNFPA, 2001). Windhoek is not an exception to this. As a result, suitable waste disposal sites have to be sought. In addition, all applicable waste management principles need to be applied. This chapter has discussed how the municipal waste is dealt with in Windhoek. It has also briefly elaborated on how other stakeholders other than the Windhoek Municipality deal with waste.

4.2. Waste Prevention within the Windhoek Municipal Area

The Division of Solid Waste Management within the City of Windhoek is acknowledged for keeping Windhoek the cleanest town in Africa (CoW, 2008a). It ensures that all waste generated is collected, transported and disposed of (Benade *pers. comm.*, 2009). Through this division, the City of Windhoek provides households and business areas with 240L containers referred to as ‘wheelie bins’

to serve the waste management needs (see Figure 4.1). Such bins are only meant for some types of waste such as food waste, domestic refuse, commercial waste and all light materials that may not cause any damage to the containers. Other types of waste such as stones, wood, bricks, iron sheet, sand, heavy metals, tree branches and grass are not to be stored in the wheelie bins. These can be stored in big containers called ‘skips’, that are distributed in some residential areas, including informal residential areas where illegal dumping of waste has been experienced (Figure 4.2). The informal residential areas are those areas where the basic residential services such as proper housing, water, sewerage and electricity are lacking (Quilan & McCarthy, 1995).

Figure 4.1. A 240L wheelie bin for storing household and commercial waste (Source: City of Windhoek)

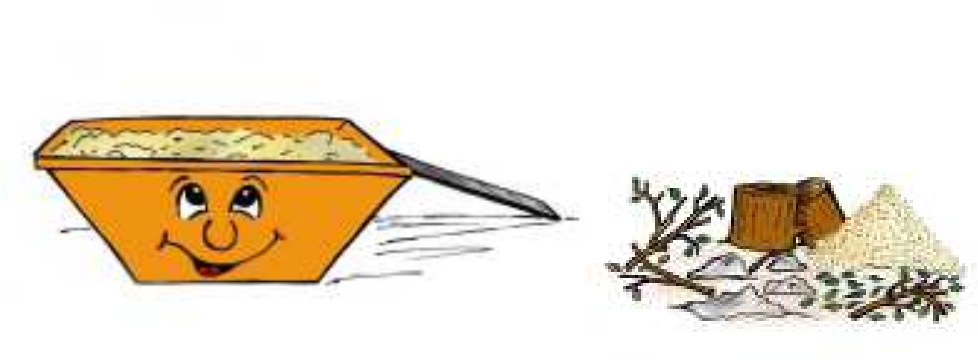


Figure 4.2. A skip container for storing waste that cannot be stored in wheelie bins and waste generated in open spaces

(Source: City of Windhoek)

In addition, black garbage bags are provided on a weekly basis to store waste generated in informal settlements and in open spaces, based on the need. These are provided by private contractors for the Solid Waste Management Division. Smaller garbage bins are also distributed along the streets by the Solid Waste Management Division, to prevent littering. Provision of garbage bins and skips within the residential area and central business district (CBD) is mainly a responsibility of the City of Windhoek. However, this job is shared with private contractors, one of which is the Rent-a-Drum Group of Companies; which also goes beyond providing services within residential areas and business areas to industrial areas. Most importantly, the Solid Waste Management Division has to ensure that waste is disposed in a safe and acceptable manner (Haindongo *pers. comm.*, 2009).

Apart from solid waste prevention, it is essential that pollution should be prevented by all means. Research has shown that air pollution in Namibia is not as significant as in other countries (CoW, 2008a). However, waste in general emits greenhouse gases. Specifically in Windhoek, the Gammams sewage plant digesters emit methane (CH_4), which is related to the mass of organic matter (CSA & Smith, 2007). Therefore, taking into consideration the negative impacts of pollution and

the need to protect the environmental integrity, pollution has to be prevented in Windhoek by all means. Consequently, the City of Windhoek's Division of Bulk Water and Waste Water is committed to controlling pollution resulting from industries, whereby effluents generated from industries such as breweries, meat companies etc. are continually monitored to ensure they don't contaminate the usable water (Iiputa *pers. comm.*, 2009). For this reason, water samples are taken on a monthly basis to test for chemical parameters, mainly the Chemical Oxygen Demand (COD). The COD tests measure the amount of oxygen absorbed, which indirectly indicates the amount of pollution in a water sample (BD, 2009). The test results indicate the amount of oxygen dissolved in water that has been consumed by the contaminants. Should the volume of oxygen absorbed exceed 70mg/L, it means water is contaminated. As a result, industries are charged a fee because of the contamination. The amount of oxygen absorbed is calculated using the following formula:

$$Q_{eff} = 306{,}81 \left[1 + 0.2 \frac{OA - 70}{70}\right] cents$$

The Scientific Services Division of the City of Windhoek also plays a role in the monitoring of water pollution. This division places efforts in monitoring various parameters that determine the water quality (Menge *pers. comm.*, 2009). Parameters being monitored are: aesthetic (e.g. pH, conductivity, temperature, turbidity, alkalinity etc.), bacteria & viruses (e.g. total coliform, faecal coliform, E Coli typtone, faecal streptococci etc.), protozoa (Giardia & Cryptosporidium), organics & micropollutants (e.g. DOC), disinfection by-products (e.g. free chlorine, total chlorine, total trihalomethane, chloroform, bromoform etc.), stability ($CaCO_3$ precipitation), natural & effluent organic matter (e.g. Ammonia, Ortho phosphate, Nitrate etc.), and inorganics (Potassium, Sodium, Chlorine, Sulphate, Fluorine, Bromine, Magnesium and Iron). These are tested in boreholes, surface water, reclaimed water and in reservoirs, tested against specific concentration standards, which if exceeded indicate some degrees of contamination. The concentrations of

the dissolved substances are expressed as mg/L and μm/L, which could be easily detected by the current systems in place. It is however a concern that some concentrations of dissolved substances may not be detected, particularly those that may be present in unmeasurable concentrations (e.g fg/L or pg/L). This is now the challenge facing the division in terms of water pollution monitoring.

4.3. Waste Collection

Waste generated from households is collected by the Solid Waste Management Division. Business waste is collected by both the Solid Waste Management Division and private companies, while the waste generated from industrial areas and from open spaces is specifically collected by individual contractors and private companies. The responsibility over skip removal is shared between the Solid Waste Management Division and a private company, Rent-a-Drum. In addition, contractors employ individuals to do the collection of waste from business areas and informal areas, to pick litter, and to clean open spaces (Haindongo, *pers. comm.*, 2009; van Wyk *pers. comm.*, 2009). Collection of waste is basically done to avoid overloading of garbage bins and skips, to improve the aesthetic view, to minimize health impacts and to avoid surface and groundwater pollution. In principle, all types of waste, both hazardous and non-hazardous waste can have negative impacts on the environment. Thus, collecting them has been placed as a priority (CoW, 2008b).

In general, increasing population is a challenge to waste management. As the number of people increases, the rate of waste generation increases too (DWAF, 1998; UNFPA, 2001; Walmsley & Bottem, 1994). Nonetheless, the amount of waste generated may also depend on the living conditions, particularly due to the fact that rich people generally generate more waste than the poor people (CoW, 2008a; SoER, 2001; SWMD, 2008). Having a high concentration of poor people in an area can however also increase the amount of waste generated (Henry *et al.*, 2006). Consequently, poor people suffer the consequences of waste as they often live in the worst conditions.

Given the above challenges associated with waste, it makes sense that the collection of waste has been placed as a priority by the City of Windhoek. This is one of the main reasons that the Solid Waste Management Division has commissioned various contractors to take care of waste collection and disposal. On a weekly basis, waste is collected from all households within the municipal area (Haindongo *pers. comm.*, 2009). Bulky waste generated at the household level can be collected on an *ad hoc* basis, upon request. Waste generated from businesses is collected weekly, based on the amount generated. Waste from skip containers is collected on a daily basis, as long as they have reached their maximum capacities. Nevertheless, collection of waste from informal residential areas can be problematic, given the increasing population there (CoW, 2008a).

4.4. Waste Disposal

In Windhoek, there are six general landfill sites known as 'satellite sites' where garden refuse and building rubbles are disposed of. These are located in various locations within the Windhoek municipal area, namely: Havana, Khomasdal, Pioneerspark, Eros, Olympia and Ludwigsdorf. As defined earlier in Chapter 3, a landfill site is an engineered facility that is designed to dispose waste. The general objective of a landfill is to avoid both long-term and short-term environmental impacts such as odour, flies, air pollution, wind-blown litter, groundwater pollution and landfill gas generation (DWAF, 1998). For this reason, it is essential that public acceptance of landfills is ensured, by ensuring environmental acceptability. Landfills are therefore operated to avoid creating nuisances or hazards to public health and to prevent negative environmental impacts. To reduce the amount of wastes disposed of in landfills, waste is compacted using an earth-moving machinery, referred to as a trash compactor. Compaction of waste is essential, as it saves space on the landfill, while at the same time controlling wind-blown litter (DWAF, 1998). Landfills are covered with a layer of soil at the end of each day's operation to improve the visual appearance of the site and to reduce odour.

Apart from the satellite sites, general and hazardous waste is disposed of at a specially engineered landfill site known as Kupferberg that is located about 11 km from the city centre. Some landfills are designed in such a way that they are divided into cells which allow segregation of incompatible wastes (DWAF, 1998; WBG, 1998b). Such a division is based on their potential to generate significant leachate, with an unacceptable high pollution possibility (DWAF, 1998). The same applies to the Kupferberg landfill site, where two separate cells are used for the purpose of waste disposal. General wastes generated from households, commercial and industrial activities are disposed of in the general cell; while the hazardous wastes are disposed of in the hazardous cell (Haindongo *pers. comm.*, 2009). The two waste disposal facilities are adjacent to one another but separated by a mesh wire fence. Hazardous wastes are a threat to public health and to the environment at large, therefore they need to be properly managed and well regulated (WBG, 1998b). For this reason, landfills designed to accommodate hazardous waste are lined, often with double or triple layers, and have leachate collection facilities (DWAF, 1998; WBG, 1998b). Specifically at the Kupferberg landfill site, there are lining layers that prevent any leakage of leachate from contaminating the soil and groundwater. Table 4.1 below presents the sources and types of hazardous wastes.

Table 4.1. Types and sources of hazardous waste

Type of hazardous waste	Source
Inorganic waste	Acids and alkalis, cyanide waste, heavy metal sludges and waste containing appreciable proportions of fibrous asbestos
Oily waste	Waste from the processing, storage and use of mineral oils
Organic waste	Halogenated solvent residues, non-halogenated solvent residues, phenolic waste, paint and resin waste and organic chemical residues
Putrescible organic waste	Waste from the production of edible animal and vegetable oils, slaughter houses, tanneries and other animal and vegetable based products
High volume/low hazardous waste	Waste that contains small quantities of highly dispersed hazardous substances e.g. sewage sludge, building rubbles which are contaminated by heavy metals, oils and other pollutants
Miscellaneous waste	Infectious waste such as diseased human/animal tissues, medical waste, laboratory waste and waste from manufacturing

Source: DWAF, 1998

Monitoring of landfill sites is an important mechanism that is applied throughout the operations of the sites. It includes being on the look out for the impacts of the landfill on the receiving environment such as gas production, water pollution, leachate generation and health impacts (DWAF, 1998). At the Kupferberg landfill site, groundwater is monitored on a quarterly basis by the Scientific Services Division of the City of Windhoek, whereby water quality is tested to see whether there is any contamination (Iiputa *pers. comm.*, 2009). A consultant has been hired to monitor the water quality in the boreholes around the site. If any contamination is detected, the Scientific Services Division acts, either by determining whether groundwater has been polluted or advise on the frequency of sampling as well as the on specific parameters to be monitored.

Monitoring also includes taking records of the type and amounts of waste being disposed of at the landfill sites. Such a practice is applied at all landfill sites in Windhoek. At the sites, masses of waste disposed of are measured using the weighbridge method as described in Chapter 3. Records for the City of Windhoek have shown that approximately 20100 m^3 of waste is managed per month at the satellite sites, of which 59% (11850 m^3) is building rubble while 41% (8250 m^3) is garden refuse (Uvanga *pers. comm.*, 2009). Assuming the two types of waste are not compacted, the amount of building rubbles handled at the satellite sites per month is roughly 23,700 tons; while the amount of garden refuse handled is roughly 2,475 tons. These weights were calculated using the following average tonnages per cubic metre:

- 1 m^3 of building rubbles ~ average 2.0 tons/m^3
- 1 m^3 of garden refuse ~ average 0,3 tons/m^3

The average amounts of building rubbles and garden refuse disposed of at the satellite sites per month in 2008 are presented in Figure 4.3. Of the six satellite sites, Eros received the largest amount of building rubbles, followed by Pioneerspark and Olympia respectively. The Havana site received the largest amount of garden refuse, followed by Pioneerspark and Eros respectively. Altogether, a total of 84,957.2 m^3 (approx. 169,915.4 tons) of building rubbles and 88,170.75 m^3 (approx. 26,442.23 tons) of garden refuse were disposed of at the satellite sites during 2008, whereby approximately 7079.77 m^3 (approx. 14,159.54 tons) of building rubbles and 7347.56 m^3 (2,204.27 tons) garden refuse were disposed of per month. In addition to the building rubbles and garden refuse, unwanted sand is also disposed at the satellite sites. The total amount of sand disposed of at the satellite sites in 2008 was 59,958 m^3 which is approximately 119,916 tons, using a conversion factor of 2tons/m^3. On a monthly basis, an average of 5,485 m^3 was disposed of at all six sites. This is more or less

equivalent to 10,970 tons. Between the six satellite sites, most sand was disposed of at Pioneerspark and Eros, while the least sand was disposed of at Ludwigsdorf.

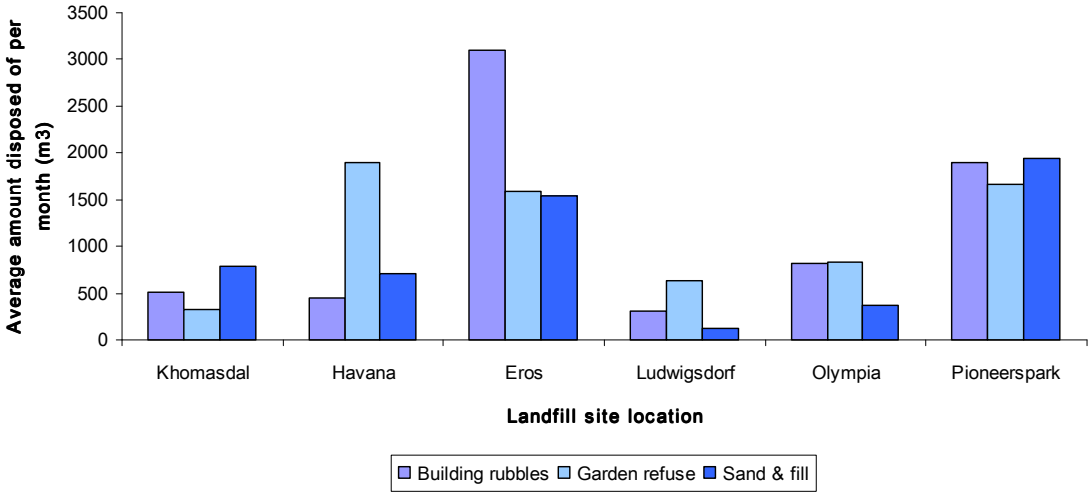


Figure 4.3. Average amounts of building rubbles and garden refuse disposed of at the six satellite sites in 2008

(Source: City of Windhoek)

At the Kupferberg landfill site, approximately 93% of general waste and at least 7% of hazardous waste are managed per month (Uvanga, *pers. comm.*, 2009). The exact amount of waste that was disposed of at Kupferberg between January and December 2008 are presented in Table 4.2 below.

Table 4.2. Amount of waste disposed of at the Kupferberg landfill site in 2008

Month	General waste (tons)	Hazardous waste (tons)
January	4,950.06	304.18
February	5,654.88	463.30
March	5,522.50	573.76
April	5,218.40	466.90
May	5,121.52	411.90
June	5,687.24	422.38
July	5,803.04	353.16
August	5,461.35	344.54
September	5,976.24	411.74
October	6,525.36	524.48
November	5,877.60	304.28
December	6,127.33	389.96
Total/year	**67,925.52**	**4,970.58**
Average/month	**5,660.46**	**414.22**

Using the estimated Windhoek population of 269,000, the above data suggest that roughly an amount of general waste that was disposed of at Kupferberg in 2008 was 229.48 kg per capita per year, while the amount of hazardous waste disposed per capita per year was 16.8 kg. Looking at the average amounts that were disposed of per month, 19.12 kg and 1.4 kg of general waste and hazardous waste were disposed per capita respectively. However, it would have been better to have the exact amounts of weights generated from various sources, for example households, industries and commercial activities, since the amounts of waste presented in Table 4.2 are not from one source. The more sophisticated the system is in being aware of how much waste is generated from which source, the more the data processing would be able to produce detailed outcomes. The method used by the researcher to calculate the amount of waste being disposed per capita is due to the available data and was suggested by the research supervisor (Berchtold *pers. comm.*, 2009).

In order to determine waste compositions from the overall general waste disposed of at Kupferberg in 2008, calculations were made based on the waste fractions presented in Table 4.3 below, that were worked out in a study conducted by the Windhoek City Engineers in 2004 (CSA & Smith, 2007).

Table 4.3. Contents of solid waste in Windhoek

General Waste	% Weight	% Volume	Kg/day/town dwellers	Tonnes
Metal	4	6	10,498	3,800
Glass	14	7	36,742	14,400
Ceramics	0	0	0	0
Plastic containers	4	14	47,239	17,200
Plastic (soft)	7	14	10,498	3,800
Organic food products	15	7	39,366	14,400
Garden refuse	32	16	83,981	30,700
Wood/timber	1	1	2,624	1,000
Paper (plain)	9	14	23,620	8,600
Paper (carton)	6	15	15,746	5,700
Total	**92**	**94**	**24,1445**	**88,100**

Source: CSA & Smith (2007)

Table 4.4 below presents the estimated compositions of waste disposed of at Kupferberg in 2008, calculated using the percentage weights for various waste compositions presented in Table 4.3. In addition, the percentage weights that were calculated during the household waste audit of 2008 for the Solid Waste Management Division were used to estimate the compositions of waste disposed of at Kupferberg, for comparison.

Out of the total amount of waste disposed of at Kupferberg in 2008, it was estimated that garden waste, unclassified waste, organic food products and glass were disposed in large amounts, based on the fractions that were calculated in the Greenhouse Gas Inventory Report of 2007 and the Household Waste Audit Report

of 2008 (CSA & Smith, 2007; SWMD, 2008). Both reports determined that metals do not make large contributions to the overall waste generated or disposed of.

Table 4.4. Waste compositions disposed of at Kupferberg in 2008

General Waste	% Weight (based on the GHG inventory)	Estimated weight (tonnes)	% Weight (based on the audit report)	Estimated weight (tonnes)
Metal	4	2,717.02	2.8	1,901.92
Glass	14	9509.50	15.8	10,732.23
Ceramics	0	0	1.7	1,154.73
Plastic containers	4	2,717.01	8.6	5,841.59
Plastic (soft)	7	4,754.79	4.9	3,083.35
Organic food products	15	10,188.83	9.8	6,166.70
Wood/timber	1	679.26		
Paper (plain)	9	6,113.30	8.6	5,841.60
Paper (carton)	6	4,075.53	4.7	3,192.50
Garden refuse	32	21,736.17	19.4	12,207.55
Others	8	5,434.04	23.8	16,098.33
Total	**100**	**67,925.45**	**100**	**66,220.50**

Using the waste compositions shown in Table 4.4., the fraction of the non-recyclable materials can be calculated, which together with the recyclable materials fractions can be diagrammatically presented in Figure 4.4. This diagram breaks the waste into two general groups: non-recyclable 55% and recycling fractions 45%.

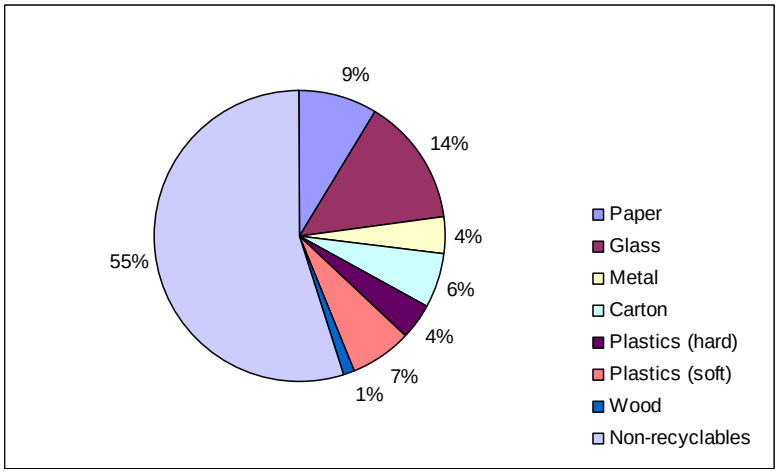


Figure 4.4. Diagramatical representation of waste compositions at Kupferberg

Altogether a total of 1,315.51 kg was disposed per capita in 2008 in Windhoek (Table 4.5). This was determined by combining different waste indicators that were calculated based on the amounts of different types of waste that were disposed of at the landfill sites in Windhoek.

Table 4.5. Waste indicators obtained from various waste streams in 2008

Waste indicator	Estimates	Estimated indicators	Units
General waste per year	67,925.52		tonnes
General waste per month	5,660.46		
General waste per capita		230	kg/capita/year
Hazardous waste per year	4,970.58		tonnes
Hazardous waste per month	414.22		
Hazardous waste per capita		17	kg/capita/year
Construction waste per year	169,914		tones
Construction waste per month	14,160.00		tones
Construction waste per capita		574.03	kg/capita/year
Garden refuse per year	26,451.30		tones
Garden refuse per month	2204.4		tones
Garden refuse per capita		89.36	kg/capita/year
Sand & fill per year	119,916		
Sand & fill per month	10,970		tones
Sand & fill per capita		405.12	Kg/capita/year
Capita	296000		
Total waste per capita and year		**1315.51**	**kg/capita/year**

It is important to note that operations at the landfill sites in Windhoek are carried out based on the South African Minimum Requirements for landfill sites (DWAF, 1998). Operations at the landfill sites are mainly responsibilities for private companies. Specifically for the Kupferberg landfill site, management and operational activities are carried out by Enviro-Fill Namibia, contracted by the City of Windhoek (Haindongo *pers. comm.*, 2009). Other landfill sites, the satellite sites are also taken care of by private contractors for the City of Windhoek.

According to the minimum requirements for waste disposal by landfill for South Africa, all sites must be adequately fenced or secured (DWAF*,* 1998). This is the case for all landfill sites in Windhoek. All sites are fenced, mainly at the entrance, since the rest of the sites are not accessible from any angle. The satellite sites are guarded on a daily basis between 7h30 am and 7h30 pm by gate controllers, so called 'spotters' i.e. those people who direct others as to where to dispose their waste of (Haindongo *pers. comm.*, 2009). At the Kupferberg landfill site, there are security guards, guarding the site on a 24 hour basis, in fact residing there.

All Windhoek residents are allowed to dispose their wastes at the disposal sites by themselves. Disposal of waste at the satellite sites is done at no cost, however, a certain fee is charged for disposing waste of at the Kupferberg landfill site - based on the amount of waste. Such a fee is used for the maintenance of the site (Haindongo *pers. comm.*, 2009).

4.5. Waste Recycling

Recycling as a waste management strategy is practiced in Windhoek. This strategy is essential particularly because recycling of waste products has some environmental benefits, including saving space in the landfills where the recyclable materials are accommodated, which may contribute to increasing the their lifespan (SWMD, 2008). Consequently, efforts are placed in collecting recyclable materials from the landfill sites. So far about 45% of waste that is disposed of at Kupferberg is recycled, while approximately 55% of the disposed waste is not recycled (Figure

4.4.). However, there is a potential for reducing the amount of waste disposed of at Kupferberg through recycling. This can be made possibly by identifying other possible recyclable materials, including garden waste.

Although the City of Windhoek is the main custodian for solid waste within the municipal area, it does not do recycling on its own. Recyclable materials collected in Windhoek are handled by recycling companies such as: Rent-a-Drum Group of Companies, Collect-a-Can and The Glass Recycling Company. These companies collect, semi-process and package the following types of waste: paper, glass, plastics and cans (see Table 4.6 for further details). The semi-processed commodities are then transported to South Africa for recycling. This is due to the fact that there is currently no recycling plant in Windhoek (Benade *pers. comm.*, 2009; Tjaronda *pers. comm*., 2009; van Wyk *pers. comm*., 2009).

Table 4.6. Some of the recycling companies in Windhoek

Company	Description	Materials recycled	Remarks
Rent-a-Drum Group of Companies (Rent-a-Drum, METRA, Khomas Recycling, Kleenbin)	Company offering a spectrum of waste management services that collects, transport, recycle and dispose waste of. In terms of recycling, it is responsible for the semi-processing of recyclable commodities, which are transported to South Africa for recycling (van Wyk *pers. comm.*, 2009).	Boxes, cans, papers, glass and plastics	• Offers employment opportunities • Saves space in the landfill • Promoting cleanliness and reducing waste • Trying to take recycling to a high level • Works closely with partners
Collect-a-Can	Recovery company that recovers cans from the environment. It emphasizes on recovering metal (steel and alumunium), which can be detrimental to the environment. It collects cans, compacts and package them, then transport them to South Africa for recycling. It is also dedicated to ensure that the used cans are in harmony with the environment (Tjaronda *pers. comm.*, 2009).	Cans	• Creates and offers employment opportunities • Saves space in the landfill • Strives to create awareness on the value of materials that make up the cans • Creates awareness among youth on reducing negative environmental impacts through can collection • Works closely with partners • Trying to take recycling to a high level
The Glass Recycling Company	Non-profit organization promoting recovery of glass from the environment for recycling. In Namibia, this company collects and transport glass to South Africa for recycling (GRC, 2009).	Glass	• Saves space in the landfill • Works closely with partners • Create awareness about the importance of glass recycling • Create employment opportunities • Striving to reduce waste • Trying to take recycling to a high level

For the purpose of collecting recyclable materials, individuals known as 'litter pickers' are formally employed and trained by private contractors on how to sort out recyclable materials from the unwanted waste disposed of at the landfill sites (CoW, 2008a; van Wyk *pers. comm.*, 2009). At Kupferberg, there is currently an individual contractor who has been contracted by Rent-a-Drum for the past 10 years, mainly doing the collection of recyclable materials at the site. This employee has so far employed 15 other people to support with the collection of the recyclables. Given the fact that picking recyclable materials from a disposal site can be hazardous, all employees at the site are provided with protective materials i.e. gloves, breath masks and boots. Apart from the employee at the landfill sites, other people have been employed/contracted to collect recyclable materials in other areas, for example in the informal residential areas and at the brewing industry. These are paid based on the amounts of materials that they collect.

The recyclable materials collected at the landfill sites are classified into categories, for example, papers, plastics, glasses and cans; after which they are compacted and weighed, before being transported to the recycling companies. The recycling companies have to ensure that all recyclable materials are semi-processed, after which they are packaged and send to South Africa for recycling (Tjaronda *pers. comm.*, 2009; van Wyk *pers. comm.*, 2009). According to the City of Windhoek's State of Environment Report for 2008, on average 6.5% of the total waste collected between March 2006 and January 2007 was for the recyclable materials. However, this data does not include the proportion of waste recycled by the recycling companies out of the city waste stream (CoW, 2008a).

Recently, a recycling initiative has been started in Windhoek, a joint venture between partners from the private sector that encourages collection of recyclable materials through recycling stations. This initiative is being driven by the Rent-a-Drum and Collect-a-Can companies (Schenck, 2009). Three companies: Woerman & Brock, Olthaver & List Group and Joseph & Snyman have set up

recycling stations at four shopping centres: AeGams, Auas, Wernhill Park and Maerua Mall as part of this initiative. At these stations, the following materials can be recycled: cans and tins (e.g. drinking cans, spray cans, aluminium food containers), papers (e.g. office paper, packaging paper, newspaper, magazine), plastic (e.g. plastic bags, juice bottles, cleaning liquid bottles, cream cups), and glass (e.g. food glass, drinking glass, bottles, glass jugs, glass cutlery).

The above mentioned recycling companies and partners (such as City of Windhoek, Namibia Breweries Limited & 4H Namibia Project) in Namibia have also taken an initiative to implement the idea of recycling in schools. Such an initiative encourages learners to take home recyclables such as papers, bottles, sweet wrappers along to schools; which are recorded by an assigned teacher as part of a competition. The learners that collect most recyclables and the schools with most tons of recyclables get prizes. Such an initiative is contributing to establishing an understanding of the value of waste materials and to waste reduction at the household level (Tjaronda *pers. comm.*, 2009).

4.6. Waste Treatment

Waste treatment as discussed earlier in Chapter 2 is one of the energy recovery strategies. One of the ways in which waste is treated in Windhoek is through incineration. Medical waste from hospitals is incinerated by the MOHSS, after which the residue is collected by the City of Windhoek for disposal at the Kupferberg landfill site (Uvanga *pers. comm.*, 2009).

Apart from the incineration of medical waste, wastewater is treated in order to be re-used. Wastewater treatment in Windhoek is essential, particularly because water is a scarce commodity, especially due to the growing population and the fact that Namibia is an arid country (du Pisani, 2006). For this reason, water demand in Windhoek is quite high. Consequently, the City of Windhoek has adapted a policy of treating wastewater in order to meet the water demand needs (Brinkman *pers.*

comm., 2009). Today, there are three water treatment plants in Windhoek, namely: Gammams Wastewater Treatment Plant (GWTP), Otjomuise Wastewater Treatment Plant (OWTP) and Ujams Water Treatment Plant (UWTP), which are used to treat wastewater for consumption (Menge, 2006; Menge *pers. comm.*, 2009). A large proportion of wastewater from the Windhoek residential areas is received at the GWTP, where it is initially treated, then further processed at the New Goreangab Reclamation Plant (NGRP), to be fit for domestic consumption (CoW, 2008a; Oaeb *pers. comm.,* 2009; Menge *pers. comm.*, 2009). The treated water from the NGRP is then blended with water from Omatako, Swakkopport and Von Bach Dams as well as from boreholes before finally distributed for use (Menge *pers. comm.,* 2009; Menge, 2006). According to du Pisani (2006), domestic sewage can be successfully re-used for potable purposes, and at least 35% of drinking water in Windhoek is reclaimed. Water from the newly developed residential areas in Windhoek is received at the OWTP, where it is initially treated, after which it is purified at the Old Goreangab Reclamation Plant (OGRP) to be fit or domestic purposes as well as for irrigation (Menge *pers. comm.*, 2009; Menge, 2006; Oaeb *pers. comm.,* 2009). One third of the waste streams of NGRP is also pumped into the OWTP (Menge, 2006). The UWTP is used to treat industrial effluents, which is used for irrigation. Through the treatment process, pollutants such as organic surrogates, dissolved particles, bacteria and viruses are removed (Menge, 2006).

The NGRP only became operational in 2002. It has a capacity of 21,000m^3/day and is operated by the Windhoek Goreangab Operating Company known as WinGOC (du Pisani, 2006; Menge, 2006). This plant has a goal to provide safe water, provide aesthetic pleasing water and to ensure that the technology applied does not create further problems. Prior to the establishment of the NGRP, the OGRP has been in use, after being operational since 1968. The old plant is currently used to treat effluents received at the OWTP, which are used for irrigating public parks and sport fields (du Pisani, 2006; Menge, 2006). The two

Goreangab reclamation plants have been established due to past experiences i.e. water shortage as a result to limited supplies and drought. It is important, however, to note that wastewater treatment can be of interest to users, as it can have many advantages such as using bio-solids (i.e. organic matters produced from waste water treatment) as fertilizers or as covers for landfills (EPA, 1999). However, bio-solids also have a potential for environmental risks due to organic contaminants from various sources (Bright & Healey, 2003).

To ensure that treated water is safe to drink and is fit for any other use, it is continually monitored (du Pisani, 2006; Menge *pers. comm.*, 2009). For this reason, parameters such as physical, inorganic, organic, microbiological and viral contents are tested (Menge, 2006). The aim is to ensure that treated water does not have health implications, neither environmental or nuisance impacts (EPA, 1999). This work is done in the City of Windhoek's laboratory. However, there is a Health Risk Programme that performs more advanced tests externally, looking at aspects such as viruses, parasites, pesticides, toxins, odour compounds and others (Menge, 2006).

4.7. Waste Auditing

Waste auditing is one of the important practical aspects of waste management. In essence, waste should be audited in order to collect valuable waste statistics, for the purpose of establishing an understanding of the real situation regarding the composition of waste generated in a specific area. With reliable waste statistics, the waste management processes can improve, waste can be minimized, and trends on waste generation can be established (CoW, 2008a; EUROPEN, 2009; SWMD, 2004; SWMD, 2008). Regular waste statistics are also relevant for implementing waste policies (EC, 2002). The City of Windhoek has adopted a system of waste auditing, currently conducted on a bi-annual basis. Waste audit in Windhoek is however performed only for formal households, leaving out the informal households and industries that are taken care of by private companies (SWMD, 2008).

According to the audits performed in 2004 and 2008, the amount of waste generated by high-income households ranges between 16kg and 20kg per week, while the amount of waste generated by the medium-income households ranges between 9kg and 13kg per week. For the low-income households, the waste generated per week ranges between 7kg and 14kg. On average, 3.4, 5.4 and 5.7 persons live in high, medium and low income households respectively (SWMD, 2004; SWMD, 2008). Based on this information, the estimates of waste generation per person are presented in Table 4.7.

Table 4.7. Average weights of waste generated by different income groups in Windhoek

Year	Income Group	Persons/ household	Average kg/household/week	Average kg/ person/week	Average kg/ person/day
2004	High	3.4	16.5	4.85	0.70
	Medium	5.4	9.0	1.6	0.23
	Low	5.7	7.5	1.3	0.19
2008	High	3.4	19	5.59	0.80
	Medium	5.4	13	2.41	0.34
	Low	5.7	13	2.28	0.33

Source: SWDM, 2004; SWMD, 2008

Overall, the average amount of waste generated per person per day in 2004 and 2008 was 0.37 kg and 0.49 kg respectively, based on household data. The 2004 waste audit data agrees with the study conducted by the Windhoek City Engineers in 2004, which revealed that an amount of 0.35 kg is generated per person per day (CSA & Smith, 2007). However, such data includes waste data from other waste streams. In addition to the above information, data collected from Windhoek households between July 2006 and March 2007 indicated that an amount ranging between 0.604 – 0.813 kg was generated per person per day in general, which is quite high and is expected to increase (CoW, 2008b). Such an amount should however be reduced.

The amount of waste generated at the household level in 2008 can be determined using a waste indicator of 2.14kg/household per day (calculated from Table 4.7 above), by multiplying it with the number of days in a year (365) and by the number of households in Windhoek (50 000). This gives an estimate of 39,055 tons that was generated from households, which means that the difference between the overall city waste estimate and the household waste estimate was generated from other sources (e.g. industries and commercial activities).

Based on the 2008's household audit, of all the types waste generated by households that were surveyed, the largest volume of waste is made up of unclassified wastes♦ (1033.2 m^3), followed by plastic bottles (617.4 m^3), papers (615.2 m^3), carton (542.7 m^3), organic garden waste (514.8 m^3), plastic bags (497.4 m^3) and glass (355.3 m^3) respectively. The least generated type of waste is medical waste, generated at 0.8m^3 per week on average. Other types of waste generated are: metals (246.3 m^3), organic food (202.4 m^3), sand and stones (33.4 m^3), textile (60.6 m^3) and chemicals (104.8 m^3). The conclusion that one can draw from this is that most households generate the unclassified waste in large quantities compared to specific waste types.

After comparing the audits conducted in 2004 and 2008, there was not so much difference found in the amounts of waste generated, therefore the 2008's waste audit has recommended that audits should be conducted every 5 years. The auditors however noticed that results can vary depending on the time of the year when auditing is conducted, as the amount of waste generated may be determined by the season during which the audit is performed (SWMD, 2004).

♦ The type of waste that could not be classified include: electronic equipment, shoes, rubber, leather, carbon sheets, foam cups ceramics and light bulbs.

4.8. Legal Framework

As emphasized by the Constitution, Namibia has adopted various laws, policies and regulations that guide the implementation of various activities regarding waste management. Windhoek specifically makes use many of those, some of which are listed in Table 4.8. Of the listed frameworks, some are only applicable to the City of Windhoek.

The Windhoek Municipality has placed the 'polluter pays principle' as a priority, therefore it strictly enforces such a principle in order to avoid and reduce negative environmental impacts. To reduce environmental pollution by industries, the City of Windhoek's Division of Bulk Water and Waste Water is committed to the monitoring of industrial effluents generated on a monthly basis and charge them fees in cases when the absorbed oxygen is above 70mg/L. The Solid Waste Management Division also charges individuals that dispose general and hazardous waste at the Kupferberg Landfill site based on the amount of waste disposed. In addition, removal of refuse from the wheelie bins is also charged a monthly fee per household, and in cases when refuse is collected more than once per week, additional fees are charged. Furthermore, businesses that pollute the environment are charged fees for that. The idea of the polluter pays principle is appropriate because the costs of pollution are taken care of by the pollution generator rather than the entire society (Glazewski, 2005).

At the moment, the Ministry of Environment and Tourism is in the process of transforming the Pollution Control and Waste Management Bill of 1999 into an Act (Nghitila *pers. comm.*, 2009). This Bill is concerned with the prevention and regulation of air, water and land pollutants; establishment of an appropriate framework for integrated pollution prevention and control, regulation of noise, dust and odour, as well as an establishment of a system of waste planning and management. In addition, the City of Windhoek has adopted the Model Drainage Regulations that have been provided by the Ministry of Regional, Local

Government and Housing, applicable at the national level. However, at the local level the City of Windhoek has drafted Sewerage and Drainage Regulations which are concerned with the water disposal within the city. It is crucial that industries comply with those regulations. These are in a process of being promulgated into an Act (Iiputa *pers. comm.*, 2009).

When it comes to the implementation and development of relevant laws and regulations regarding waste management, many stakeholders that were consulted indicated that there has been a slow progress. All laws, policies, regulations that have to do with pollution control, waste management, drainage and sewerage have to be implemented as soon as possible to ensure sound waste management. However, many of such are still new and still need to go through some stages before they can be implemented.

Table 4.8. Laws, policies and regulations applicable to the City of Windhoek and Namibia at large

Framework	Description/Emphasis	Applicability
Environmental Management Act No. 7 of 2007	Emphasizes sound waste management and safe disposal	Nationally (yet to get into force)
General Health Regulations	Control water pollution, refuse removal and disposal and emphasizes cleanliness in general, particularly on matters which could be detrimental to health	Nationally
Hazardous Substances Ordinance 14 of 1974	Provides for the prevention of dumping of hazardous matter that may be detrimental to the environment	Nationally
Labour Act 15 of 2004	Stresses taking precautions against dust in, or about any premises or in connection with any operation	Nationally
Local Authorities Act 23 of 1992	Empowers local authorities to regulate the maintenance of services such as waste removal and disposal, and those of sewerage works and drainage systems	Nationally
Model Sewerage and Drainage Regulations	Regulate the provision of sewerage pipelines, effluent control and drain layers registrations	Nationally
Pollution Control and	Emphasizes the prevention and regulation of	Nationally

Waste Management Bill of 1999	pollutants, pollution prevention and control, regulation of noise, dust and odour, and sound waste management	
Pollution Prevention Ordinance 11 of 1976	Provides for the prevention of atmospheric pollution, emphasizing on the following: control of offensive gas, atmospheric pollution by smoke, dust control and air pollution by vehicles	Nationally
Sewerage and Drainage Regulations	Prepared to regulate the provision of sewerage pipes, control of effluent and drainage within the City of Windhoek	Locally
Street and Traffic Regulations	Control noise pollution, environmental pollution and deals with sweeping of streets in front of businesses	Locally
Town Planning Ordinance No. 18 of 1954	Provides for town planning schemes and the provision, management and closure of public open spaces	Nationally
Town Planning Scheme	Responsible for the control of disposal of refuse, rubble or hazardous substances that may pollute groundwater except at designated waste disposal sites	Locally
Water Act 54 of 1956	Deals with the purification of industrial water and effluents, based on the SABS standards that prescribe the use and restriction of boreholes, and the protection of the aquifer	Locally
Water Demand Policy	Controls the provision of, and undue wastage of water supply within Windhoek	Locally
Water Resource Management Act 24 of 2004	Stresses that permits should be obtained for the purpose of discharging effluents or construction of effluent treatment facilities	Nationally
Water Supply Regulations	Regulate the prevention of undue water consumption and supply of non-portable water to the council, private boreholes and the laying of pipes in streets and public places	Locally

4.9. Conclusion

The Division of Solid Waste Management is acknowledged for keeping Windhoek the cleanest city in Africa. Other departments and divisions: Planning, Urbanization and Environment; Scientific Services; and Bulk Water and Waste Water are placing efforts on environmental management at large and have roles to play in waste management and pollution control. Waste production in Windhoek is influenced by the increasing population as well as the level of income.

For the purpose of waste prevention and storage, 'wheelie bins', street bins, skip containers and black garbage bags are distributed to households, businesses and informal residential areas. Private contractors through the Division of Solid Waste Management do the collection of waste from garbage containers for disposal. Pollution by industries is controlled by the Division of Bulk Water and Waste Water. Garden refuse and building rubbles are disposed of at six satellite sites in different locations within Windhoek, while the household, commercial and industrial waste; including hazardous wastes are disposed of at the Kupferberg landfill site. The sites are monitored to ensure environmental acceptability. They are also guarded. All landfill sites in Windhoek are operated according to the minimum requirements of landfills for South Africa. The City of Windhoek contacts waste audits on a bi-annual basis to get valuable waste statistics on household waste. Industrial and commercial waste is audited by private companies.

Various recycling companies exist in Windhoek, some of which have recently established a recycling initiative for recycling paper, glass, plastics and cans, using recycling stations placed at various shopping malls. The intention is to recover energy and to reduce waste. In terms of treatment, medical waste and waste water are the only types of waste that are treated in Windhoek. Treated water is used for domestic consumption and for irrigating parks and sport fields.

There are many legal frameworks that are of relevance to waste management and pollution control in Namibia, many of which are used by the City of Windhoek. However, some of the frameworks are only specific to the Windhoek city. In addition, a slow progress has been experienced in the development and implementation of relevant laws. This issue needs to be addressed.

Chapter 5: Areas of Improvement and Recommendations

5.1. Introduction

High level of environmental protection is essential to promote healthy environments in Namibia, which will contribute to the quality of life for all citizens (MET, 2008). Currently there is an increasing demand of waste management in Namibia, as a result of the growing population and industrial development. Consequently, increased efforts in making use of the existing waste management strategies are necessary, as they will contribute to environmental protection through the reduction of waste volumes. Increased efforts in waste management in all towns of Namibia will also promote urban sustainability.

As pointed out earlier in the previous chapters, managing waste on its own is a challenge, because it can result in negative environmental impacts, for example, use of land for landfills, emission of greenhouse gases from landfills, air pollution, water pollution and generation of secondary waste streams from recycling plants (Christiansen, 1999). Regarding this notion, the negative consequences that can occur in the process of managing the target waste should not be ignored. Therefore, placing efforts in waste management should still remain a priority, while at the same time trying to avoid the possible consequences.

Having an understanding of how the web of life operates, as described by Capra (1996; 1999), can contribute to improved waste management; such that all levels of the waste management hierarchy should remain interconnected. As a result, environmental impacts such as high volumes of waste generated, poor aesthetic views, smell nuisance, health hazards and shortened life spans of landfills will be reduced. Such an understanding needs to be established all over Namibia.

Apart from the waste management hierarchy, other principles of waste management described in Chapter 2 are necessary, and should be put into practice. In addition, engagement of relevant stakeholders for waste management

in different towns of Namibia is essential, and cooperation between them should be encouraged. On top of these, the use of legal frameworks in terms of waste management should be given a high priority. In essence, the notion of basis of informed decision-making is the knowledge about waste streams. Furthermore, other aspects of waste management such as information availability, limited management capacities, an urgent need for training and awareness building measures on the part of public administrations and commercial enterprises combined with insufficient budgets should be emphasized. The fact that recycling can reduce disposal cost and that it has been proven to be cost-effective also need to be realized.

This chapter has considered the practical aspects of waste management in various towns of Namibia and has identified some of the areas that need improvement.

5.2. Waste Generation and Statistics

In theory, waste generation depends on how resources are consumed, on the population density, on GDP, as well as on the income levels (Christiansen, 1999; Henry *et al.*, 2006; OECD, 2002; SoER, 2001; SWMD, 2004; SWMD, 2008). It is crucial to have comprehensive and reliable data on waste, as it contributes to improved knowledge on potential trends of waste levels, and their composition will provide background information especially when it comes to the identification of waste problems, in the process of developing waste management strategies or policies (Christiansen, 1999). Lack of such data also makes it difficult to assess whether negative environmental impacts associated with waste management are improving or deteriorating (Fatta & Moll, 2003).

Reliable data obtained during this study were mainly for household waste, general waste, as well as data from the satellite sites in Windhoek. However, in future, waste data from other sources, such as industries and businesses also need to be collected, as it can give a clear picture of waste generation and management in a

specific town. In fact, most of the waste data availed for this study were obtained from Windhoek, followed by Ondangwa. This study has found that not many towns are collecting waste data at the moment. Therefore in terms of waste statistics, Namibian towns are well advised to learn from Windhoek.

Knowing the composition of waste as well as the total waste generated at the town level is indispensable, as it helps to determine the waste indicators (Broderson *et al.*, 2002). At least the Greenhouse Gas Inventory of 2000 has provided an insight on solid waste composition in Windhoek. In essence, waste indicators such as waste generated per capita or overall waste generated at the town level need to be determined, as they point out the problematic areas and possibilities of improvement (Fatta & Moll, 2003). These may be determined by the type of waste produced. They also provide an overview of the waste situation for a specific source in order to change the rate of waste generation. Waste statistics cannot only be applied at the town levels, they can as well be applied at the national level as informative tools which integrate environmental data with economic aspects (Fatta & Moll, 2003). It is essential that all towns should be in positions of providing detailed data on the composition of wastes.

Waste data are also needed in the implementation of environmental auditing systems (Starkey, 1998). Therefore, waste audits need to be emphasized in all towns of Namibia, for the purpose of making environmental decisions regarding waste management. It is required by ISO14001 that audits should be undertaken to check whether environmental management systems meet their requirements (Starkey, 1998). Town municipalities and councils in Namibia therefore need to familiarize themselves with such a system, as it can help them to measure both their environmental performances as well as their efforts to improve performance in the management of waste at town levels.

Windhoek is to be acknowledged for being in a position to provide reliable waste data. Nevertheless, most of the data collected in Windhoek that is presented publicly is from the municipality. It is imperative that private waste management companies should report the type, amount, origin and destination of waste collected and handled to public waste statistics from various waste streams. Such data should be included, and those stakeholders (private companies) should be involved in the development of policies geared towards waste management, as well as in decision-making concerning environmental activities.

Generally, all types of waste have environmental impacts. There are high possibilities that environmental impacts will increase if waste is not well handled, especially for the fact that the Namibian population is increasing. Such impacts can be reduced by placing increasing waste management efforts, including implementing better technologies for dealing with waste (OECD, 2002). Namibia could also adopt some of the recommendations for the OECD[f] countries that have been proposed in the Guidance Manual on Environmentally Sound Management of Waste (OECD, 2007). Overall, governments of the OECD countries have been recommended "*to implement policies and/or programmes to ensure that waste is managed in an environmentally sound and economically efficient manner*" (OECD, 2007:20). Implementing such a recommendation requires governments to engage in activities that are promoting sustainable development; such as use of regulations, recycling of materials, use of less/non-hazardous substances, use of cost-effective materials; and considering other factors such as geographical (e.g. climate, geology, population density etc.), industrial structure (number and size of enterprises), characteristics of waste (e.g. less or more hazardous), type of operation (collection, disposal, recycling), legislation at different levels (national or local) and economic utility of resources and products involved, as well as the use of market incentives.

[f] OECD – Organisation for Economic Cooperation and Development

Out of this recommendation, a total of eleven specific recommendations have been derived and made to the governments of such countries, one of which Namibia can make use of.

Recommendation 3: "*Member countries should ensure that waste management facilities are operating according to the best available techniques, while taking into consideration the technical, operational and economic feasibility of doing so, and work towards continually improving environmental performance*" (OECD, 2007:23). Using the Best Available Techniques (BAT) should be seen as a tool for ensuring that waste is managed in an environmentally sound manner within a particular waste management facility (OECD, 2007). Considering the fact the use of BATs brings about environmental benefits, its implementation should consider using national or international regulations. Such benefits can be derived through various initiatives such as promotion of existing techniques, use of incentives, development of waste management programmes, improving the current operating practices and updating of data related to waste management techniques etc. Through such an approach, environmental performances of waste management facilities are likely to improve. This can be made possible with reliable waste statistics in place.

With the waste management hierarchy in mind, waste managers should be in a position to tell as to what proportion is generated in total, what proportion out of that is recycled, how much is treated and how much is disposed of. Consequently, all towns need to realize that availability of regular and comparable data on recycling, re-use, treatment and disposal of waste plays a role in the implementation of waste management strategies (Fatta & Moll, 2003). Such information needs to be known since each of the existing waste management strategies may have its own negative impacts, and each may need to be dealt with in its own way. Therefore, such a hierarchy needs to be applied in all towns.

5.3. Waste Prevention

The fact that Windhoek is the cleanest city in Africa has given Namibia so much credit in terms of waste management. However, such credit is due to the Division of Solid Waste Management within the City of Windhoek. Similar efforts need to be placed in all towns of Namibia. The City of Windhoek has contracted some companies which are responsible to keep the city clean. At the same time, the Solid Waste Management Division keeps being on the outlook for the unattended waste and works closely with such contractors, to make sure that the city is clean (Haindongo *pers. comm.*, 2009). Despite the fact that other town municipalities and councils also have contracted companies to deal with waste, some towns still appear to be untidy. This could mean that the town municipalities are not strict when it comes to waste prevention, or the management capacities are still lacking. Consequently, action needs to be taken to overcome the waste problems in other towns. Based on my personal observations, lack of training and awareness is one of the factors that contribute to filthiness in some towns of Namibia. Some people tend to dispose waste (litter) in open areas despite the fact that garbage containers are in the vicinity. Such a practice needs to be stopped, possibly through creating awareness on the environmental impacts of waste. In addition, all opportunities that will lead to environmental improvement in terms of waste management need to be identified in all towns.

Minimization of waste should be prioritized by all towns. This is possible through the application of the waste management hierarchy, which has given preference to waste prevention, followed by recycling/re-use, treatment and disposal respectively (Jacobsen & Kristoffersen, 2002). Once the waste is generated at a source, it can be passed on to other companies that can use it to avoid the costs of waste disposal (Starkey, 1998). Useful waste materials can also be re-used for other purposes. Waste that cannot be recycled can be treated, which can reduce the amount that can be disposed of. It is also essential to shift the current waste management strategies from collection and disposal to the waste management

hierarchy approach, mainly emphasizing waste prevention, followed by recovery and finally environmentally sound disposal only for non-recoverable waste (OECD, 2002). At the moment, the towns that were surveyed mainly collect and dispose of some waste materials, for example garden refuse, while placing no efforts on recovery. In such a way, the web of life is broken.

Waste minimization is also possible through the reduction at a source, re-use of products and quality improvements such as reduction of the hazardous waste (Jacobsen & Kristoffen, 2002). Increasing waste quantities can cause pressure on treatment facilities, which makes it difficult to reduce landfilling but rather raise the recycling rate. For this reason, waste prevention, recycling and re-use of waste materials must be encouraged in all towns, which will reduce the volumes of waste that may be treated before the final disposal.

For the purpose of preventing and minimizing waste, Namibian towns should strive to adopt the BATs. In essence, they should aim to use low-waste technologies, use less hazardous substances, recover and recycle substances, treat waste, minimize the negative environmental impacts of waste and make use of technologies which have been tried with success (OECD, 2007).

5.4. Waste Recycling

Recycling can be of environmental, technical and economic benefits (Jacobsen & Kristoffersen, 2002). In addition, it reduces usage of space in the landfills and lengthens their life spans. For this reason, the benefits of recycling need to be realized by all towns in Namibia. At the moment, the recycling systems may be poor, and there could be lack of economic capital to improve the infrastructure and technology for more environmentally sound waste management; however, that cannot be an excuse for not recycling (OECD, 2002).

The recycling initiative in Windhoek has demonstrated that recyclables can easily be collected at collection stations, which is convenient for all the people in those

areas. From this, lessons can be learned by other towns of Namibia in order for them to endorse similar initiatives. Nevertheless, there are currently some challenges associated with costs, waste transportation and management of services. In order to influence the development of similar practices in other towns, such challenges need be addressed at a speedy rate. For this reason, sources of funding towards recycling need to be sought. Once the recyclables are collected, they need to be packaged and transported (Starkey, 1998). Therefore, negotiations with companies that transport goods between towns also need to be made, as they can possibly help to transport recyclable materials to Windhoek (Tjaronda *pers. comm.*, 2009). Most importantly, there should be cooperation between various companies that support recycling. All such efforts will contribute to reduced waste volumes.

In essence, the government in collaboration with private sector and municipalities should support existing recycling schemes and encourage the development of new and environmentally sound ones, through providing incentives to potential recycling participants (OECD, 2007). Communities should therefore be encouraged to participate in recycling and should start to 'see waste as money' - meaning that for every waste being collected, or for a certain composition of waste being collected, a certain price should be paid to the collector (Tjaronda *pers. comm.*, 2009).

It is also worthwhile to consider the fact that business activities also contribute to waste generation, which as a result have impacts on the environment. Therefore, businesses should realize the relevance of re-using and recycling materials as an approach to reducing environmental impacts. Business activities involve extracting raw materials from the environment, which in return generate waste that is fed back into the environment (Starkey, 1998). Consequently, there is a relationship between business and the environment. Nevertheless, not all businesses extract raw materials from the environment, as some are only supplied by other firms

through supply chains. Thus, the supply chain has a link with the environment (see Figure 5.1).

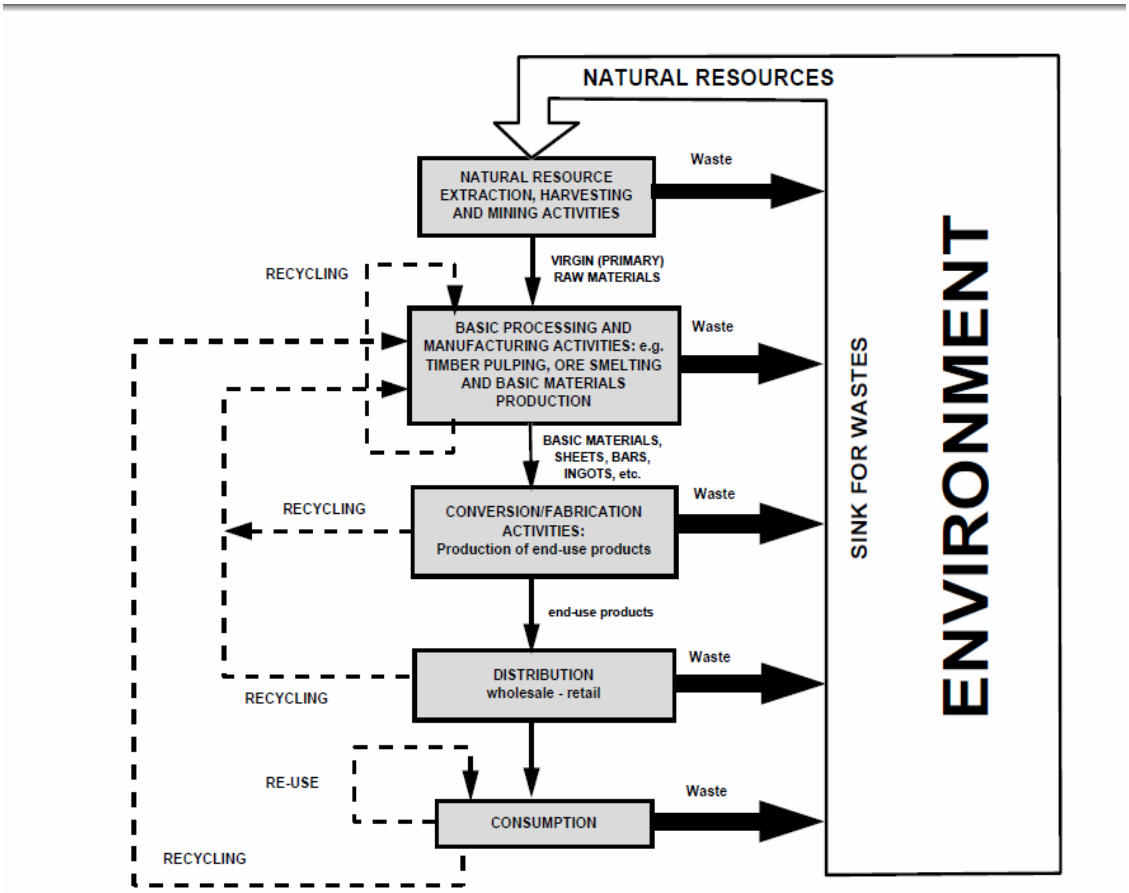


Figure 5.1. Relationship between the environment and the supply chain (Source: Starkey, 1998)

5.5. Waste Treatment

Waste treatment is not really a common practice in the towns of Namibia. The types of waste being treated are mainly medical waste and wastewater. Treatment of wastewater has been proven useful for providing potable water in Windhoek (du Pisani, 2006). If this method can be applied in other towns in Namibia, the needs of water provision can be met; especially that Namibia is an arid country. Any

challenge to this strategy such as financial constraints and capacity to do it need to be identified. Alternatively, Namibian towns (those that can) may opt to use the water from the Atlantic Ocean, which can be made possible by making use of solar energy (steam driven) to pump the water from the ocean, de-salinate it and pump it into the country. This would also mean a lasting investment into the infrastructure. Since such a system can easily break, towns may invest in the treatment plants to treat the sea-water before pumping into municipal water networks.

Based on the findings of this study, not many towns are currently practicing solid waste treatment; however, such a waste management strategy can reduce the amount of waste being disposed of, as well as negative environmental impacts. Garden refuse is one of the types of solid waste that is disposed of in landfill sites, however it can be used for other purposes if treated. In actual facts, garden refuse can take up much space in the landfills despite the fact that they can be compacted, which can shorten the life spans of the landfill sites. Depending on its composition, garden refuse can be composted, possibly along with other biodegradable waste such as kitchen organics etc. Composting of biodegradable waste can reduce the total volume of waste being disposed (OECD, 2002). In this case, a wood shredder and a caterpillar would be required to move the piles while composting. The compost may be a useful fertile resource in the arid and sandy Namibia, especially in soils with low nutritional content (Habitat Namibia, 2008). The proposal for this method agrees with the recommendation made by the waste audit for the City of Windhoek performed in 2008, particularly for the fact that high composition of garden waste was observed during the audit, especially from the high income and medium income households (SWMD, 2008). Through composting, garden refuse can as well be used as humus for (re)cultivation or as energy carrier/wood-biomass (Berchtold, *pers. comm.*, 2009).

In terms of waste water treatment, the end product is the sewage sludge. Treated sludge can be used as fertilizer (SC, 2001). Specifically in Windhoek, sludge is used as compost by gardeners and farmers, and can simply be disposed of in case no one uses it (Brinkman *pers. comm.*, 2009; Menge *pers. comm.*, 2009; Oaeb *pers. comm.*, 2009). Using sewage sludge as fertilizer can reduce the requirements for artificial fertilizers and can contribute to soil conservation through humus build-up and prevention of land erosion (Mara & Cairncross, 1989). Although soil and ground water can potentially be polluted by agricultural use of human excreta, negative impacts can be minimized through scientific sound planning and effective management of fertilization regimes (Mara & Cairncross, 1980). Nevertheless, there are plans to start using sewage sludge from the treatment plants in Windhoek as commercial fertilizer since agriculturalists need it for their agricultural practices (Menge *pers. comm.*, 2009). Sewage by weight is heavy, thus it is planned to transform it into pellets, which can be easily transported between towns. The same could be done in other towns.

Other types of waste being disposed of in open dumping sites and landfill sites such as hospital waste, may not be safe for the environment within which they are disposed, especially if there are no strict operations for such disposal sites. Such types of waste therefore need to be treated, not only to reduce waste volumes, but mainly to reduce negative environmental impacts such as health hazards. Apart from the treatment of solid waste, treatment of liquid waste for example wastewater can reduce negative environmental impacts, for example, pollution (OECD, 2002). If only the positive side of treatment can be realized in the towns of Namibia, negative environmental impacts are likely to be reduced in the long-term.

5.6. Monitoring

However, having 33.3% of the towns contacted during this study, and possibly more which did not consider conducting EIAs for the disposal sites means that the environment around such sites is threatened. Those towns represent approximately 2.6% of the total Namibian population and 6.4 % of the urban

Namibian population, made up by a population of just over 830 000 people. The above proportions represent the populations being at risk of environmental impacts of the disposal sites according to the study. While the environment around the site is threatened, groundwater is also threatened, as it can get polluted. However, Namibia cannot afford to contaminate groundwater, the main source of water in a water scarce country. Not only water contamination, other likely impacts such as health hazards and smell nuisance can be experienced. As a result, monitoring of the disposal sites is essential (DWAF, 1998).

This study has found that monitoring of the disposal sites needs to be placed as a priority. Improvement needs to be made in the monitoring of the disposal sites, particularly because monitoring is a valuable environmental management tool. So far the monitoring of disposal sites being done in most towns mostly considers the types of waste being disposed of and to ensure that the site is in an acceptable condition. However, that is not quite enough, more needs to be done. Windhoek is a good place to learn from. Ideally, all towns should have some standard monitoring and operation guidelines for their disposal sites.

Open dumping sites are more vulnerable to vandalism and pose health hazards and smell nuisance due to soil, groundwater and air pollution compared to the operated landfill sites. Monitoring them strictly is therefore essential to ensure their safety and to reduce negative environmental impacts. In fact, such a practice needs to be stopped in all towns so that they can make use of landfill sites for disposal. It is essential that monitoring should go beyond the superficial features to other parameters such as the soil, soil vapours and groundwater quality. Nevertheless, the operated landfill sites are also vandalized. For this reason, security around the disposal sites needs to be strict, as vandalism still persists despite the fact that sites are currently guarded. Those sites that are only guarded during the day need to be guarded on a 24 hour basis.

5.7. Legal Frameworks

In political reality, good governance and sustainable development cannot be separated. Therefore the use of policies, laws, and regulations towards the management of waste in various towns on Namibia is acknowledged, as they are elements of governance for promoting sustainable development. At the moment, it is a bit discouraging that there is a slow process in implementing some of them, despite the fact that they are the guiding frameworks for the implementation of various environmental activities (EMA, 2007; MET, 2008). Such a process needs to be speeded up. In addition, relevant laws such as the Pollution Control and Waste Management Act and the Sewerage and Drainage Act for the City of Windhoek need to be in place as soon as possible. Furthermore, it would be ideal for all town municipalities and councils to develop their own laws and policies for local use. While some towns still present poor aesthetic views, they need to be strict in terms of environmental law. Windhoek is a good place to learn from. Should the Namibian towns decide to implement new technologies (BATs), such technologies should be part of the national regulations.

5.8. Conclusion

The identified weaknesses concerning waste management in the towns of Namibia can be used as opportunities for improvement. Reliable waste data need to be provided, as they play a significant role in waste management. Availability of such data contributes to decision-making processes, as well as to the implementation of waste management strategies. So far, waste data readily made available is on household waste; however, other data such as industrial and business waste also need to be collected. Through the application of the waste management hierarchy, waste is likely to be minimized. Data from all levels of the hierarchy i.e. the amount of waste generated, recycled, treated and disposed of need to be collected. Windhoek is currently doing a great job in waste data collection and in maintaining cleanliness. Other towns should just learn from it.

Waste indicators such as waste generated per capita are needed to point out the problematic areas and possibilities of improvement. These can be calculated through waste audits. All towns in Namibia need to practice conducting waste audits, to fulfill the ISO14001 requirement. This will help to ensure that their systems for waste management are meeting their environmental management requirements.

Waste needs to be minimized as much as possible, particularly through the application of the waste management hierarchy. Minimization of waste is also possible through the reduction of waste at a source as well as through quality improvement, which includes the reduction of the hazardous wastes. In addition, the benefits of recycling need to be realized, and recycling needs to be promoted to attain those benefits. Through implementing the recommendation for the OECD countries, as quoted: "*to implement policies and/or programmes to ensure that waste is managed in an environmentally sound and economically efficient manner*", improvement in the waste management practices in Namibia is likely. This can be made possible through the use of BATs as well as the use of market incentives to ensure environmentally sound recycling.

The recycling initiative in Windhoek can be replicated in other towns of Namibia. Current challenges for having similar practices in other towns only need to be addressed. Funding opportunities to support the recycling initiatives need to be sought. In addition, Cost-Benefit-Analyses (COBA) may demonstrate the profitability of waste prevention and recycling. Further to that, means of transporting recyclables between towns need to be in place. Moreover, cooperation between various recycling stakeholders needs to be developed and strengthened.

The relationship between the environment and business needs to be understood, as this can enhance the re-use and recycling practices in Namibia. It should be

noted that disposing waste is not a solution to reducing waste volumes, using other alternatives for dealing with waste such as composting garden refuse and placing more efforts on recycling, re-using and treatment of waste materials can be a solution. Handling waste in such a way can lengthen the life spans for the landfills, while at the same making use of waste materials.

Monitoring of disposal sites should be placed as a priority. Such a tool should consider aspects such as the general conditions of the site, security of the site and other important parameters such as groundwater quality. Further to that, treatment of waste reduces negative environmental impacts, and this needs to be realized all over Namibia. Additionally, wastewater and sea water can be treated to meet the water demands in Namibia.

In terms of governance, the implementation and enactment of relevant laws towards pollution control and waste management should be speeded up. It is also essential to have legal frameworks at town levels. To ensure that waste producers and importers take responsible steps towards the minimization of environmental impacts of the waste products, particularly those chemicals that have certain hazardous properties; the “product-stewardship principle” should be practiced across Namibia. Further to that, having inventories for such products and substances may form the basis for producers/importers’ liability frameworks and orderly collection and treatment of resulting wastes.

Chapter 6: Possible Waste Management System for Urban Namibia

6.1. Introduction

In terms of waste management, Namibia can only be a better place if appropriate waste management technologies are being implemented in all towns across the country. So far the local town councils and municipalities are doing their utmost best to manage waste in their respective towns; however, to some extent there are some areas that still need improvement. Issues such as waste minimization, landfill site monitoring and reduction of negative environmental impacts still need attention. Furthermore, systems for collecting waste statistics need to be in place in order to ensure that relevant data on waste are collected to inform decision-making. Most importantly, the use of legal framework and law enforcement should be regarded crucial. Through the development of a standard waste management system, the current weakness can be addressed, and should in fact be seen as opportunities for improvement.

This chapter serves to introduce a possible system for handling waste in the urban Namibia. Such a system will involve the use of a waste indicator model.

6.1. Estimation of waste indicators

Organized reporting systems for waste data need to be developed for all towns in Namibia. To ensure all types of waste being generated by different towns are identified, it is essential that registers for recording different types of waste should be in place. Registers can be used to record different types of waste collected, which can as well be categorized as: recyclable materials, re-usable materials, hazardous waste, general waste etc. Composition of waste from different waste streams such as house holds, industries, agriculture, veterinary services etc. need to be recorded. Such data is essential for estimating statistical waste indicators, which can be calculated using the following formula.

Waste indicator = total amount of waste generated/local population per time series (yearly, monthly or daily)

(KV3, 2003; Scheshinski, 2001)

Waste indicators can be estimated for the types of waste generated over a certain period of time, such as: sewage sludge, recyclable materials, hazardous waste and the overall general waste. Waste statistics are needed to raise awareness among decision-makers within the local authorities, the government and all relevant stakeholders so that they can address the main problem (Scheshinski, 2001). They can also be used in the development of policies.

The above formula can be applied at the town level, as well as the national level. Table 4.5. in Chapter 4 has provided an estimate of the total waste generated per person per year in Windhoek, based on data collected from different waste streams i.e. households, industries and commercial activities. That Table can be referred to as a waste indicator model. Based on the calculations, it was estimated that an amount of 1,315.51 kg was generated per person per year. However, this figure excludes the amount of waste that was collected independently by private companies for recycling. It also excludes the amount of sludge produced from wastewater treatment, which could not be obtained during this study. Nonetheless, it is worthwhile to note that the screened materials from the treatment plants are also disposed of at the Kupferberg landfillsite (at least 2 skip loads per week), whose amounts are included in the general waste. Assuming this is the amount of waste generated per person across all towns of Namibia, the amounts of waste generated in individual towns can be calculated, in order to determine the national urban waste generated in a given year (Table 6.1).

Based on the findings in Table 4.5, the amount of waste disposed person per year is quite high, however it needs to be reduced. In order to reduce the amounts of waste being disposed of and to create space in the landfills, it is essential that the BATs should be applied where possible. At the moment, large proportions of waste disposed of in the landfills in Windhoek are made up by general waste (comprising recyclables and non-recyclables), garden refuse, building rubbles and sand (see Figure 6.1). Nevertheless, the Solid Waste Management Division is doing its best to collect all recyclable materials such as bricks, woods, metals, plastics, papers, glass etc.; which actually reduces the amount of waste disposed per capita per year. So far, garden waste is only disposed of without considering the alternative options to make use of it. Therefore, composting should be considered as an alternative for handling garden refuse rather than diposal, whereby waste should be collected for degradation purposes and be used for gardening or agricultural purposes. Alternatively, garden waste can be jointly biodegraded with sewage sludge.

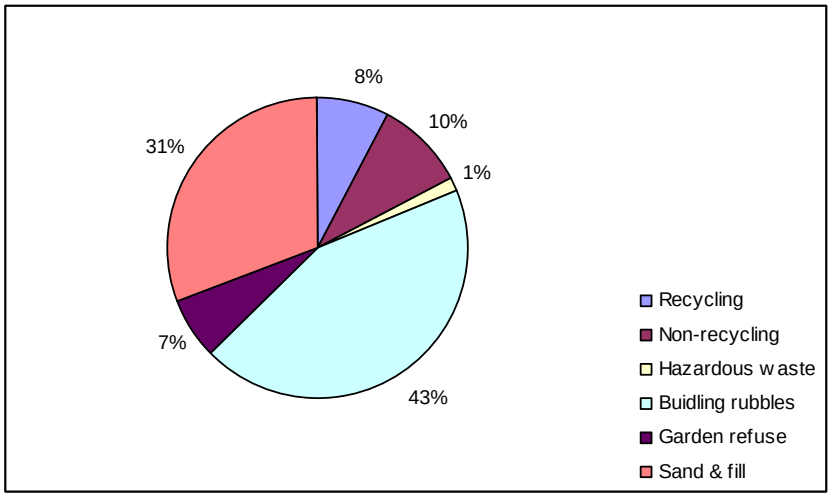


Figure 6.1. Fractions of the different types of waste disposed of at the landfill sites in Windhoek

With the exception of the non-recycling fraction going that is landfilled and the hazardous waste, the above diagram visualizes the total recycling potential. Building rubbles can be recycled almost 100%. The same applies to sand and garden refuse, as they can be used for some purposes.

Table 6.1 below presents the amounts of waste generated in individual towns of Namibia, after which the national urban estimate for 2008 was calculated. The amounts generated in individual towns were calculated by multiplying the total population with the waste indicator of 1,315 kg per capita per year that was calculated for Windhoek. Two different populations were used to estimate the amounts of waste generated, one of which was based on the 2001 Census, while the other was more recent, which was obtained from internet websites, reports and through personal communication. Based on the two different populations, the estimated amount of waste generated in 2008 in the Namibian towns ranges between 788,841.24 and 1,096,130.64 tons. Large proportions of that estimate were contributed by Windhoek, followed by Walvis Bay, Rundu, Oshakati and Swakopmund respectively; whose populations are relatively high. The least contributions were made by the small towns with small populations, for example, Outapi, Okakarara, Karasburg and Henties Bay.

Nonetheless, all towns need to make use of the waste management strategies will contribute to waste reduction, in order to reduce the amount of waste generated both at the town and national levels. Such efforts will make urban Namibia clean.

Table 6.1. Estimated total waste generated in 2008 at town level

Town	Population[g]1	Population[h] 2	Total waste 1 (tons)	Total waste 2 (tons)
Katima Mulilo	22,134	25,027	29,216.88	33,035.64
Walvis Bay	43,611	65,000	57,566.52	85,800.00
Swakopmund	23,803	25,047	31,419.96	33,062.04
Omaruru	4,761	6,792	6,284.52	8,965.44
Arandis	3,974	5,000	5,245.68	6,600.00
Karibib	3,726	11,784	4,918.32	15,554.88
Henties Bay	3,285	3,000	4,336.20	3,960.00
Usakos	2,926	9,147	3,862.32	12,074.04
Rehoboth	21,308	21,378	28,126.56	28,218.96
Mariental	9,836	13,380	12,983.52	17,661.60
Keetmanshoop	15,778	16,800	20,826.96	22,176.00
Luderitz	13,295	15,137	17,549.40	19,980.84
Oranjemund	4,451	8,496	5,875.32	11,214.72
Karasburg	4,075	6,054	5379	7,991.28
Rundu	36,964	58,172	48792.48	76,787.04
Windhoek	233,529	296,000	308,258.28	390,720.00
Outjo	6,013	6,557	7,937.16	8,655.24
Khorixas	5,890	12,021	7,774.80	15,867.72
Opuwo	5,101	12,000	6,733.32	15,840.00
Eenhana	2,814	24,000	3,714.48	31,680.00
Gobabis	13,856	16,000	18,289.92	21,120.00
Outapi	2,640	4,577	3,484.80	6,041.64
Oshakati	22,255	42,649	29,376.60	56,296.68
Ondangwa	10,900	15,000	14,388.00	19,800.00
Ongwediva	10,742	10,000	14,179.44	13,200.00
Tsumeb	14,929	20,000	19,706.28	26,400.00
Otjiwarongo	19,614	21,224	25,890.48	28,015.68
Grootfontein	14,249	24,099	18,808.68	31,810.68
Okahandja	14,039	20,879	18,531.48	27,560.28
Otavi	3,813	10,620	5,033.16	14,018.40
Okakarara	3,296	4,562	4,350.72	6,021.84
Total	**597,607**	**830,402**	**788,841.24**	**1,096,130.64**

[g] Population based on the 2001 census
[h] Recent population estimates from various sources: www.population.mongabay/population/namibia, www.otc.iway.na, www.eenhanatc.org.na, http://en.wikipedia.org/wiki/List_of_cities_and_towns_in_Namibia, SWMD, 2008 and personal communications

6.2. Waste Management Systems

This research has found that the waste management system currently being used in Windhoek can be used as a model for the entire Namibia, as it has made it the cleanest city in Africa. Although not perfect, the current waste management system in Namibia has a potential of being improved, and can therefore be considered the best-practice waste management system in Namibia. Table 6.2 below presents the current system being applied in Windhoek, including suggestions of improvement.

6.2. Waste management system used in Windhoek and its potential for improvement

Waste management strategy	Remarks	Possibility of improvement
Waste prevention and minimization	- There are legal frameworks in place, while some are underway that aim to regulate the management of waste. - The Solid Waste Management Division is committed to controlling, monitoring and preventing waste across Windhoek. - City of Windhoek is continually exploring new ideas and identifying better and advanced waste management technologies in other countries in order to keep the city clean. - The Education Division within the City of Windhoek is committed to educating and creating awareness among the community members, physically and through the use of monthly newspapers.	- The use of clean technologies should be promoted. - Policies currently not in force need to be implemented. - Pending Acts need to be promulgated and implemented as soon as possible.
Waste recycling/re-use	- There are various recycling companies in Windhoek that are committed to collecting recyclable materials. - The recyclable materials are collected from the disposal sites (separated from unwanted waste by waste pickers). - Valuable waste materials such as bricks, metals, etc. are re-used. - Currently there is a recycling initiative operating at shopping malls, aiming to reduce the amount of waste being disposed, to reduce litter and to promote material recovery.	- Recyclable materials can possibly be recycled using the Best Available Technology Not Entailing Excessive Costs (BATNEEC). - Regulatory frameworks that can potentially support recycling activities can be developed (e.g. environmental taxes, waste taxes and tax deductions for best practices).

	- Waste collection, storage and transport systems are in place.	- Cost Benefit Analyses can be applied in the recycling initiatives.
Waste treatment	- Waste water is treated and reclaimed. - Medical waste is treated. - Sewage sludge is used by the community as compost (for gardeners).	- Sewage sludge can be treated and be used as commercial fertilizer (plans are underway). - Garden refuse can be composted.
Waste disposal	- Landfill sites are used for waste disposal. Windhoek has landfill sites specifically used for garden refuse and building rubbles, and a special site for disposing general waste and hazardous waste. - Recyclable materials are collected from the disposal sites. - Waste pickers are provided with protective gloves, breath masks and boots. - EIAs were conducted for the disposal sites. - Landfill sites are continually monitored.	- Landfill life spans can be lengthened by reducing the amounts of waste being disposed using all possible approaches as possible e.g. composting of garden refuse.
Waste data collection	- Data on waste are continually collected from various waste streams. - Auditing is performed bi-annually.	- Available data should be used in policy development on future waste management. Private companies handling waste data should work closely with the Municipality, share data and should be involved in policy development.

In the view of the findings presented in Table 6.2 above, other towns can make use of the waste management system being used in Windhoek to improve their own systems currently in place. Such a system can work hand in hand with the proposed system for dealing with waste in urban Namibia presented in Figure 6.1 below.

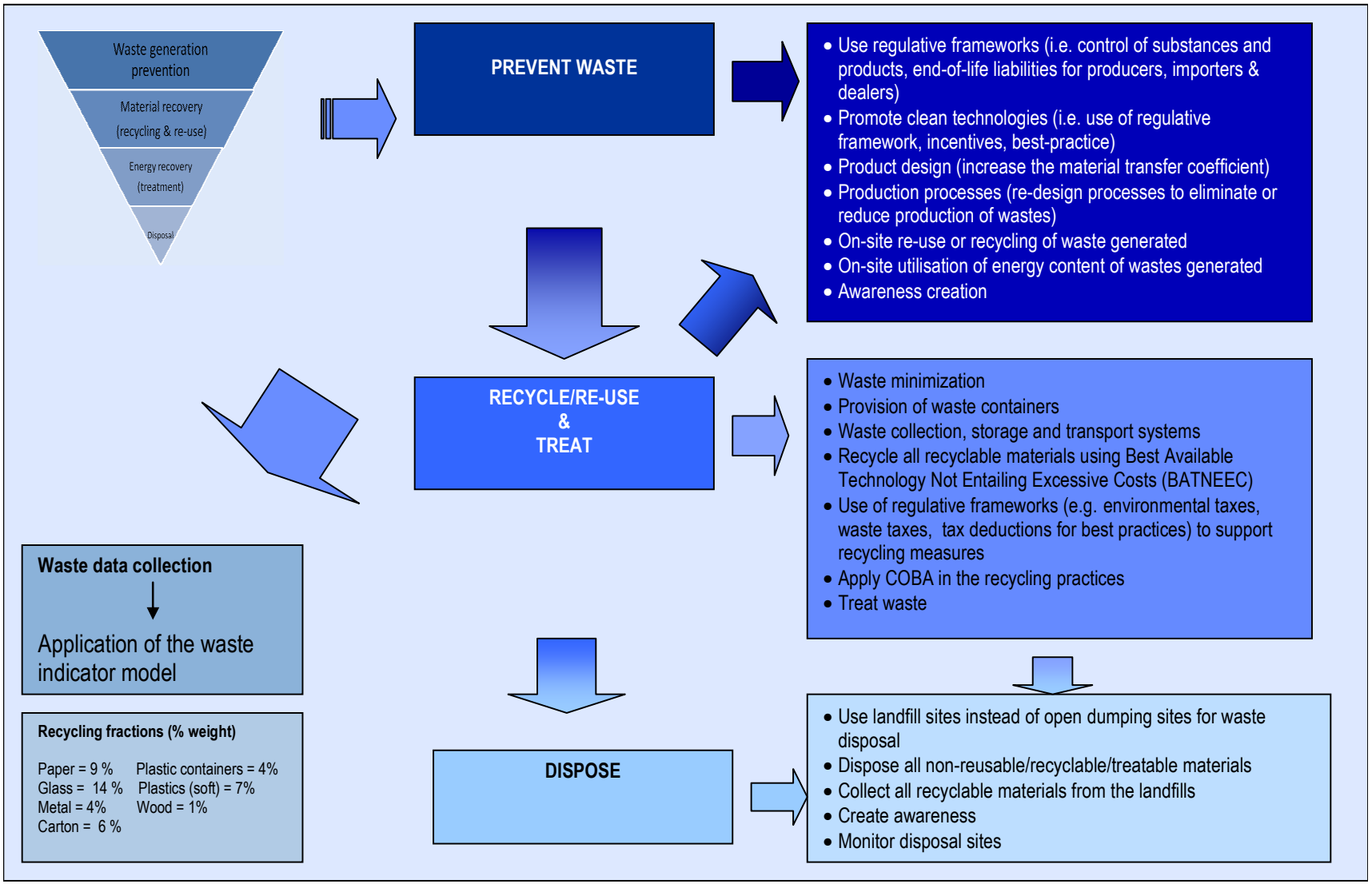


Figure 6.2. Diagrammatical representation of the possible system of waste management for urban Namibia

The diagram presented above depicts the possible system that could be used by all towns of Namibia. To ensure effective implementation, an understanding of the waste management hierarchy needs to be established. With that in mind, all levels of the hierarchy will be given considerable attention, hence keeping the web of life functional. In essence, waste should be prevented through the use of regulatory frameworks (including control of substances and products, end-of-life liabilities for producers, importers and dealers); promotion of the use of clean technologies (i.e. using regulative frameworks; incentives and all applicable best practices), embarking on product designs (i.e. increasing the material transfer coefficient), pay attention to the production processes (i.e. re-design processes to eliminate or reduce production of wastes); promote on-site re-use or recycling of waste generated; promote on-site utilization of energy content of waste generated as well as awareness creation.

As part of the waste management hierarchy, waste materials should be re-used and recycled or else treated. Therefore, town municipalities and councils should place efforts in minimizing waste by all means, providing waste containers, developing waste collection, storage and transport systems to ensure sound waste material and energy recovery. To ensure environmentally sound recycling, the use of regulatory frameworks, for example, environmental taxes, waste taxes, tax deductions for best practices, should be priorities in order to support recycling measures. In addition, Cost Benefit Analyses should be applied in the recycling initiatives. Furthermore, all treatable waste should be treated.

In terms of disposal, landfill sites should be used instead of open dumping sites, considering the negative impacts of the open dumping sites. All those materials that cannot be reused nor recycled, neither treated must be disposed in the landfill sites. Awareness regarding the negative impacts on open dumping, advantages of landfilling, and the positive side of monitoring should be created. It is essential that landfill sites should be continually monitored.

In the process of handling waste, data on waste generated can be collected, which can be used to estimate waste indicators. This is due to the fact statistical data are important for decision-making and policy development processes. Specifically for recycling, the waste compositions for recyclable presented in the diagram can be useful in estimating the amounts of recyclable materials from the total waste generated.

6.2. Conclusion

Implementing appropriate technologies for waste management in Namibia can improve the current waste management practices.

For the purpose of determining the waste indicators, waste data need to be collected and calculated using the waste indicator model described in the text. Such a model can be use at the town level as well as to estimate the amount of waste generated at the town level. The current waste management system used in Windhoek can potentially be improved, yet can still be used as the best practice by other towns. In addition, the waste management system presented in Figure 6.1 is a ‘one size fits all’ and is therefore applicable to all towns.

CHAPTER 7: CONCLUSION

The current status of waste management in Namibia indicates a need for improvement. In spite of the identified weaknesses, this study concludes that at least all towns in Namibia are to some extend managing their waste. The weaknesses only need to be addressed.

Among other towns, Windhoek has placed so much effort in strengthening its waste management system; which has placed it in a position of being the cleanest city in Africa. Nevertheless, there is still a potential for the waste management system in Windhoek to improve. Despite this fact, its current system should be seen as a model for other Namibian towns.

Regarding the question as to how Namibia can maintain a well-managed system for municipal waste management in future; if all towns are to become committed to implementing the ‘one size fits all’ proposed system in this thesis, a well-managed system for urban Namibia can be maintained.

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9. APPENDIX I: RESEARCH STUDY QUESTIONNAIRE ON MUNICIPAL WASTE MANAGEMENT IN NAMIBIA

This questionnaire presents the questions which the towns that were contacted had to answer. The aim was to get an idea of how such towns are managing their waste.

1a). Is waste being prevented in your town? (Yes/No)

b). If yes, how? (e.g. through provision of bins, awareness campaigns, etc).

2a). Does your town recycle some waste materials? (Yes/No)

b). If yes, which type of waste is recycled? (e.g. bottles, papers, etc.)

3a). Does your town re-use some waste materials?

b). If yes, which type of waste is re-used? (e.g. cans, bottles etc.)

4. a) Is the waste in your town disposed at a landfill site(s)? (Yes/No)

b) If yes, which type of waste? (e.g. household waste, hazardous waste etc.)

c). Was an environmental impact assessment (EIA) conducted before your landfill site was selected? (Yes/No/Don't know).

d) Is the landfill monitored? (Yes/No)

e) How many landfill sites/dumping sites are in your town?

f). Are these collection sites secured or open to garbage miners living on the residues of other people?

5a). Is waste in your town treated? (Yes/No)

b). If yes, which type of waste is treated? (e.g. wastewater/sewage etc.)

6. Does your town use the “polluter pays’ principle” (Principle which requires the waste producers to pay for the waste generated or the damage caused)? (Yes/No)

7. Does your town use the “user pays’ principle”, (Principle which requires the user of waste resources to pay the service providers for services offered on the management of such resources)? (Yes/No/Don’t know)

8. Does your town use the “product-stewardship principle”? (Principle which requires the waste producer or importer of a product to take responsible steps

towards the minimization of environmental impacts of the product) (Yes/No/Don't know)

9. Does your town council/municipality use any waste management policy? (Yes/No)

10. Who are the stakeholders of waste in your town? (I refer to all the people/companies/organizations/institutions that have a stake in waste management)

11). Is there an organized collection of waste from households or do people bring their wastes to collection sites?

12). What are the provisions for business wastes? Are they dealt with differently from household wastes?

13). Do you have some statistics on waste data e.g. how much waste is disposed per year/per person/per household etc.