

*An Analysis of Municipal Solid Waste  
Management in South Africa using the  
Msunduzi Municipality as a Case Study*

*by*

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June 2009

# ABSTRACT

Municipal Solid Waste generation has become an inevitable consequence of lifestyles and daily living. However, the nature (quantity and quality) of this waste stream can vary and is largely dependent upon the manner in which waste production is managed, by both government and the public. The increasing practices of littering, dumping and burning of solid waste by households (and industries though not extensively dealt with in this study) in South Africa has led to the finding that municipal solid waste is being irresponsibly managed. In this regard, it becomes necessary to investigate the attitudes and behaviour of individuals and households toward solid waste practices, which further include mitigating measures such as reduction, reuse and recycling for the generation of solid waste. The role of the South African government in providing a refuse removal and safe disposal service to all citizens is suggestive of the responsible role of government to ensure that solid waste is being effectively managed by all sectors of society.

The aims of this study in light of the above were to review the municipal solid waste policies and strategies of local government authorities in South Africa, highlighting the shortcomings and discrepancies that exist between legislative policies and actual management practices; which is also reflective of the attitudes and approaches to solid waste management by households. This was achieved by focusing on the case study of the Msunduzi Municipality and included investigations into socio-economic and cultural influences on solid waste disposal practices.

The objectives of the study were achieved by means of a questionnaire survey that elicited specific responses from 650 sampled households in five suburbs of differing socio-economic status. A further analysis to identify the nature of household municipal solid waste for landfilling from three suburbs of differing socio-economic status was conducted by categorizing 25 tons of garbage at the New England Road Landfill Site, leading to inferences about consumer purchasing power and disposal practices. Further, key personnel in the Msunduzi Municipality's waste management division were interviewed to ascertain the solid waste challenges faced at local municipal and national levels of government.

The study revealed several significant findings of which the most important is that the implementation of South Africa's national municipal solid waste legislation policies and strategies are inconsistent with local government practices and procedures; thus compromising equity, efficiency, effectiveness and the sustainability of municipal solid waste disposal. Factors contributing to this are shown to be inadequate management and service delivery. The research has shown that monitoring and control systems which purported to ensure environmental sustainability are lacking and inadequately address issues where the implementation of municipal solid waste regulations are in contravention with national solid waste policies.

The outcomes of the questionnaire survey and the assessment of household municipal solid waste for landfilling reveal that socio-economic status and culture do in fact influence the nature of solid waste and the disposal methods used by residents. The receptiveness of households towards adopting suggested municipal solid waste disposal practices was also investigated. The non-compliance of residents with municipal solid waste legislation and policies points towards a lack of monitoring and control measures, thereby not providing for a sustained and adequate service delivery which is environmentally sound. The research further suggests that all sectors of the South African public and the government are inadequately informed in terms of aspects of municipal solid waste. This has led the researcher to recommend that further education and awareness campaigns and its role in environmental sustainability are needed so that a sharing of responsibility between government and the public can be effected to aid municipal solid waste management in the country.

It is argued that the insight into the roles of socio-economic status and cultural influences over solid waste practices provide a platform from which municipal authorities can work to specifically address the problems associated with municipal solid waste at a community level. It is the task of the national government to ensure that South Africa's municipal solid waste is being responsibly managed at the local municipal levels so that the health and safety of the environment and its citizens are suitably addressed, hence the focusing on solid waste legislation and national policies (which have been recognized internationally as being environmentally sound and sustainable) must be translated in terms that local municipalities can adopt, *assuming* that they have been sufficiently empowered in terms of both knowledge and adequate budgeting.

## **DEDICATION**

Most Revered Swami Sivanandaji Maharaj and beloved Swami Sahajanandaji Maharaj, where Divine Grace knows no bounds; and at the lotus feet of each, I dedicate this research project.

# DECLARATION

I hereby declare that the research in this thesis is of my own investigation. Where use has been made of the work of others, this has been duly acknowledged in the text.

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

**K. Naidoo**

As research supervisor I agree/ do not agree to submission of this thesis.

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

**Prof H Beckedahl**

## ACKNOWLEDGEMENTS

I would like to express my sincere and heartfelt thanks and appreciation to those individuals who assisted in and contributed to my study. I am especially indebted to the following persons:

- Prof H Beckedahl: Thank you for your supervision, insight, understanding and faith.
- Prof B Maharaj: Thank you for your insight, encouragement and guidance.
- Michelle Francis: “Thank You” a million times over would never be enough. I am truly indebted to you!
- C. Whyte: Thank you for your guidance in the initial stages of my study.
- Shani and Shaun Ramroop: Your support, guidance and assistance are immeasurable.
- Donavin de Vos: Your willingness to assist is truly an invaluable asset to UKZN.
- Brice Gijbertsen: Thank you for your most valued assistance and support.
- Ruth Howison: Your maps added value to my work. Thank you.
- Cyril Naidoo: Thank you for enlightening me and adding value to my research.
- Pat Reddy: Your honesty and love for the environment inspires me still.
- Jimmy Pather: Thank you for your assistance and support.
- Radhakrish Gounden: Thank you for your assistance and support.
- Ramu Raghunandan: Thank you for “kick starting” this research study!
- Ravi Naidoo: StatsSA should give you a medal! Thank you for assisting.
- Suresh Chaine: Thank you so much for your unwavering assistance.
- Sandy Govender: Your love, support and tolerance can never be quantified. Thank you for spurring me on and believing in me. I couldn’t have asked for a better half in this lifetime. Your zest for life is truly inspiring and has helped me fulfill a goal I almost never did.
- Mum, Mum-in-law, Darsh and Nev: Thank you for your continued love and support. I couldn’t ask for more.
- Yougan: I could never have asked for a more loving and supportive brother. Thank you for always being there for me and for running around!

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## **ACRONYMS**

|                       |   |
|-----------------------|---|
| <b>BANANA</b>         | Build Absolutely Nothing Anywhere Near Anybody  |
| <b>BEE</b>            | Black Economic Empowerment                      |
| <b>BMR</b>            | Bureau for Market Research                      |
| <b>CARISA</b>         | Cancer Research Initiative of South Africa      |
| <b>CC</b>             | Carbon Credit                                   |
| <b>CDM</b>            | Clean Development Mechanism                     |
| <b>CER</b>            | Certified Emission Reduction Certificate        |
| <b>CH<sub>4</sub></b> | Methane Gas                                     |
| <b>CO<sub>2</sub></b> | Carbon Dioxide                                  |
| <b>CSIR</b>           | Council for Scientific and Industrial Research  |
| <b>CTC</b>            | Carbon Trading Credit                           |
| <b>DEAT</b>           | Department of Environmental Affairs and Tourism |
| <b>DEC</b>            | Dec Consultants cc                              |
| <b>DWAF</b>           | Department of Water Affairs and Forestry        |
| <b>ECA</b>            | Environmental Conservation Act                  |
| <b>ECOSAN</b>         | Ecological Sanitation                           |
| <b>EIA</b>            | Environmental Impact Assessment                 |
| <b>EPA</b>            | Environmental Protection Agency                 |
| <b>ESKOM</b>          | Electricity Supply Commission                   |
| <b>EU</b>             | European Union                                  |
| <b>eWASA</b>          | e-Waste Association of South Africa             |
| <b>GHG</b>            | Greenhouse Gas                                  |
| <b>H<sub>0</sub></b>  | Null Hypothesis                                 |
| <b>H<sub>1</sub></b>  | Alternative Hypothesis                          |
| <b>HAMSW</b>          | Household Municipal Solid Waste for Landfilling |

|                       |  |
|-----------------------|--|
| <b>HFC</b>            | Hydrofluorocarbon  |
| <b>HIV/AIDS</b>       | Human Immuno Virus/ Antibody Immune Deficiency Syndrome  |
| <b>H<sub>2</sub>S</b> | Hydrogen Sulphide  |
| <b>HSRC</b>           | Human Sciences Research Council  |
| <b>IAP</b>            | Interested and Affected Party  |
| <b>ICT</b>            | Information Communication Technologies   |
| <b>IP and WM</b>      | Integrated Pollution and Waste Management  |
| <b>IT</b>             | Information Technology   |
| <b>ITA</b>            | Information Technology Association   |
| <b>IUCN</b>           | The International Union for Conservation of Nature, also known as The World Conservation Union |
| <b>LCA</b>            | Life Cycle Assessment  |
| <b>LFG</b>            | Landfill Gas   |
| <b>LULUs</b>          | Locally Unwanted Land Uses   |
| <b>MSW</b>            | Municipal Solid Waste  |
| <b>NEMA</b>           | National Environmental Management Act (Act 73 of 1989 and Act 107 of 1998)                     |
| <b>NERLS</b>          | New England Road Landfill Site   |
| <b>NGO</b>            | Non Governmental Organisation  |
| <b>NIMBY</b>          | Not In My Back Yard  |
| <b>NWA</b>            | National Waste Act   |
| <b>NWMS</b>           | National Waste Management Strategy   |
| <b>NWS</b>            | National Waste Strategy  |
| <b>NO</b>             | Nitrogen Oxide   |
| <b>N<sub>2</sub>O</b> | Nitrous Oxide  |
| <b>O<sub>2</sub></b>  | Oxygen   |
| <b>PC</b>             | Personal Computer  |



|                 |   |
|-----------------|---|
| <b>PCB</b>      | Pietermaritzburg Chamber of Business                  |
| <b>PCBS</b>     | Polychlorinated Biphenyls                             |
| <b>PCF</b>      | Prototype Carbon Fund                                 |
| <b>PVC</b>      | Polyvinyl chloride                                    |
| <b>RDP</b>      | Reconstruction and Development                        |
| <b>SA</b>       | South Africa  |
| <b>SME</b>      | Small and Medium Sized Enterprise                     |
| <b>SPSS</b>     | Statistical Package for the Social Sciences           |
| <b>SRK</b>      | SRK Environmental Consultants                         |
| <b>STATSSA</b>  | Statistics South Africa                               |
| <b>SWICO</b>    | Osec Business Network Switzerland                     |
| <b>The Bill</b> | The New Waste Management Bill (2007)                  |
| <b>UN</b>       | United Nations  |
| <b>UNFCCC</b>   | United Nations Framework Convention on Climate Change |
| <b>VOC</b>      | Volatile Organic Carbon                               |
| <b>WEEE</b>     | Waste through Electrical and Electronic Equipment     |
| <b>WRC</b>      | Water Research Commission                             |

## **LIST OF APPENDICES**

- APPENDIX A: QUESTIONNAIRE FOR HOUSEHOLDS ON SOLID WASTE (FOR THE PURPOSE OF THE QUESTIONNAIRE SURVEY).**
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# **CHAPTER 1**

## **CONSIDERATIONS FOR MUNICIPAL SOLID WASTE IN SOUTH AFRICA**

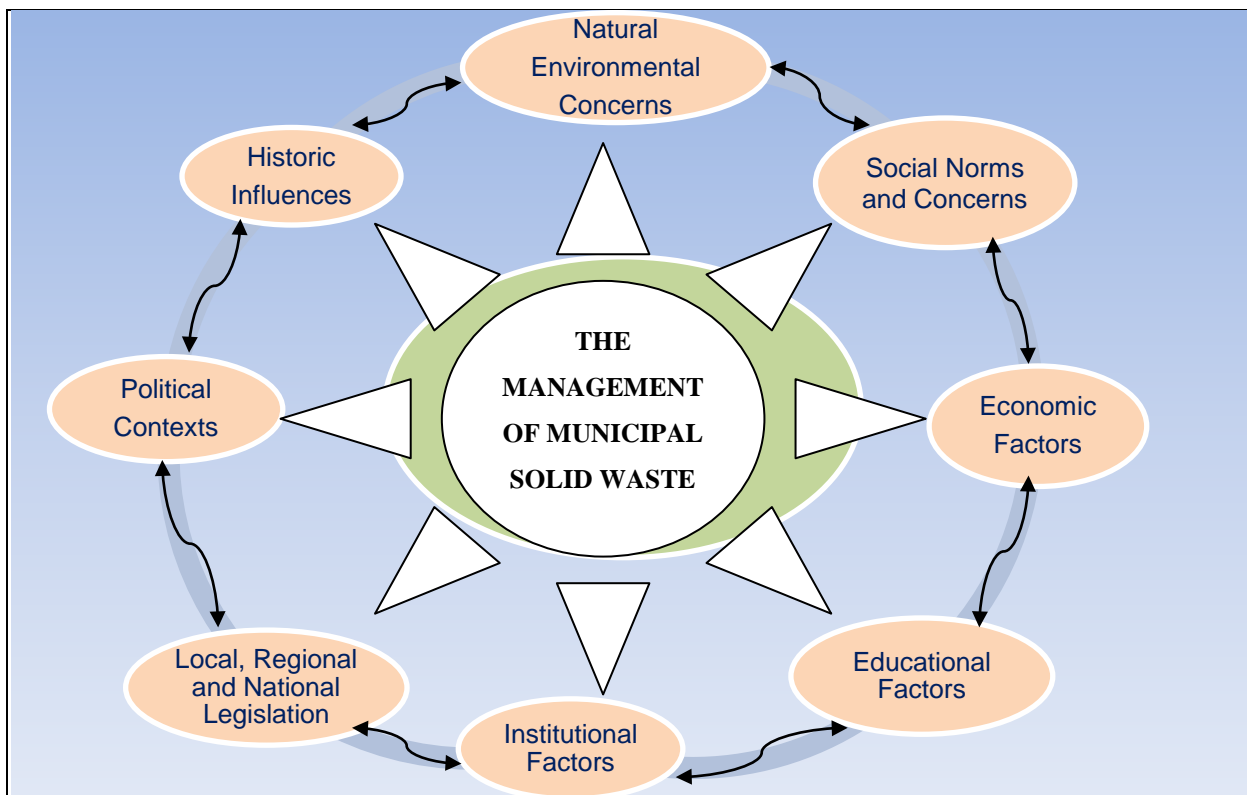
### **1.1 Introduction**

Green issues have become cohesive factors that surpass divisive socio-economic and political government agendas. One of these issues is municipal solid waste, and as such requires further investigation regarding its role in the daily occurrences of homes and societies – not just locally, but nationally and internationally. Further, it can be viewed as a component of the environmental management process, as well as impacting on socio-economic and political issues by mere virtue of it being a government provision in the form of service delivery that a country's citizen is entitled to. First World countries have already given Municipal Solid Waste management priority by adopting strict regulations and ensuring that the necessary monitoring and controls are in place to enforce such legislation.

### **1.2 Factors influencing municipal solid waste management in South Africa**

There are several factors that influence Municipal Solid Waste (MSW) management in any country. It is therefore important to identify these factors in order to understand and examine the efficacy of the method by which municipal solid waste is managed. The question of determining whether MSW in South Africa is responsibly and adequately managed in the broader interests of local, national and global environmental sustainability essentially remains as a key investigative issue since the latter cannot be excluded from that aspect of anthropogenic sustainability (Imbach *et al.*, 1997).

The factors that may directly or indirectly influence MSW in South Africa may be summarized as shown in Figure 1.1. Accordingly, these influences bring to the fore the fact that MSW needs to be viewed in a holistic light when ascertaining its role and management in environmental sustainability. This is further complicated by the fact that the country's vast and varied historical and political background has resulted in a segregation of the myriad of cultures and their inherent beliefs, traditions and practices which ultimately affects all facets of daily living and lifestyles. Solid waste management at all levels of society is likely to mirror this complex structure of attitudes and behaviour.



**Figure 1.1: Factors influencing the management of Municipal Solid Waste in South Africa and their interdependence (after Imbach *et al.*, 1997).**

Each of the above factors will be briefly reviewed so as to highlight the influences that each can have on the management of MSW in South Africa, thereby contextualizing the inherent concepts and challenges.

### **1.2.1 The natural environment**

South Africa abounds with a wide variety of fauna and flora and is the bearer of numerous World Heritage Sites and many renowned tourist attractions (The International Marketing Council of South Africa, 2004; *The Witness*, 29/06/05; Sparrow, 2007). It is therefore important to maintain environmental cleanliness and healthy ecosystems to allow for sustainable tourism development and foreign revenue. Furthermore, tourism itself generates additional MSW and as such places increasing requirements for adequate service delivery.

The Midlands Meander Association in KwaZulu-Natal, where Pietermaritzburg is a city within the Midlands region and the area of this study, boasts an average of six hundred thousand domestic visitors and sixty thousand international tourists per annum and has incorporated initiatives to promote environmental conservation through educating learners about negative solid waste practices such as littering and illegal dumping into the school curriculum within this region (Dyer, 2007). This initiative serves to enhance not only environmentally educating locals, but indirectly educating tourists; simultaneously managing MSW and reducing environmental pressure as well as aiding solid waste service delivery.

One also needs to be mindful of the fact that the nature of a geographical area with specific reference to its terrain, wind velocities and precipitation patterns are important determinants for potential ground, air and water pollution through the incorrect management of MSW (Keith, 1991). These natural elements (terrain, wind and precipitation) can negatively influence solid waste management by exacerbating the litter and the contamination of water resources that South Africa already experiences (Raghunandan, 2005). Even the level of land surfaces in established urban settlements can increase considerably due to the accumulation of solid waste, especially where landfill sites or large dumps occur (Goudie, 2001).

The rainfall received in the western and eastern escarpments of the country also differs, and as such influences the nature of landfill sites, and their resultant engineering with regard to the production of liquid by-products. The east coast of South Africa receives higher rainfall as

compared to the western half of the country, and would therefore produce far more liquid by-products resulting from the decay of organic matter at landfill sites (Keith, 1991).

### **1.2.2 Historic influences**

The provision of potable water, of safe sanitation for all citizens; the creation of employment opportunities and the improvement of literacy levels have become national priorities, especially since post 1994. This has facilitated an increasing recognition of the need for solid waste management strategies and the incorporation thereof into national policy planning strategies for improved service delivery to the public, exemplified inter alia by the National Environmental Management Act of 1998 (Bhorat *et al.*, 2004; Blignaut *et al.*, 2004).

The colonial period in South Africa (18<sup>th</sup> and 19<sup>th</sup> centuries) and that of the Apartheid regime saw the introduction of the Group Areas Act (1950 and 1966) which led to land use zoning racial segregation (Pacione, 2001; Zetter *et al.*, 2002). Most of these racially marginalized zones were not entitled to basic infrastructure and municipal services such as potable water, safe sanitation, tarred roads, community centres and refuse removal (Sandercock, 1998; Pacione, 2001). This could be a plausible explanation for the negative solid waste disposal practices such as illegal burning and illegal dumping that still prevails today, albeit on a much smaller scale but by a greater number of people who span the entire population. This is however, merely a suggestion used in a hypothesis-building attempt to understand the behavior and reasoning behind certain solid waste disposal practices that can arise from socio-cultural and political influences, and will be revisited later. In deep rural areas where the facilitation of municipal services is difficult, citizens still practice open veld burning, composting and dumping to get rid of their household waste (Reddy, 2007). This is however, not advocated in congested urban areas that are prone to pollution, environmental degradation, and experience consequential human health implications, which is by no means specific to or condoned in rural areas (Miller, 2005).

Solid waste management has an important role to play in the strategies aimed at curbing poverty and disease. Untreated waste that accumulates in any area be it rural or urban, business or

residential poses an environmental threat and is a human health hazard. It develops into a breeding ground for pests and promotes the proliferation of disease-causing agents such as lice, flies and rodents. Waste disposal is a municipal service that should be afforded to every citizen, while ensuring its comprehensive management to alleviate environmental hazards and promoting anthropogenic safety (Reddy, 2007). The recovery, reuse and recycling of waste has important implications for the alleviation of poverty and skills development through creativity and innovation. This will be further discussed in Chapter 2.

The historic and structural background of South Africa can offer much insight into the attitudes of its citizens towards solid waste and the disposal practices that are inherent to this aspect of study. The disadvantaged backgrounds of the majority of South Africans which saw inadequate education facilities have contributed to the high illiteracy rates prevalent today. Poverty further exacerbates this problem as the poor masses cannot afford education or gain easy access to the various media options that are currently available (Pacione, 2001). It is against this background that the present study was conceptualized with the following aims and objectives given below.

### **1.3 Aims and Objectives of the present study**

The main aim of this research study is to review the municipal solid waste policies and strategies of local government authorities in South Africa, highlighting the shortcomings and discrepancies that exist between legislative policies and actual management practices; which is also reflective of the attitudes and approaches to solid waste management by households through adequate information and enforced legislation.

This will be achieved by focusing on the following objectives which will be applied to the local Msunduzi Municipality (in the city of Pietermaritzburg), South Africa:

1. To ascertain the efficiency and effectiveness of Msunduzi's Municipal Solid Waste management services within the context of sustainability; thereby focusing on South Africa's discrepancies between management policies and practices.

2. To gauge the views of responsible members of households in the Msunduzi Municipality regarding refuse removal, their disposal methods; and their willingness to practice suggested Municipal Solid Waste management strategies.
3. The influence that socio-economic status has on the nature (quantity and composition) of Municipal Solid Waste, and whether correlations between culture (race group) and historic backgrounds do in fact influence the attitudes and behaviour of people with regard to solid waste disposal practices.
4. To investigate whether the New England Road Landfill Site is viewed by the public as a positive or a negative instrument in the management of Municipal Solid Waste.
5. To determine and suggest reforms that can be made to local, provincial and national service delivery strategies, aiding equity, affordability and accessibility with regard to Municipal Solid Waste.

In light of the above aims and objectives of the study, it becomes necessary to examine the remaining factors that influence the nature and management of MSW as given in Figure 1.1.

#### **1.4 Additional factors influencing municipal solid waste**

Together with the discussion of the natural environment and historic background inherent to South Africa, there are other factors such as the technological, social, economic, political, institutional, legislative and educational factors that commonly exert an influence on the country's population and the manner in which they are governed, notwithstanding the way in which people's attitudes and behaviours are further influenced. These factors will be discussed hereafter with the intention of providing as holistic a setting as possible to understand the nature of solid waste and how it influences and is influenced by the residents of South Africa. However, it should be noted at the outset that the research study will be conducted in Pietermaritzburg (Msunduzi Municipality), which is the capital city and the second largest city of KwaZulu-Natal.



### **1.4.1 Technological expertise and credibility**

South Africa and its increasing technological advancements, especially its strong manufacturing industries, aided by an abundant supply of labour and natural resources have further contributed to increasing solid waste streams. Broadley and Cunningham (1992) cite that advancing technologies and the specific location of industries results in consequential patterns of population density and distribution.

Mining, manufacturing and energy provisions form the core of South Africa's economic activities, with the service sector experiencing the most exponential growth (Anderson and Rathbone, 2000; Dixon *et al.*, 2005; Habitat for Humanity South Africa, 2007). Rapid urbanization has also led to the decentralization of congested towns and cities, where commercial businesses then choose to locate around residential areas and shopping complexes (Pacione, 2001). The majority of MSW produced annually by the industrial, domestic and commercial sectors in South Africa alone are in estimate of 534 million tons (Blignaut *et al.*, 2004).

### **1.4.2 Social aspects**

As South Africa continues to rapidly urbanize, its population has begun to increasingly adopt the attitudes and behaviour of Western consumer societies, where well packaged produce is favoured above open markets and unpackaged goods (Pacione, 2001; Riddell, 2004). Women are no longer predominantly viewed in their traditional roles as wives and mothers, but also as career-driven breadwinners that contribute to the socio-economic sustainability of a household (Pacione, 2001). Well packaged products can be a marketing strategy that attracts the attention of consumers and promotes convenience buying among time-strapped households, but contributes significantly to the waste stream.

South Africa also possesses a wide variety of socio-cultural value systems in terms of religious practices, social up-bringing, economic status and educational levels; hence giving rise to

divergent attitudes and behaviours which may influence solid waste management practices (Dixon *et al.*, 2005; Swiss e-Waste Guide, 2005).

The pressure of rapidly expanding populations can be viewed as an additional factor contributing to increasing solid waste streams (Miller, 2005). Population expansion lends itself to greater frequencies of and numbers in social gatherings and events that tend to lead to littering and irresponsible solid waste disposal behaviour. Significant rises in litter and other environmental stressors such as air and water pollution, including the degradation of ecologically sensitive areas like the protected sand dunes of St Lucia in KwaZulu-Natal are especially noted during peak tourist seasons (Shaw *et al.*, 1996).

The ever-increasing influx of cross-border migrants and illegal immigrants from African countries into South Africa due to political strife, unemployment and poverty contributes to the rising urban population figures. This occurs simultaneously with a continual flow of rural-urban migration due to the perceived attractive recreational and economic improvement opportunities present in city centres; hence placing enormous pressure on existing urban MSW service delivery infrastructure. The abolition of Apartheid and the Group Areas Act has facilitated this process (Crush and Pendelton, 2003). This has ultimately resulted in the numerous informal settlements that characterize the urban and residential fringes, particularly along metropolitan transportation routes (Wall, 2000). Solid waste collection services are practically non-existent in these informal settlements, giving rise to further problems of illegal dumping, illegal burning and littering (Blignaut *et al.*, 2004).

The majority of informal settlers engage in street vending to earn a living and contribute even further to litter and unsanitary solid waste disposal practices, thus creating high visual expressions of poverty and economic recession (Satterthwaite, 2001). Poverty and unemployment motivates many impoverished families in developing countries to seek remuneration by informal salvaging on landfill sites for items to reuse and scrap metal to sell to recyclers; and often leads to the establishment of informal settlements near landfill sites and toxic dumps (Pantelic *et al.*, 2005; Naidoo, 2007).

### **1.4.3 Economic considerations**

South Africa (post 1994) is succeeding in its macro-economic policies to attract foreign investment and property development revenue, while government controls are far from rigid and the population density of cities continues to increase (Zetter *et al.*, 2002). This alone places stress on the provision of adequate services such as refuse removal and street cleaning as higher density areas clearly tend to produce more solid waste than less dense areas. The indiscriminate mixture of land-use zones which sees industries being located in residential areas has allowed for an even greater complex control and monitoring of service provision and rapid environmental degradation, as industrial waste now becomes intermingled with domestic solid waste (Zetter *et al.*, 2002; Glassner *et al.*, 2004). Further to this, the health and safety implications are high as industries release toxic air, water and soil pollutants which cause carcinogenic, respiratory, skin and immune system ailments, notwithstanding the fact that children are prone to freak accidents at industrial sites where there may be chemical spills, ground excavations and heavy machinery involved.

The factors that have been viewed as the largest contributors to increasing solid waste generation in South Africa are population growth and economic growth (Blignaut *et al.*, 2004). Cointreau *et al.* (1990) argued that a rise in the population income levels has led to a rise in the quantity and the value of waste. This rise in value can be attributed to the increasing purchasing power of consumers and the attractive consumer packaging that exists today (Enviromark, 2007).

### **1.4.4 Political considerations**

Municipalities and their districts are influenced by politics. The influence of major political parties on provincial and national issues cannot be underestimated. These are in turn affected by the attitudes and approaches of the electorate, and it is of significance that “green” issues such as solid waste and environmental sustainability do not feature prominently on political party manifestos. Solid waste management does not rank as a priority in South Africa but has gained considerable attention since 1998 although the municipal budgets more often than not do not

adequately compensate for the basic operation of a refuse removal system and a landfill site at local levels of governance.

It has been shown that the different government sectors in South Africa tend to ignore financial or economic considerations and accountability due to political and social influences. This occurs irrespective of whether the services provided have met the consumers' needs or not, and has been especially applicable to water and sanitation requirements (Wall, 2000). Recent developments in Europe suggest that the "happiness" of societies play a significant role in political choices (Friedland, 2007). It is just not a matter of a proportional relationship between happiness or wellbeing and wealth. The types of culture and the wellbeing of natural environments do actually present themselves laterally in developing and sustaining the wellbeing of society and the ability to effectively deal with political challenges – especially in a country such as South Africa, where poverty, racialism and disease (HIV) rate high on the agenda (Friedman, 2007). The main point here is that if the government can aid the wellbeing of societies by adequately and equitably providing services such as the delivery of potable water, ensuring safe sanitation and the regular removal of refuse, then the relative happiness of the South African society can be ensured in the interests of health and safety (Wall, 2000).

A general obstacle in developing countries is the high levels of illiteracy which prevents societies from knowing and understanding their legal rights and the service delivery levels that citizens are entitled to. The emphasis has always been on basic necessities such as potable water and safe sanitation. However, once these criteria have been met, the issue of MSW will claim attention as the remaining service delivery that ought to be provided to every household by their respective municipalities. This lends to the argument that the public at large is therefore unaware of the prevailing 'human rights' and the relevant laws that exist for their protection and that of the natural environment, where MSW is definitely not an exclusion (Wall, 2000).

#### **1.4.5 Legislation and administration**

South Africa is characterized by a three-tier government system where Parliament controls

legislation. It has local, provincial and national governing bodies that functions with a top-down approach (South Africa Government Online, 2007).

The national government has afforded local municipalities the option of directly presenting their grievances (in the worst case scenarios) to the national authorities for resolution, hence bypassing the provincial legislative authorities. Solid waste management needs to be looked at more closely in this context as it may not always facilitate the ideal management structures that have been envisaged for MSW which also functions according to the South African top-down governing approach (South Africa Government Online, 2007).

It has been argued that the decentralization of refuse removal on a district municipality level does not allow for timeous or smooth service delivery interventions on the part of provincial and national governments. Where one might hope that the converse is true, one might find that the linking of property rates and refuse removal services creates barriers to the efficiency of MSW management (Bhorat *et al.*, 2004). The provincial and local government minister, Minister Sydney Mufamadi proposed a re-evaluation of the South African provincial legislatures in an attempt to support the idea that restructuring into fewer but more comprehensive provincial legislature functioning bodies would promote affordability, equity, accountability and aid service delivery – which includes refuse removal and municipal solid waste management (Xundu, 2007). Whether such legislative restructuring will actually improve solid waste service delivery and the effective management thereof remains debatable at present. Legislation is usually formulated at a national level, enforced at a provincial level and implemented at a local level, and will be dealt with in greater detail in Chapter 5 (Swiss e-waste Guide, 2005; South Africa Government Online, 2007).

In their “State of the World Population 2007” report, the United Nations argue that urban policymakers should be proactive and cater for the poor urban masses who either migrate in or experience natural population increases (fertility) by providing them with municipal services and infrastructure, instead of hoping that this lack of service provision would be a deterrent for immigrants and the poor (United Nations Population Fund Online Report, 2007).

According to the South African Bill of Human Rights (1996):

“Everyone has the right:

- to an environment that is not harmful to their health or well-being; and
- to have the environment protected for the benefit of present and future generations through reasonable legislative and other measures that:
  1. prevent pollution and ecological degradation;
  2. promote conservation; and
  3. secure ecologically sustainable development and the use of natural resources while promoting justifiable economic and social development”(Attfield, 2003).

It has been established that even low cost government housing schemes and informal settlements in South Africa and especially in the KwaZulu-Natal region, do not receive refuse removal services on a regular basis (Naidoo, 2007). The plight of the urban poor goes beyond just poverty and unemployment. It can be seen as an infringement of human rights and as a health hazard to all citizens when municipalities withhold basic service provisions such as regular refuse removal to these areas (United Nations Population Fund Online Report, 2007). It is advisable that the governments of developing countries take heed of the rapid rate of global urbanization by being proactive in their policy planning as discussed earlier, where it is predicted that most urban newcomers will be poor.

#### **1.4.6 Institutional capacity**

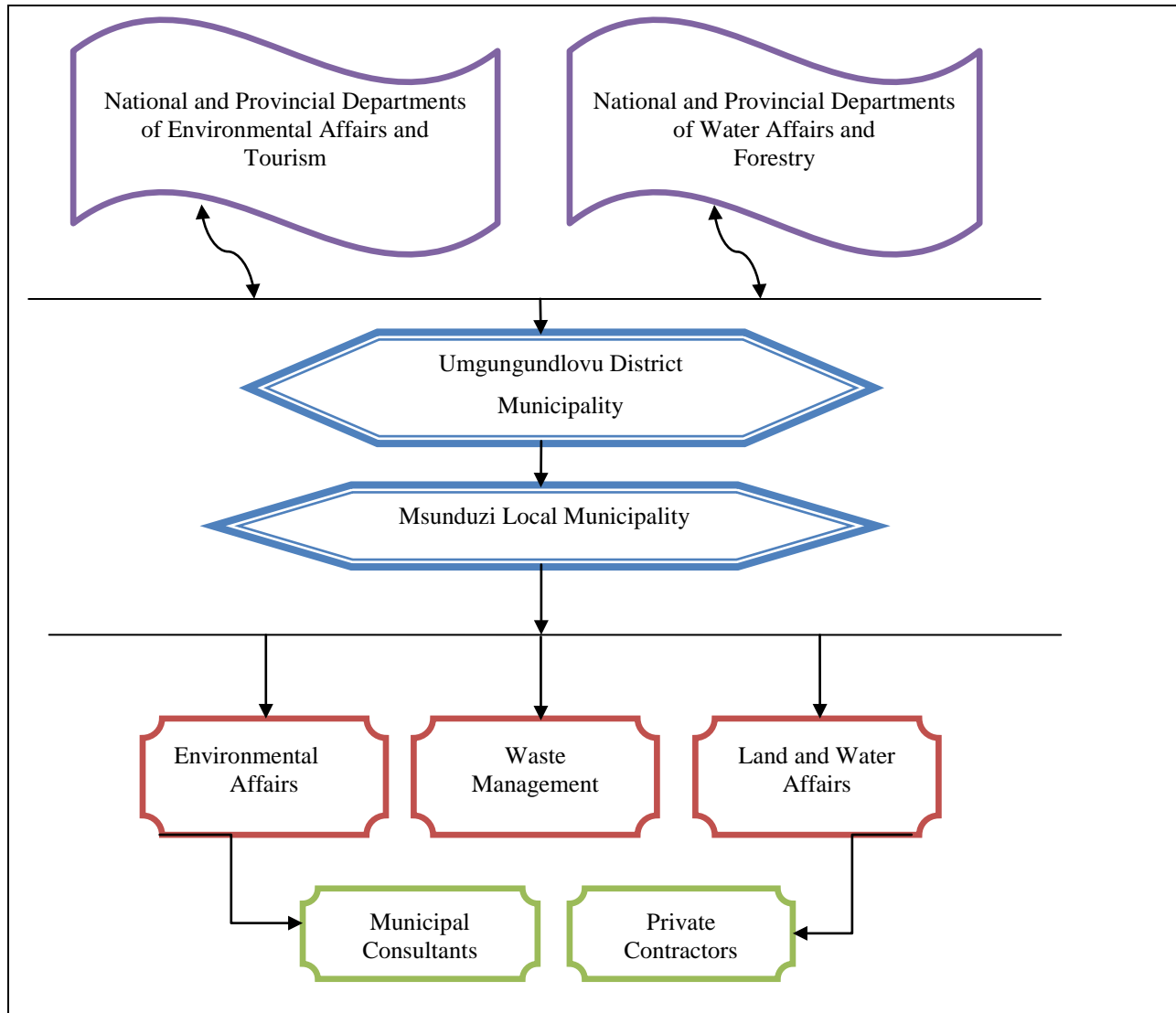
The South African Government has many departments that are actively tasked with integrated environmental management, where solid waste is receiving more attention and priority than previously. The inclusion of South Africa into the global economy since 1994 saw the Departments of Environmental Affairs and Tourism (DEAT) and Water Affairs and Forestry (DWAF) lending additional focus and resources (human and monetary) into the concept of integrated waste management strategies and policies (Blignaut *et al.*, 2004). The consequential result of this focus led to the legislation of the White Paper on Integrated Pollution and Waste

Management (IP and WM) Notice No 227 of 2000, and the National Waste Management Strategy (NWMS) which was an action plan for the treatment and disposal of solid waste formulated in 1999 (DEAT, 2007e).

The intention of the above legislative process was to move away from the idea of “end-of-pipe” waste solutions such as landfilling and incineration towards an integrated approach to waste management. This would mean that the primary objective would be a sequential process of waste prevention, re-use, recycling, treatment and finally the recommended disposal methods (Blignaut *et al.*, 2004). The implicit suggestion that is made towards resource sustainability through solid waste management cannot be mistaken.

Figure 1.2 provides a basic or a typical organisational framework for MSW management in South Africa, where the different departments on national and provincial levels (such as DEAT and DWAF) actually enforce or dictate legislation at the district and local municipality levels.

The organisational framework on a local level can be quite comprehensive when the various functions, departments, and stakeholders are taken into account to ensure sound administration and operational viability in the interests of adequate service delivery to the public. Even though the South African government now encourages environmental and agricultural management studies through educational incentives, institutional capacity-building and research are still lacking with regard to sustainable development (Dixon, *et al.*, 2005). This highlights the vast economic and technological discrepancies that generally exist between the Northern and the Southern hemispheres with regard to environmental responsibility and technical expertise (with the exception being the technologically advanced and economically stable developed Australia in the Southern Hemisphere).



**Figure 1.2: A Typical Organizational Framework for Municipal Solid Waste management in South Africa (after Massoud *et al.*, 2004).**

Looking abroad, the European Union (EU) had several stringent environmental and solid waste management strategies and policies in place – as early as 1975. Some of these environmental waste legislations (known as directives) are:

- Waste Framework Directive (1975);
- Recycling of end-of-life Vehicles (Council Directive 2000/53/EC);



- Landfill of waste, setting targets for reduction in biodegradable waste going to landfill, banning co-disposal (Council Directive 1999/31/EC);
- Requirement of an environmental assessment for certain prescribed developments, for example: incinerators and landfill sites (Council Directive 85/337/EC);
- Recycling and recovery of packaging and packaging waste (Council Directive 94/62/EC) and so forth (Williams, 2005).

Legislation with regard to solid waste management may be “paper-perfect”, but is it really “practice-efficient” or practice-deficient? How do we truly avoid this situation and reform our negative solid waste behavioural patterns into one which enhances environmental sustainability? Can South Africans capitalize on the MSW experiences of First World countries? Clearly, a positive way forward is needed; more so by practice than mere policy-making. Chapter 5 looks into the actual laws that govern MSW in South Africa and will therefore not be dealt with here.

#### **1.4.7 The role of education**

Education has been seen as the key the world over in establishing environmental consciousness and conservation (Wall, 2000). The South African government has taken measures since 1994 to ‘rectify’ the injustices of Apartheid which has to some degree been responsible for the high illiteracy rate that the country possesses currently (Pacione, 2001). The result of this saw substantial national budget allocations for social services, education, health and welfare which are supposed to be invaluable long-term aids to capacity building (Manuel, 2000). However, as political changes occur and ruling parties succeed each other in government, priorities may change and the “green government initiatives” cannot be guaranteed of the same status. It could mean that the succeeding government may place more or less emphasis on environmental issues that affect our country and the world as a collective whole. The broader concern is that government alone cannot be held totally accountable for environmental degradation, including the mismanagement of solid waste.

Effective and efficient MSW management can be developed through community participation. This would mean the inclusion of communities into the decision-making processes, hence the need for community capacity building. This is achievable through general education, formal skills training or practical experience (Wall, 2000). The next collective unit after a household is that of the community, thus indicative of the role of households and communities constituting the bottom-up approach towards achieving responsible MSW management. This further extends itself into socio-cultural values and behavioural practices of households and communities. Imbach *et al.* (1997) in their IUCN Sustainability Assessment project made mention of the fact that communities should go beyond ignorance and uncertainty by educating themselves about how the interaction between the environment and themselves becomes necessary for ecosystem and human sustainability or progress. Solid waste and resource conservation becomes vital aspects of this truly thought-provoking process.

Education inexorably links itself to culture and values aided by technological, social and environmental influences (Imbach *et al.*, 1997). It is imperative to introduce some sort of formalized environmental education skills into the national school curriculum in South Africa so that the reasoning and the consequences behind responsible environmental behaviour is facilitated. There are many such environmental initiatives in the country which can be truly applauded, such as schools that encourage learners to participate in river clean-up projects, the formation of environmental school clubs that encourage active local community food projects which utilise vegetable off-cuts and waste water as fertilizers. However, these are not implemented on a national level, nor is there much consistency in the levels of practice in the country. This sort of capacity building and education that is incorporated into the national education system need not occur mainly for environmental competitions and 'prize money,' but rather as a genuine endeavour towards environmental and anthropogenic sustainability.

The story of Bonginkosi Daniel Phakathi who lives in Sobantu that borders the New England Road Landfill Site is one of encouraging initiative as an individual who believed that he could make a difference to the environment. He has decided to educate the residents of Sobantu and clean up the area together with the Msunduzi Municipality's Environmental Health Unit. Phakathi said that he was frustrated by the extent of littering and illegal dumping in the area

which gives rise to disease-spreading vectors (Ramphal, 2008). This is just one more positive “social responsibility” step towards environmental health concerns in South Africa. As environmental awareness increases in the country, one can only hope that it continues to do so and gains much more momentum which is sorely needed if drastic solid waste changes are to be made. It is the masses who need to adopt these positive approaches.

Watts cited by Dixon *et al.* (2005) argued that manpower is an indisputable asset to any nation and this accounts for the important role of education in the spheres of social and economic development. He further stated that the high level of illiteracy in Sub-Saharan Africa is a major contributor to the economic instability and poverty that prevails here.

There is a need to determine whether socio-cultural, socio-political, socio-economic, educational, technological, and other factors (see Figure 1.1) do in fact play a substantial role in influencing MSW practices and behaviour in South Africa. This adds to the challenges that South African municipal authorities face with regard to improving solid waste removal services and its management. Fuggle and Rabie (1983) believe that legal, economic and societal frameworks can be used to effectively control environmental problems such as pollution and degradable waste.

Having identified the factors that could greatly influence the generation and subsequent management of Municipal Solid Waste in South Africa, it becomes necessary to ascertain whether the current approaches, policies and strategies with regard to Municipal Solid Waste management in South Africa are sustainable and environmentally sound. This will be primarily achieved as outlined by the aims and objectives which form the core of this research study in identifying the inherent aspects and problems associated with the topic at hand. The Msunduzi Municipality was chosen as the area of study (apart from it being the residence of the principal researcher), due to the fact that it has a regional landfill site known as the New England Road Landfill Site; and it is the capital city of the province of KwaZulu-Natal. The high status of this city should allow one to assume that the policies advocated by environmental legislation and service delivery are being implemented in a most responsible and efficient manner.

Chapter 2 examines the concepts surrounding Municipal Solid Waste and the critical issues that are inextricably linked to its generation in South Africa. The discussions here pertain to aspects such as incineration, landfilling, waste disposal methods and considerations stemming from climate change. Chapter 3 outlines the methodology of the study, where the research design and framework for the data collection methods and the analysis criteria are set out.

Chapter 4 reports on the results and analysis of the data collection, which includes the results of a questionnaire survey and a case study, based on a MSW analysis of a local landfill site. Chapter 5 briefly examines the existing legislation and policies which govern MSW on local levels. It is in this context that the implementation of such legislation and policies on a local level is examined; as national legislation informs local policy implementation and procedures for managing MSW. A landfill site permit, issued by national government will be critiqued in this chapter as well, thus highlighting the direct link between local and national government in managing MSW in South Africa.

Chapter 6 provides a concise overview of the research results, whilst Chapter 7 forms the concluding chapter which presents the findings of the research. Recommendations for MSW and the implications for policy direction and further research studies are also expounded upon here.

# CHAPTER 2

## THE NATURE OF MUNICIPAL SOLID WASTE AND ITS MANAGEMENT

### 2.1 Municipal solid waste

Chapter 2 examines the various aspects pertaining to the generation of MSW which includes the many disposal routes that it can follow. The focus is predominantly on solid waste generated at the household level, hence the use of the terms “municipal solid waste” or “household refuse.”

A product or a material becomes a waste when it is discarded or unwanted by the owner. It may however, become a resource for others. The highly positive aspect of waste materials being processed into finished products where a market-demand exists, means that the production demands for natural resources will be reduced (Page, 2008). The World Bank formally defines waste as the stage at which the owner or generator discards a material without expecting to be compensated for it (Arlosoroff, 1985).

The owner may be a manufacturer, a consumer, or an inheritor of the item. Waste generation is indicative of life in a consumer-orientated, technocratic society. The demographic structure of such a society requires that the regulation of waste disposal practices be based on a broad insight into the socio-economic, socio-political and environmental framework of that society.

The general definition of MSW is the waste or refuse that is removed from residential and/ or commercial areas to facilitate health, hygiene and sanitation (Tworeck, 1979). Williams (2005 p15) also defines MSW as “waste collected by, or on behalf of municipalities.” This can range from waste generated in households, commercial

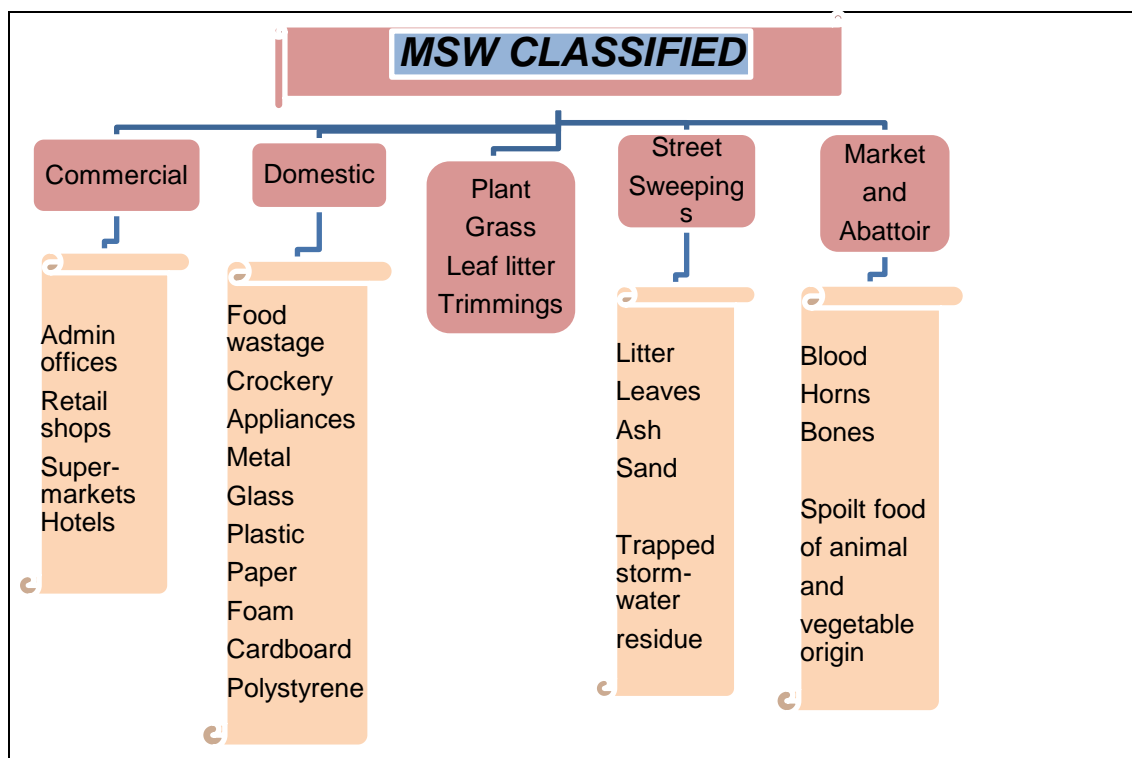
enterprises including factories, office blocks and small businesses, to government administrative buildings. In addition to this, the solid waste stream can increase in bulk as garden, park and street-cleaning refuse (trees/branches/leaves) are seen as the responsibility of municipal authorities.

There are different solid waste categories and a distinction is usually made between MSW and Industrial or Hazardous waste. This is very much dependant on the volume, content and toxicity of the waste which usually requires special handling. Household wastes can also pose as a hazard due to the fact that they can be toxic, corrosive, flammable, explosive, reactive or pathological (Smith, 1992). Paints, solvents, batteries and waste oil are considered as household hazardous waste (DWAF, 1998a).

There is a relatively new type of waste that is escalating in quantity and toxicity, namely: electronic waste. This is due to rapid and continual technological advances in the Information Communication Technologies (ICT) sector. Dysfunctional electronic equipment is often discarded onto a landfill site or onto illegal dumping grounds like vacant municipal land or plots (Venter, 2007). This occurrence is due to the fact that there are no strategic disposal facilities in place for electronic equipment, which are in fact toxic or hazardous to the environment and to people when inappropriately dismantled. Households have electronic items such as personal computers, televisions, radios, washing machines and fridges (among others) that need safe disposal once it is no longer needed (Anderson, 2007; Venter, 2007). Smaller waste electrical and electronic equipment (known in Europe as WEEE) such as irons, kettles, hair styling aids, small vacuum machines, toasters, mobile phones and reading lamps are usually discarded into solid waste bin bags for disposal onto a landfill site. The toxic components from these household electrical and electronic wastes include cadmium, lead, mercury and certain ethers (Manning, 2007). The distinction that needs to be made is that electrical and electronic equipment should not be a fraction of household solid waste to be disposed of at a sanitary landfill site (Anderson, 2007; Venter, 2007).

There is a simple classification system for solid waste in South Africa and this is given in Figure 2.1. This classification of solid waste is still in use today, even though

it was published in 1979 and should be understood in the context that each sector of waste production can and often does overlap with one or more other sectors. An appropriate example would be that of polystyrene, glass, crockery and food wastage which continually occurs at hotels and supermarkets and is not confined to the domestic sector. In addition to this, hotels have large quantities of leaf litter due to their general occupation of large green surrounds to appeal to their clientele base. It is also important to note that the classification system in Figure 2.1 specifically excludes waste from factories (industrial waste), regardless of whether it is hazardous or not.



**Figure 2.1: The Classification of Municipal Solid Waste (after Tworeck, 1979).**

It is pertinent to analyse South Africa's solid waste stream as a process from the acquisition of raw materials, through to its subsequent production levels by manufacturers, which eventually spirals through to suppliers and retailers of finished and sometimes unfinished products. A chain reaction becomes visible hereafter as the links continue to filter through to primary and secondary consumers such as fast food outlets and restaurants and grocery shoppers, until it is disposed of (whether on the landfill site, by littering, or through dumping).

This process of MSW generation through to its disposal can be assessed according to a “cradle-to-grave” or a life-cycle assessment approach, which generally entails monitoring an item or materials of interest such as paper, plastic and metal from production (cradle), until it is discarded (grave) or no longer needed. The focal points are elaborated on in Chapter 3 where there are different disposal or reuse options that can exist, especially for items considered as MSW.

The solid waste stream that is dealt with in this context is that of domestic waste (see Figure 2.1) which is also referred to as municipal or sanitary waste, and non-hazardous industrial waste. Lund (1993) concisely states the gist of the issue at hand when he relates that it is human nature to produce and discard solid waste so that it becomes a “burden” to society to manage it; and that environmentally safe disposal methods and measures such as recycling must be seen as the way forward.

It has been observed that the greater the human population of an area, the greater the concentration of solid waste from homes and businesses inherent to urban areas. It has been a longstanding practice of municipalities to take on the responsibility of ensuring the timely and efficient removal of municipal solid waste due to public health and safety (Miller, 2005).

“Human behaviour” has been implicated as the main cause of ecosystem degradation, thereby contributing to a lack of sustainability on a global scale. However, the very same cause which is human behaviour is also the solution to this problem. An understanding of the “motivations behind such behaviour” would be crucial to the problem at hand (Imbach *et al.*, 1997 p9).

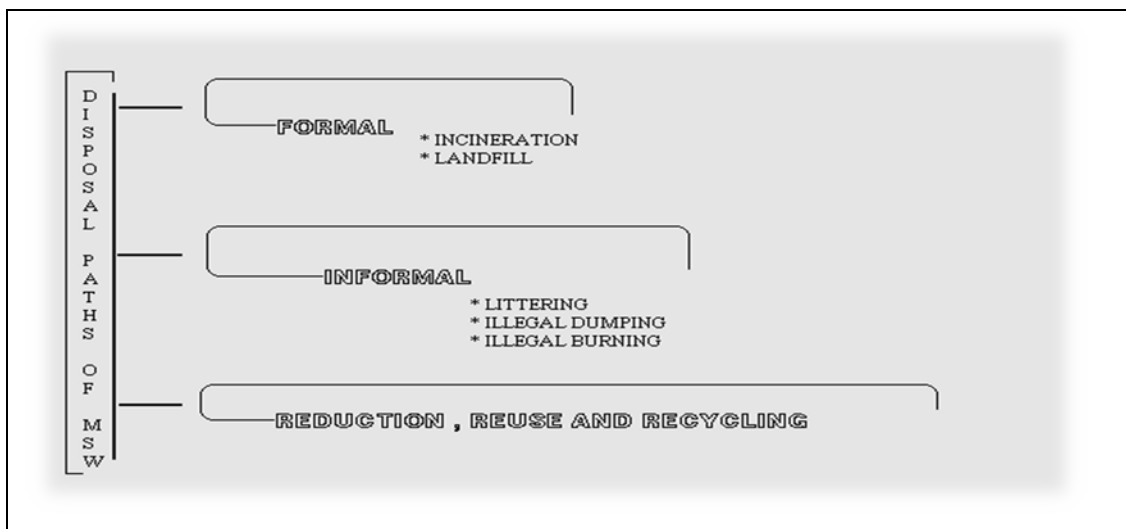
## **2.2 Municipal solid waste formal disposal paths**

The actual collection and transportation of waste, and the disposal paths that MSW tends to follow need to be investigated. These could be formal (recommended) or informal (prohibited) routes such as landfilling or dumping respectively. There are several practices currently in place for the disposal of MSW. However, not all of these



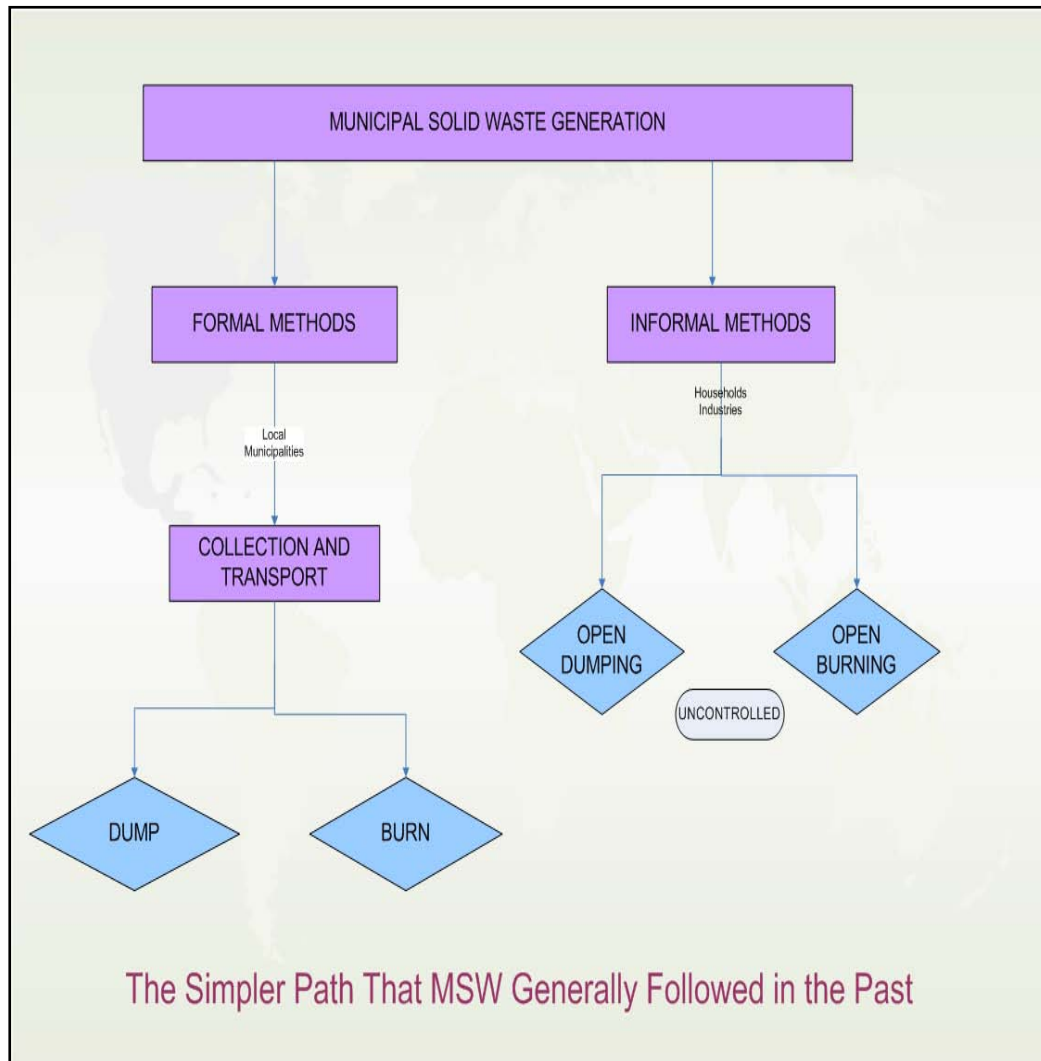
practices are in keeping with the relevant prevailing legislation. Considerations of regional landfill sites with transfer stations to facilitate the waste collection and transportation process seems to be more prevalent today, as in the case of the uMgungundlovu District Municipality which is currently trying to establish a suitable regional landfill site that can service all of its local municipalities (Boswell, 2007; Phelamanga Projects, 2008). The important aspect that needs to be determined is whether the predominant disposal method of the MSW generated is appropriate or sustainable in the interests of human and environmental health and safety.

It is of environmental importance and human wellbeing to determine how, and by what means and methods MSW is being disposed of. The focus of this study is directed toward the most recognised and practiced disposal methods and the related issues of MSW pertaining to individuals and households, indicated in Figure 2.2. There are various factors governing the disposal of different types of waste based on the production and composition thereof. Factors such as the geographical area, population dynamics and the availability of appropriate disposal sites are also taken into consideration (Tworeck, 1979).



**Figure 2.2:** The public-private partnerships for solid waste management services in the Greater Beirut Area (after Massoud *et al.*, 2004).

Figure 2.3 shows the different disposal options that were inherent to MSW in the past. It is highly noticeable that options for mitigating solid waste generation for disposal or reduction did not feature in waste disposal strategies. There were formal and informal methods which consisted of controlled and uncontrolled burning and dumping.



**Figure 2.3: General Municipal Solid Waste practices by municipalities throughout South Africa (adapted from Massoud *et al.*, 2004).**

Of importance to researchers and to the national government is the level of institutional capacity and how responsibly the Msunduzi Municipality manages its solid waste. The critical questions that arise from the management of solid waste are

two-fold; namely: what are the detrimental effects on the natural environment; and what are the negative impacts on human health? These questions are scientific in nature and can be relatively easily determined. However, the views of the general public on this aspect of municipal management gives an indication as to their interpretation of the extent of the problems experienced in solid waste management and their willingness to help alleviate it. This further supports the constitutional requirement that the general public be considered as an important stakeholder for matters that affect the environment, and especially where the impact is greater in their immediate vicinity. This would also include the impact that a proposed activity or venture can have on a person's well-being.

An important issue that arises from the capacity of government itself to manage MSW is that of co-operative governance, where the different departments need to work together to enhance common goals. This is suggestive of the fact that MSW has a snowball effect dependant on the manner in which it is managed. The irresponsible management of MSW can lead to the contamination of groundwater and other water bodies, as well as air pollution, which then affects the health of the people. Therefore, departments concerned with aspects of governance such as waste management, health and safety, water and air quality can actually form strategic alliances to work together to maintain optimal functioning of individual departments.

### **2.2.1 Incineration of municipal solid waste**

Incineration in this context can simply be explained as the burning of solid and added liquid wastes at high temperatures. An incinerator is used for burning municipal, hazardous, medical and other waste in municipalities throughout the world. Williams (2005) explains that in an incinerator, when combustible material is burnt at exceedingly high temperatures (oxidation occurs) products such as heat, water vapour, nitrogen, carbon dioxide and oxygen become the outputs of incineration. He also postulates that during incineration pollutant emissions may vary according to the MSW content and can include: carbon monoxide, hydrochloric acid, fluoride, furans,

sulphur dioxide, volatile organic carbon (VOC), polychlorinated biphenyls (PCBS) and other dioxins, as well as heavy metals.

Incineration is considered as a viable alternative to landfilling and is practiced throughout the world. This form of waste removal is commonly used in South Africa for the disposal of medical and other hazardous waste. The general rule in South Africa is that municipal and other non-hazardous wastes are not mixed with medical and hazardous wastes for disposal. However, incineration as opposed to landfilling, as in South Africa, is the principal means of MSW disposal in Europe with Germany and France incinerating between 25 and 35% of their MSW (Williams, 2005). The fact that household waste separation, recovery and recycling are widely practiced in Europe with stringent solid waste management control measures, largely accounts for its success in being responsibly managed. The issuing of fines for households that contravene MSW legislation is a strong deterrent and the monitoring thereof is on a continual basis (Environmental Protection Agency, 2008).

The main opposition that the general public has to municipal solid waste incineration is that it causes atmospheric pollution due to the fact that when the solid waste is burnt, it is converted into what is known as 'fly ash.' It has been calculated that as much as 30% of the original weight of the waste and between 40 to 50% of the initial volume of waste is still occupied by the ash as a waste residue of incineration (Environmental Justice Networking Forum, 2005). Incinerator ash is toxic and is mainly disposed of by landfilling at a hazardous landfill site, hence increasing the concentration and toxicity of leachate at a particular landfill (Goodstein, 2005). Also, the high particulate emissions from incinerators usually contain toxic pollutants such as heavy metals, dioxins, furans, carbon and acidic gas forming substances (Williams, 2005). Dioxins and furans actually affect the physiological system of humans, causing health problems such as a weakened immune system, skin disorders, liver and renal impairment, and certain types of cancer (Williams, 2005). But, one of the focal points of incineration is that it is the drastic reduction of solid waste volume and not weight that allows for this to be a viable MSW disposal route (Citizens' Clearinghouse on Waste Management, 2003).

According to the Department of Environmental Affairs and Tourism (DEAT's) website (2007) on South Africa's 2006 State of the Environment on *Incineration Operations*, gas emissions from incinerators can belong to one of the four categories as listed below:

- The more common type of gases that is popularly known by the general public such as sulphur dioxide, carbon monoxide, nitrogen oxides and lead.
- Gases that result in acidic compounds such as chlorides, fluorides and bromides that are derivatives of hydrogen.
- Gases that are derived from metal based compounds of chromium, arsenic, cadmium, mercury, manganese and so forth.
- Dioxins and furans.

The emission of these gases by municipal incineration is toxic enough to cause severe and persistent respiratory and cardiovascular health problems, skin and eye disorders, and ailments such as nausea, vomiting and coughing (Khan, 2005). But, unlike landfill sites, methane gas is not a by-product of incineration and therefore, does not account for significantly contributing to global warming (Williams, 2005). However, incinerators do incite more public outcries for concern as the elevated emission stacks release larger quantities of concentrated and toxic gases that can be highly visible as a pollution cloud in the immediate atmosphere surrounding an incinerator. This then becomes an air pollution controversial site that would warrant air quality control measures (DEAT, 2005). The advantages and disadvantages between landfilling and incineration are discussed further in the chapter, providing greater insight into aspects that require consideration when incinerating MSW.

Plasma gasification for the incineration of MSW is being considered as a solid waste disposal option in South Africa. It involves a process whereby MSW turns into vapour once it comes into contact with a plasma reactor – hence the term “plasma gasification”. This vapour is known as synthetic or syngas and can be used as a fuel alternative (Gabru, 2008). However, the cost of installing such an incinerator runs into almost two billion rand and it would require a really long-term investment of more than twenty years to recover the cost – even if it were to be a carbon trading credit

venture. The high financial implications for the installation, operation and repair costs of incineration in South Africa has been a deterrent, with landfilling being favoured as a more viable option for MSW management.

Carbon trading is an initiative to reduce global warming by reducing the emission of greenhouse gases such as carbon dioxide and methane gas into the atmosphere. First World countries need to reduce their global emissions drastically and have devised a method to earn “carbon trading credits” by investing in Third World countries that are willing to reduce their greenhouse gases. Carbon trading credits have real monetary value attached to them and results in financial gain or foreign revenue for those countries who have decided to go this route (Blignaut, *et al.*, 2004). Therefore, incineration of MSW would mean that methane gas would not be a trading commodity as it is not a substantial by-product as compared to landfilling. This will be discussed further in section 2.5.3.

Materials such as plastics, rubber and tyres, and other synthetic fibres that are manufactured from petroleum by-products do not degrade easily, if at all. Plastics can be divided into its most common polymers of polyethylene, polystyrene and polyvinyl chloride or PVC, where incineration of these can be responsible for the release of toxic and carcinogenic compounds into the atmosphere (van den Bergh, 1999). Rubber products such as motor vehicle tyres are slow to burn in incinerators even though it can be considered as a good heat retainer. Following the tyre regulations of the Environment Conservation Act (Act No 73 of 1989) which lacked clear guidelines and the capacity to monitor the safe disposal of waste tyres, DEAT has gazetted the *Waste Tyre Regulation* on 13 February 2009, where the responsibility of waste tyres would lie with tyre producers (RubberSA, 2009). The date of implementation with regard to this new tyre regulation together with the Waste Management Bill of 2007 concerning the recycling and recovery of waste tyres by tyre producers is yet to be announced by the Minister of Environmental Affairs and Tourism - although expected to take effect in August 2009.

The options between optimal MSW disposal routes need to be carefully considered and weighed against one another for a most viable choice. With regard to incineration

and landfilling, each of these options has its own advantages and disadvantages. Also, the municipal areas, the climate and geomorphology, and their waste streams may differ. This would then be an important consideration when deciding on a suitable solid waste disposal route (Illich, 2004; Goodstein, 2005). The next option for MSW disposal is landfilling. It is a widely practiced and predominant MSW disposal method in South Africa (Department of Minerals and Energy, 2003).

### **2.2.2 Landfilling municipal solid waste**

A sanitary or municipal landfill site in South Africa has a national government permit that allows it to accept domestic or municipal solid waste. MSW landfill sites in South Africa are governed by the rules of Section 20 of the Environmental Conservation Act (Act 73 of 1989). It is further subjected to the regulations of DWAF's Minimum Requirements for Waste Disposal by Landfill (DEAT South African Waste Information Centre, 2007).

The Department of Water Affairs and Forestry (DWAF) defines a sanitary landfill as differing from a dump in that, it is a formal and structurally engineered waste disposal site that is designed to suitably compact and cover waste, so that pollution is minimised (DWAF, 1998b). Everyone generates waste and in so doing, everyone needs to be responsible in assuring that these wastes are properly disposed of. In most district municipalities, domestic waste is left on curbs or roadsides in bin bags at least once a week – usually on the allocated day for collection in specific suburbs, to be picked for disposal (Naidoo, 2007).

Municipal or privately contracted companies that are registered as waste transporters, transport municipal solid waste to permit-holding landfill sites. Industries and companies, including households also make use of landfill sites for discarding unwanted materials and bulky garden refuse. They are usually charged a fee depending on the quantity or density of MSW that is determined by weigh bridges at the respective facilities. Refuse removal itself in residential and commercial areas is a municipal service billed to ratepayers. It has been estimated that the South African

waste stream comprises an annual total of 15 million tons of domestic waste, 16 million tons of industrial waste, 20 million tons of waste resulting from power generation, 20 million tons of agricultural and forestry waste, 12 million tons of sewage sludge and 450 tons of mining waste (Blignaut, 2004; DEAT: A Report on the State of the Environment, 2007). Solid and/ or liquid waste, as well as commercial and industrial waste can literally be ‘dumped’ onto a demarcated area of the landfill, covered with a suitable soil layer and thereafter compacted by earth-moving vehicles to ensure maximum space availability.

The selection of a landfill site is governed by the NEMA Environmental Impact Assessment Regulations (2006), which is in the process of being amended to ensure public and environmental safety. This includes environmental impact assessments (EIAs), which conform to the newly established laws of all interested and affected parties (IAPs); as well as site selection criteria which further include the impact assessment of all potential sites. Socio-economic factors and environmental safety are now considerations that are taken into account when siting a prospective landfill (Smith, 1992). Non-governmental organizations (NGOs), environmental action groups and concerned citizens can actively campaign against the site selection of landfills. The most popular of these in the fight for environmental conservation and health security as listed by Smith (1992 p161) are LULU’s (locally unwanted land uses), NIMBY (not in my backyard syndrome), and BANANA (build absolutely nothing anywhere near anybody). A plausible reasoning behind this negative site selection process is that of landfill sites still being viewed as a more technologically advanced open dump. People may still have the image of pests, filth, untidiness and toxicity in mind (Zetter *et al.*, 2002; Heimlich, 2005).

The Minimum Requirements for Waste Disposal by Landfill (1998) as set out by DWAF is an important guideline or framework for the different governmental bodies and the public to monitor and make sure that landfill sites are operating according to safe standards – during the phases of MSW collection, transportation, treatment and disposal (DWAF, 1998a). Blight (2004) cited by Furter (2004 p29) explicitly states that the reasoning behind the legislation of The Minimum Requirements for Waste Disposal by Landfill (1998) was to make sure that the welfare of the public could be



protected against the harmful effects of MSW disposal within reasonable financial expenditure. It is still speculative as to whether landfill sites throughout South Africa actually abide by these requirements, especially since it has been observed by the principal researcher that landfill sites do in fact contravene some of the requirements such as a suitable soil cover on a daily basis.

The short-term impacts of landfill sites are usually unpleasant odours, litter scattered by weather elements such as wind and water, pests such as flies and rats, noise disturbances due to the use of operational equipment and solid waste transportation vehicles, including compactors and bulldozers. The long-term effects cover issues such as methane (landfill) gas generation and pollution or contamination of land, air and both surface water bodies and groundwater (Khan, 2005).

Landfill sites are graded according to the size of their waste stream, the type of waste that is accepted, and the degree of environmental hazard posed (especially leachate). Each class of landfill sites have their own requirements to conform to (DWAF, 1998a). For example, the NERLS is classified as a “**G:L:B+**” landfill site which indicates that it is a general (G) and large (L) landfill site that does not accept hazardous waste and it does produce leachate (B+); and is discussed in Chapter 5.

Leachate is the liquid seepage from landfills resulting from a mixture of precipitation, liquid by-products of anaerobic microbial action and liquids already present in MSW (eThekweni Online, 2008b). Geotextile liners are usually used to prevent leachate from seeping into the ground at leachate-bearing landfill sites (DWAF, 1998).

Food wastes of animal and plant origin are easily biodegradable, but plastic waste does not degrade on its own at a landfill site or at any other area of disposal (Page, 2008). There are various types of plastic which require different melting points to degrade. This has important environmental pollution and contamination implications (DWAF, 1998a). It therefore becomes imperative for a sound leachate collection and monitoring system especially for biodegradable waste and the use of a suitable geotextile liner in order to keep this toxic by-product in check. Regular monitoring of leachate at landfill sites is required via monitoring boreholes to determine the

quantities and toxicities thereof (DWAF, 1998c). According to Heimlich (2005), landfill leachate can be 20 to a 100 times more concentrated than raw sewage; which he termed “landfill liquor.”

It is apparent that a total review of the management of MSW from production to transportation, to landfilling and leachate monitoring needs to occur. The monitoring of solid waste goes further than just collection and landfilling. It will be evident later as the research suggests that on occasion municipal landfill sites operate in clear violation of environmental guidelines.

### Drawing comparisons between incineration and landfilling

It has been a longstanding debate as to whether landfilling or incineration is a better municipal solid waste disposal method, where the advantages of one are weighed against the disadvantages of the other. We take a closer look at the different options below while keeping in mind that landfilling is the most preferred and practiced municipal solid waste disposal method in South Africa.

The incineration of municipal solid waste can have the following advantages over landfills (DEAT, 2005; Williams, 2005; Marshall, 2007):

- i. Incineration usually occurs in close proximity to the collective waste points. Great distances are usually necessary to haul waste, due to the location of landfills away from cities on account of lowered availability of suitable land.
- ii. The ash produced by incineration of solid waste is far lesser in density and quantity once burnt than compaction of the same on landfill sites.
- iii. Incineration does not produce methane gas as a landfill does (even after closure), thereby aiding in the combat against global warming by reducing the emission of greenhouse gases.
- iv. Incineration is a preferred method (regarding environmental safety) for the reduction of hazardous and toxic waste.
- v. Ash residues from incineration can be added as bulk to building material, especially when constructing roads.

- vi. Steam production can be utilized as an energy source from waste incineration to provide electric power and industrial heat requirements.
- vii. The nuisance of pests and informal salvaging are greatly reduced.

The most common disadvantages of landfills can be noted as follows (Citizens' Clearinghouse on Waste Management, 2003; Khan, 2005; Anderson, 2007; Reddy, 2007; Bates, 2008):

- i. Landfills are open to public outcries of suspicion, misunderstanding and fear.
- ii. The location of landfill sites do not necessarily take into account the economic, environmental and geotechnical aspects in the wake of political and governmental jurisdictions.
- iii. The problem of aesthetic appeal, increased traffic and noise pollution in its vicinity are problematic for host communities.
- iv. Landfills require large tracts of land.
- v. Upon closure, rehabilitation of the landfill site becomes necessary. This could prove to be a costly and time consuming task.
- vi. Informal salvaging on landfill sites pose as a major health hazard to the salvagers themselves and to those who they may pass their contaminating pickings to. Further, the well-being and safety of the general public in the vicinity of landfill sites become threatened due to the fire outbreaks caused by negligent salvaging of metals. Such toxic fire outbreaks have been known to continue for a week or more.
- vii. Landfill sites are labour and machine intensive, requiring skill and large tracts of land to supervise. There are also more processes involved in the monitoring of a landfill site such as, leachate collection, methane gas flaring and lateral movement (if any), ordering and payment of cover material and so forth.

The importance of landfill sites in South Africa can be viewed against the backdrop that it becomes necessary to maintain safety and health standards by adequately disposing of MSW, especially with regard to the proliferation of pests and diseases in urban and residential areas. This is the primary reason as to why municipalities provide a refuse removal service. Unfortunately, due to high operating costs, it has

become an expense to the ratepayer. The disposal of bulky refuse such as trees and obsolete appliances is facilitated. A landfill site can accommodate large volumes of waste and is a legitimate place for the disposal of difficult and environmentally damaging items. This reduces the need to dump in forbidden areas. The New England Road Landfill Site currently accepts five hundred tons of MSW a day (Raghunandan, 2005; Naidoo, 2007).

The advantages of landfilling over the incineration of MSW pertain mainly to the fact that sanitary landfills generally cause less air pollution than incineration. There are also more options available when landfilling to manage solid waste by composting, reuse, recycling, and creating employment opportunities. Landfilling is considered more economically viable than incineration which requires large quantities of waste to burn and produce energy, and it is capital intensive. Further, more employment opportunities are created at landfill sites due to its labour intensive requirements. Incinerators do require highly skilled and well trained operators to ensure that operations are maintained at optimal levels at all times.

Methane gas production from landfill sites can be utilized for electrical energy requirements, simultaneously increasing the revenue and council coffers after landfill closure for a time frame of up to thirty years. Landfill sites can then be rehabilitated post closure to allow for recreational zoning. Unlike incineration plants, the chance of localised acid rain production is decreased, and the disadvantages of landfilling are easier and less costly to rectify (Bates, 2008; eThekwini Online, 2008b).

### **2.3 Illegal municipal solid waste disposal methods**

Littering, unauthorized (by government) burning and dumping of MSW are considered as illegal in South Africa. People often fail to realize that their actions such as littering, illegal dumping and the burning of solid wastes (which may seem insignificant at the point of committing the act), actually have far-reaching negative consequences.

Fuggle and Rabie (1983 p2) highlight the environmental consequences of thoughtless actions, especially littering as postulated by their quote given below.

*“Environmental problems are often of an insidious nature. The collective impact of many small actions – discarding a beer can, a smoking chimney, picking wild flowers, damming a river, the loss of one or two hectares of farmland – in themselves insignificant become serious if multiplied several thousand times. Man-land relationships require an ability to appreciate the many aspects that make up the real problem – economic, technical, biological, social, legal and moral.”*

### **2.3.1 Littering**

There are different types of litter and various sources, as well as high litter generating events. The most common types of litter are plastics, paper, metal, glass, vegetation and sediment. The sources of litter often include household trash sites, commercial waste dumpsters, loading docks, building construction or demolition, uncovered vehicle loads, pedestrians, and motor vehicle occupants (Armitage *et al.*, 1998). The most common high generating litter events include community events, a lack of litter bins, lost vehicle loads, fast food establishments, and garbage disposal at remote locations.

Environmental Affairs’ Minister Valli Moosa (in 2001) was responsible for changing the plastic bag production and pricing fee by consumer legislation in South Africa (DEAT, 2001). This was an effort to deter littering and he humorously, but seriously acknowledged the nickname of the plastic bag as South Africa’s new “national flower” that adorns trees and fences, clogs drainage systems and litters streams (Marais *et al.*, 2003). The legislation promoting the use of thicker and recyclable plastic shopping bags became legally effective on 9 May 2003 (Enviromark, 2007).

Figure 2.4 is a photograph depicting the unscrupulous dumping of MSW on Greytown (Chota Motala) Road on a vacant piece of land next to *Save You* Supermarket in

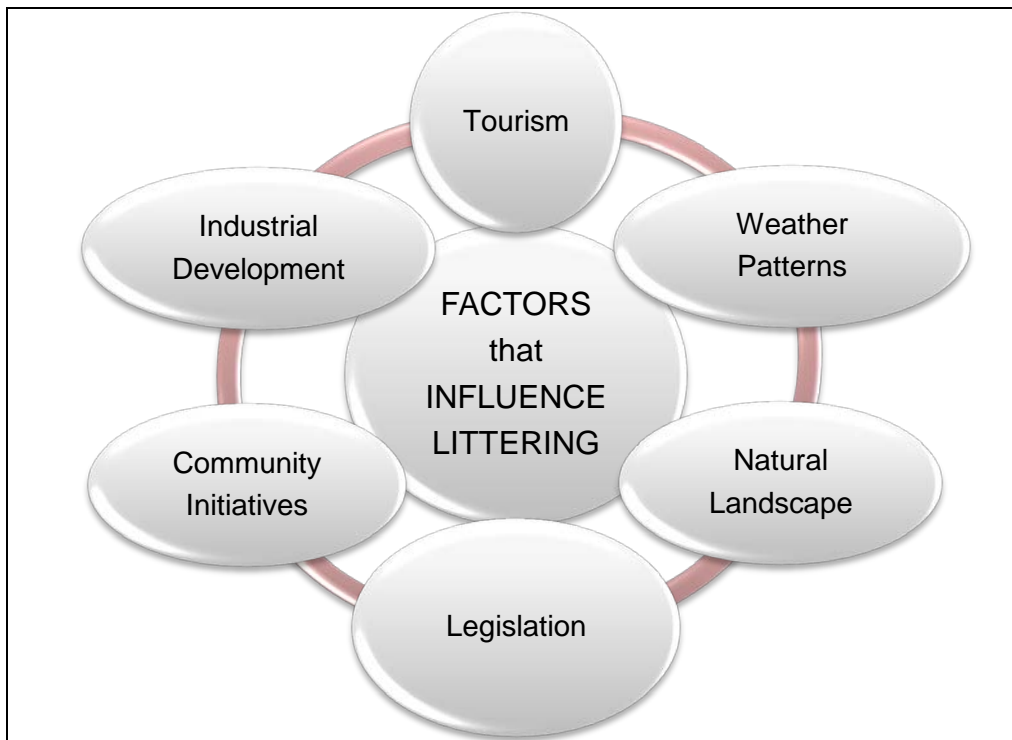
Raisethorpe, in the suburb of Northdale in Pietermaritzburg. This area is a hive of commercial activity as small and medium businesses trade on a daily basis. A number of grocery stores and supermarkets are found in Raisethorpe, where street vending by local and foreign nationals have also escalated in the past five years.



**Figure 2.4: A Photograph depicting litter and dumping in the suburb of Northdale in Pietermaritzburg (Govender, February 2008).**

In 1999, the Greater Johannesburg Metropolitan Council cited informal settlements and the influx of informal street traders as major contributors to litter, illegal dumping in open spaces, the burning of refuse and land pollution. The lack of regular refuse removal services and the inappropriate location of rubbish bins were also cited as a problem. Litter was noted for blocking storm water drainage systems as well. The high organic litter load in settlements was regarded as a health hazard as it drew large numbers of pests according to DEAT in their *State of Land Pollution according to Major Sources* Report (DEAT, 2007c).

The various factors which influence the composition and quantity of litter are shown in Figure 2.5. These factors can be considered in their entirety or viewed as interdependent factors. Littering has become a serious issue and a defacing menace to South Africa. This is starkly apparent as one walks through the streets of major city centres. Even the highways are strewn with litter and require regular refuse removal.



**Figure 2.5: Factors contributing to litter (after Shaw *et al.*, 1996; Marais *et al.*, 2003).**

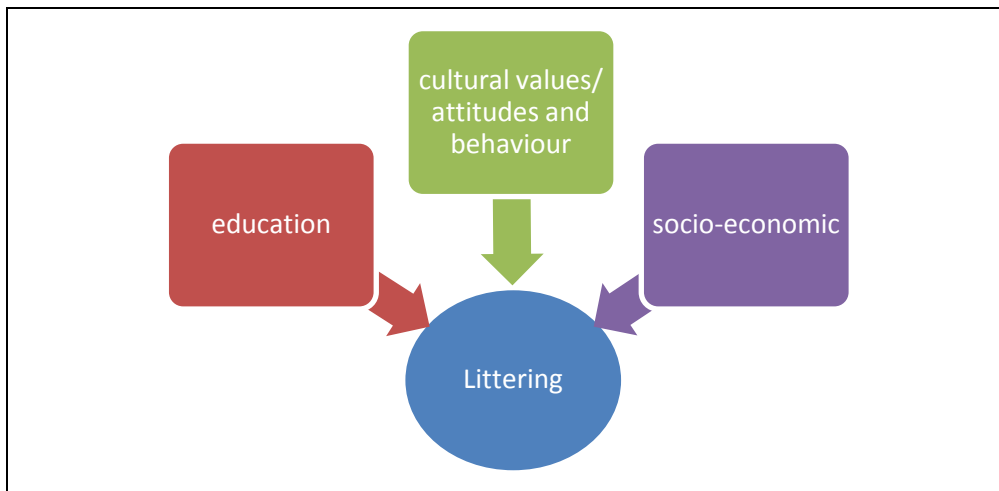
There are several issues pertaining to litter in South Africa which needs to be analysed and dealt with in an accurately quantifiable and sound scientific manner. These aspects are currently lacking. There are numerous factors which influence the composition and quantity of litter such as:

- i. A boost in tourism which tends to see a major generation of rubbish on a seasonal basis. As positively as mass tourism brings an influx into the local and national economy; it can just as equally on the negative extreme of a continuum, degrade and deplete natural resources and create intense environmental pressures that affects the local residents of an area (Shaw *et al.*, 1996).
- ii. Predominantly industrial developments (commercial and industrial) in a geographic area are often noted for increasing the litter percentage when compared to residential areas.
- iii. Weather patterns such as high seasonal winds, cyclonic activity, heavy rainfall or dry conditions exacerbate the spread of solid waste material; thereby unintentionally constituting litter.

- iv. Prevailing legislation and management policies of local and national authorities play a major role in curbing litter, especially when people are fined for littering or if recycling and reduction efforts are legalized. The lack of such stringent laws and the enforcement thereof facilitate the litter problems encountered today in South Africa.
- v. Community initiatives and the different levels of environmental awareness also affect the quantity and composition of litter. Those communities who are more environmentally aware and engage or participate in environmental clean-up or tree planting programmes are less likely to litter or illegally dump rubbish.
- vi. The natural landscape of a region, with indigenous or exotic vegetation can increase leaf litter quite considerably. Tree branches can add a tremendous amount of bulk to landfills due to their difficulty in compacting. Wood chipping and the sale thereof should be encouraged at landfill sites to alleviate this problem. Further, composting of leaf litter projects would lead to job creation and the reduction of garden refuse at landfill sites.
- vii. What is especially noticeable during the festive seasons in South Africa is the almost doubling or tripling of bin bags containing MSW. This can be attributed to the fact that relatives from neighbouring provinces prefer holidaying in KwaZulu-Natal and people generally spend more on food and other consumables during these periods (Naidoo, 2007).

Although the factors listed in Figure 2.5 can be considered as those that contribute to litter, of equal consideration is that of the possible motivating factors that coerce people into committing the act of littering. Figure 2.6 depicts three primary factors that can be considered as those that motivate behaviour such as littering. These factors are socio-economic, cultural and education. Socio-economic and educational factors are viewed as integral constituents in the development of cultural values and attitudes that eventually determine an individual's behaviour.





**Figure 2.6: Possible motivating factors for littering (after Imbach, 1997).**

It is important to understand why people behave in a manner that poses as a great threat to the natural environment and as a health hazard to themselves and others. Do education, socio-economic status, cultural values and attitudes play a significant role in the relationship between human behaviour and environmental practices? What motivates behaviour? Does society itself and natural disasters such as flood, fires and earthquakes influence such behaviour? It is considered a growing trend that as technology advances, natural environmental changes occur, and cultures adapt likewise with respective changes (Imbach *et al.*, 1997).

Thomson (1991) emphasized his view by stating that every person is influenced by culture and its inherent backgrounds in terms of their daily actions and decision-making. He further stated that the type of culture is not as important as understanding and identifying how culture influences and determines people's behaviour. Norms and behaviour governed by it invariably change with changing and divergent socio-cultural groups in any society (Johnston *et al.*, 2002). Cohen (1995) cited by Johnston *et al.* (2002) states that the different populations, environments, economics and cultures are interactive and should not be considered as separate entities when analyzing a situation.

Skogan's (1990) research on litter and neighbourhood decline in America cited by Marais *et al.* (2003), showed that there is a strong correlation between social and physical disorder, where litter and other environmental degradation cues are in

keeping with “neighbourhood decline.” In this instance, litter can be classed in the same frame of light as “incivility, vandalism, dilapidation and a symbol of disorder” (Marais *et al.*, 2003).

The City of Tshwane (known as Pretoria, the capital city of South Africa) issued a press release on 23 November 2005 captioned as, “Capital City...Clean City.” The executive mayor cited the lack of education and awareness among poorer communities as the causes behind unsustainable solid waste management practices. These practices included littering, illegal dumping, illegal burning and general pollution. These factors were also seen as contributors to environmental degradation and human health deterioration; which was further linked to “crime and grime” (Tshwane, 2007).

Fuggle and Rabie (1983) mention that environmental degradation is not a premeditated or “evil act” by humankind. They see it as an inevitable by-product of advancing technology in the quest for superior human needs at the expense of irresponsible utilisation of natural resources, ignoring the long term consequences while enjoying the short term benefits gained.

Together with littering, the large scale occurrence of illegal dumping is fast becoming a norm in South Africa. The Plastic Federation of South Africa in their *Enviromark* publication (2007), has cited “irresponsible social attitudes” as the primary cause of littering. The very same factors that influence littering may be equally applicable to the dumping of waste that seems to be inherent to every society. However, its frequency and scale may differ according to the extent of socio-cultural, economic and educational influences.

### **2.3.2 Dumping**

An open dump is a refuse disposal site that has been deemed appropriate for the “dumping” of or discarding of domestic solid and liquid waste, and/ or industrial waste on a land site that has not been subjected to the rules and regulations governing

such a structure (eThekweni Online, 2005). It may be an individual, industrial or community initiative to get rid of solid waste. It generally lacks the practice of soil cover which promotes litter, the control of informal salvagers, and the concern for the spread of disease and pests. Furthermore, aesthetic appearances, soil, and air pollution problems including unpleasant emanating odours are issues that are simply ignored (Miller, 2005).

Illegal open dumps can also be a real hazard in terms of contamination of groundwater through uncontrolled leaching, and the disruption of ecological marshes and wetlands in its vicinity through surface runoff contamination. If an open dump is situated near streams and rivers, the possibility of contamination of these water bodies through leachate is great (Environmental Protection Agency, 2008).

Informal settlements play a significant role in illegal dumping. These informal structures with no definite ownership, stability or adequate facilities and infrastructures are susceptible to the dumping of waste and littering that is mainly due to the apathetic conditions that characterize these settlements. The same is often applicable to low-cost housing settlements (Reddy, 2007). Informal settlements have now become more of a permanent feature of our towns and cities, rather than a sporadic occurrence. The South African government faces a mammoth task in adequately providing for and accommodating the inhabitants of such settlements.

Illegal immigrants, poverty, socio-political intolerance and the influx of rural dwellers into urban fringes in the hope of better have been cited as the primary reasons for the establishment of informal settlements (Sheppard *et al.*, 2003; Wall, 2000; Cooper *et al.*, 1995). Often, these informal settlements are in the vicinity of large dumps or landfill sites, where salvaging becomes a way of life to meet basic living needs.

Attitudes do play a substantial role in determining such detrimental environmental behaviour and what needs to be investigated is the mindset of people and their attitudes toward environmental responsibility. Actions such as dumping and littering indicate that a social problem does exist in terms of environmental apathy. Whether such mindsets and actions can be largely pinpointed to any particular group of people,

due to socio-economic and cultural influences will be looked into further in the following chapters. The reasoning governing actions of littering and dumping are applicable to burning as well; which is largely attributed to ignorance of the harmful environmental consequences of such an action.

### **2.3.3 Burning**

The household practice of burning waste in one's backyard is no doubt a cause that aids air pollution. It may seem harmless when analysed as a single household practicing this technique of refuse removal once a week. However, multiplied by hundreds of households practicing the same technique in a geographic region, the effects of air pollution (the release of toxic and greenhouse gases), possible soil and water contamination, the resultant smog, the possibility of hazards such as uncontrollable veld burning, glass and metal material explosions – it makes one think if it really is a practice worth practicing in an environmentally aware age!

In a study cited by the Cancer Research Initiative of South Africa (CARISA), the burning of household waste in a drum in a backyard actually releases more dioxins than a municipal incinerator which is responsible for burning thousands of tons of MSW daily (Halden, 2008). This is due to the fact that most municipal incinerators are designed to trap emission particulates that cause air pollution, and this includes dioxins which are toxic organic pollutants that float in the air and are stored in animal and fish fat when ingested (Halden, 2008). Also, the quantity and composition of waste usually influences the efficiency of the combustion process, whilst mass burn incinerators are designed to ensure that waste is reduced to as much ash as possible to aid proper disposal thereof (Williams, 2005).

Combustion processes release large amounts of carbon dioxide, especially when coal, oil or natural gas is utilized as fossil fuels. This process is applicable to the burning of wood and household refuse, where the organic makeup of most items is carbon. The phenomenon of 'acid rain' is essentially a result of the carbon dioxide released during combustion and combining with water to form carbonic acid in rain. Other elements

such as nitrogen, nitric oxide and sulphur are also released during combustion processes to form stronger acidic solutions (Lund, 1993).

There can be several economic reasons possibly contributing to informal MSW disposal practices. Poverty has most often been cited as the main reason, where informal MSW disposal practices occur across informal settlements and low-cost housing schemes throughout the country. This is due to a lack of service delivery in these areas, especially in informal settlements due to the illegality of their nature. The Human Sciences Research Council (HSRC) reports have indicated that in 2004, 50% of South Africans were living below the poverty line of R1290.00 a month for a family of four. Although strides have been made by showing an increase in bridging the gap of economic inequality among South Africa's dominant race groups, the Black population still retains the largest fraction of poverty (van Wyk, 2005). It can therefore, be reasonably concluded that due to the larger fraction of South Africa's poverty-stricken population being Black and occupying informal settlements (as compared to other race groups in the country), informal solid waste disposal practices are bound to be practiced mainly by the informal Black dwellers. However, this does not exclude other race groups who may also occupy informal settlements, albeit on a much smaller scale when comparing population race groups.

One can argue that according to the Batho Pele: People First Principles drawn up by the Department of Health in KwaZulu-Natal, the basic rights of clean and safe drinking water and sanitation, food, shelter and housing that each and every South African citizen is entitled to (which is also reflected in the South African Constitution as the Bill of Rights) and those that are being received by informal settlement dwellers is a controversial issue (KwaZulu-Natal Department of Health Online, 2005).

Religious beliefs sometimes contribute to negative and false beliefs about environmental degradation. In a case study conducted in Brazil in 2004 by Christine Storey and Hayde`e Torres De Oliveira, in acknowledgment that education plays a role in environmental awareness and behavioural influences; it was found that the women saw smoke during agricultural slash-and-burn practices as an "apocalyptic sign...of the end of the world" drawing near (Storey *et al.*, 2004). In Lebanon, the

dumping of municipal solid waste in an unsightly manner was blamed on the state of civil unrest and inefficient municipalities that prevailed for fifteen years (Massoud *et al.*, 2004). To reiterate, the possible motivating factors behind littering would also apply to dumping and burning.

It must be stressed upon yet again, that the burning of refuse and dumping contributes significantly to air pollution and global warming; as well as soil and water pollution caused by rotting solid waste and the resultant leachate production (DWAF, 2005; Tshwane Online, 2007). However, of further importance is the fact that inadequate waste collection practices and a lack of local institutional capacity with regard to the provision of efficient waste transportation could be responsible for creating frustration and self-practice methods among residents, who then choose to dump and burn waste. This inadvertently leads one to question the national and local policies and monitoring mechanisms of such policies in place (if any, especially at the local governing levels) to responsibly and as comprehensively as possible manage waste collection and transportation services.

## **2.4. Mitigating negative municipal solid waste practices**

To really practice responsible solid waste management, we need not think about how to 'get rid' of waste only, as the process also entails the practices of reducing, reusing and recycling. It means that one's actions become an invaluable solid waste tool for adopting the 'cradle-to-grave' approach for enhancing sustainable development. In developing countries especially, reduction, reuse and recycling can be seen not just as a means of environmental conservation, but also as a means of acquiring economic and social sustainability (Arlosoroff, 1985).

Reduction, Reuse and Recycling of MSW are considered as the Three 'Rs' of sustainable municipal solid waste management, and has now been incorporated into a 'waste hierarchy' process to formally manage waste in South Africa. Recovery is known as the fourth "R" in this process, but is often combined with the reduction and reuse aspects of waste (Smith, 1992). The availability of suitable land for new landfill

sites and the environmental degradation that accompanies landfilling are issues of concern, which have resulted in municipalities throughout the country and the world searching for sustainable solid waste reduction methods. These important issues are elaborated upon below. The concept behind the waste hierarchy is to follow the route of the most preferred method first, which is waste prevention, followed by minimization, reuse, recycling, energy recovery and disposal as the final and least preferred route – in the interests of sustainable waste management. This process is to ensure that the quantity of waste for disposal onto landfill sites in South Africa is reduced as much as possible due to a lack of suitable sites for new landfills and consideration for mitigating destructive global climate changes.

#### **2.4.1 Explaining Reduction, Recovery and Reuse**

The terms ‘reduce’ and ‘reuse’ are self-explanatory; but what exactly do they mean in solid waste terminology? In the context of solid waste management, ‘reduce’ would mean to use less of, and ‘reuse’ would mean to use a product more than once.

The inception point of solid waste reduction should be at the source, whilst embracing the concept that favours the generation of less waste. This would better accommodate a ‘disposable-loving consumer society’ who prefers the convenience of packaged products (Smith, 1992).

A reduction in solid waste can also include composting of vegetable or organic matter that is known as municipal perishables. This can be used as garden fertilizer for plants and the growing of vegetables. Composting is a much desired and environmentally enhancing practice. There does however exist, the risk of heavy metal and toxic contamination of soil and groundwater. This is dependent on the type and quantity of compostable material. Composting can be considered as recycling due to the organic material being converted into fertilizer through a process of collection and fermentation.

Reuse can also be viewed in a negative light, where it may be an “antithesis of growth and progress” (Smith, 1992 p164). This option to solid waste management can also have negative social connotations if a society sees it as a sign of poverty. Education in this respect would be the key factor for the removal of such a stigma.

The simple strategy of reusing the cooled excess water after boiling eggs for watering plants is actually an excellent example of reuse being practiced on a household level. Here, not only do the plants benefit from the rich calcium that has leached into the boiled water from the egg shells, water itself is a natural resource that you can conserve and the need for purchasing plant fertilizers or enhancers is reduced (*Real Simple*, 2008). These are just basic examples of reuse that any householder can practice, but when practiced conscientiously and collectively, it can become a dynamic recycling technique. Once again, knowledge and public education plays an enhancing role in this instance, as well as changing mindsets towards the “green” practice of everyday living. Such strategies can prove to be powerful eco-tools.

Recovery is considered as a fourth ‘R’ in the interests of managing MSW and has been viewed as an undesirable option. It is usually associated with incineration (Smith, 1992). However, recovery and repair do occur on landfill sites and in other areas of the country; where informal salvagers and the “poorest of the poor” scrounge for a living off the rubbish or on the discarded MSW of more affluent others (Templehoff, 2005). These concepts have become more attractive in current societies as the quest for environmental sustainability combined with economic gain and global recognition from such an activity surpasses negative connotations.

Recovery also occurs where companies have ‘buy-back’ policies for their used items and process this to manufacture new items. The recovery of glass, paper, metal and other recoverables generally go back into the manufacturing process for new production or are sometimes used in creative art, hence falling under the category of ‘reuse.’ Waste is essentially recovered so that it can be recycled. For example, waste glass that is recovered in the glass industry is called ‘cullet’ and can be recycled any number of times to produce a manufactured glass product that is not inferior in quality at all (The Glass Recycling Company, 2008).



Governments and environmental organisations are now also introducing another 'R' concept to the *reduction, reuse, recycle and recovery* options for waste management, which is 'Rethinking' about products before you purchase them so that unnecessary waste production can be avoided (Imagine Durban, 2008). Although this initiative can be seen mainly as a public-directed project, it is applicable to every consumer in the country, be it an individual, organisation or government body. The directive here is for consumers to practically search their 'environmentally conscious selves' and ask the question of whether or not they can do without buying heavily packaged products that merely contribute to the growing waste production trend; which further begs the question of whether they would be content in accelerating the global environmental problems arising today!

#### **2.4.2 Discussing Recycling as a waste minimising option**

Recycling is a solid waste management strategy that entails the conversion of discarded consumer products, essentially called 'waste' into useful or environmentally desirable products. This may mean utilization of a product's original discarded form by another user; or subjecting the waste matter through a process of purification. It can be an individual, household or a mass process, where waste material is collected, separated, cleansed and processed into useful, marketable products. It can also occur within a manufacturing or any other business itself, where damaged goods or off-cuts of a material such as glass, paper or plastics can be fed directly back into the manufacturing process instead of being discarded (Williams, 2005; Lund, 1993).

According to an abstract report from The World Bank Technical Paper Number 30 by Arlosoroff (1985) on integrated resource recovery, the recycling of municipal refuse can be defined to include aspects of resource recovery, reuse, repair and energy conversion of solid waste material. It is envisaged that sustainable economies can be created from recycling due to the fact that when solid waste is recycled, the value that was added to that waste from certain industrial sectors like mining and agriculture, are not lost (Cointreau *et al.*, 1990). Smith (1993) is of the opinion that waste can be viewed as a resource base especially in the context of recycling, but states that as

opposed to other resource bases, the waste resource base has been steadily increasing. He further mentions that even then as a resource base, the goal of waste management should be to reduce rather than maintain this resource base.

The National Waste Management Strategy (1999) of South Africa refers to the recycling of waste as the materials that can be separated at the source of waste generation to be reused, thereby reducing the impact of disposal at landfill sites. The health and safety risks are also minimized if waste is separated at the source instead of at the landfill site itself (DEAT, 2007e).

Ruiz, cited by (Lund, 1993 section 3), speculates about the complex “recycling perplexity” by querying what recycling actually means, if it has a definite beginning and an end; and whether recycled paper for example can be termed “virgin material” when used as a raw material in manufacturing.

“Salvaging” is the term that can be given to recycling and reuse. It can be looked at further in terms of “using wastepaper for papermaking crushed glass in glass manufacture or scrap iron in steel mills” (Tworeck, 1979 p5). However, one must be mindful that a demand must exist for a supply of recyclable material – and this will only occur if there is a market for recyclable products. Consumers must be willing to buy recycled products. The economic and environmental costs of such ventures must also be equally weighed (Lund, 1993).

Recycling initiatives have been largely successful across Europe due to incentives such as government subsidies, buy-back schemes and established markets for recyclable materials. In addition to this, strictly controlled environmental legislation such as Article 174 of the Treaty and the Fifth Environmental Action Programme (1993-2000) which was established by the European Commission in 2000, government enforced initiatives such as the polluter pays principle, ‘bring and collect’ systems where kerbside collection of separated household waste occurs, favours cleaner recycling technologies and solid waste management (Williams, 2005).

According to Delanie Bezuidenhout (2007) in her Information Technology Association (ITA) report, the material footprint in terms of the natural resources utilized for the manufacture of one personal computer (PC) is equivalent to 2, 3 motor vehicles, or 70 washing machines or 160 microwave ovens! Therefore, the ITA is embarking on a massive recycling and responsibility campaign together with other interested organizations and manufacturers in the IT industry to take the initiative of collecting and recycling disused PCs. The eWaste Association of South Africa (eWASA) also plays a major role in supporting the recycling initiatives inherent to the IT industry (*Enviromark*, April 2007).

A major concern at present is the fact that while Provinces such as Gauteng and Cape Town are well ahead in the recycling and consumer responsibility initiatives aimed at protecting the natural environment; KwaZulu-Natal lags far behind even though it is one of the most recognized and technologically advanced provinces in South Africa. PIKITUP is a private contractor for waste management in Gauteng, where households in suburbs are encouraged to separate solid waste at the household level. PIKITUP's vehicles then collect this separated waste (process called kerbside collection) and transports it to their recycling and buy-back centres throughout the Gauteng area (Venter, 2007).

There are many noteworthy MSW management services success stories in KwaZulu-Natal though. One of them is Dan Naidoo from the multimillion rand Commercial Waste Services, who lives by the philosophy of "waste not, want not." Due to a lack of funds and scepticism by the commercial sector, Naidoo started out with a second hand dump collection truck eleven years ago and eventually targeted waste collection from the corporate world. He believes that South Africa can reduce its solid waste by half if it is recycled; and that the Polokwane Declaration for zero waste by 2012 is overstated (Dardagan, 2006). Other environmentalists in the country agree that this target is far-fetched (Templehoff, 2005). However, if it results in considerable waste reduction which would have not been achievable within a shortened timeframe or merely stated as a commitment, then the declaration was worth the effort.

Recycling has several encouraging points. It is surprising to note that we can save 17 trees, 40% energy and 30% water when one ton of paper is recycled. One and two

tenths of a ton of raw materials and a 114 litres of oil energy are saved for every ton of recycled glass. A 74% saving is achieved when iron is produced from scrap ferrous rather than from iron ore (Illinois Recycling Association, 2008). Increasing anthropogenic comforts relies on the advancement of technology, which in turn demands the use of non-renewable natural resources.

If recycling promotes the sustainability of these resources, it should be vigorously implemented. However, as van den Bergh (1999) notes in his *Handbook of Environmental and Resource Economics*, author Robert Ayres mentions that seemingly insignificant or small uses of metal such as bottle caps, razor blades, foil, mattress springs and metal nails are not readily recoverable or recyclable. These metal items are subsequently disposed of onto a landfill site as litter, and do not degrade easily because of the high resistance to corrosion inherent to such products.

DEAT (2007) has formulated a national waste hierarchy as advocated by the White Paper on Integrated Pollution and Waste Management (2000) for the prevention and cleaner production of waste, as well as reduction, reuse, and recycling of MSW with minimal solid waste for disposal by landfilling (Blignaut *et al.*, 2004). The national waste hierarchy is also advocated by South Africa's National Waste Management Strategy (NWMS) which incorporates all aspects of waste management, from the generation of waste to the final waste disposal methods. The NWMS is subjected to a progress review every five years and the draft review is currently scheduled for public comment after restructuring, due to a lack of institutional capacity for implementation, monitoring and control (DEAT, 2009). The national waste hierarchy process in South Africa is usually visually represented by a pyramid structure that is divided into the waste management options of prevention, minimization, reuse, recycling, energy recovery, and disposal (respectively); where prevention is considered as the most favourable and disposal as the least favorable options for waste management (DEAT, 2007e). The objectives and directives of the NWMS are in keeping with Europe's waste management directives that promote cleaner technologies and waste minimisation.

Informal settlements or “shacks” that characterize quite a sizeable portion of South Africa’ landscape today is actually “an innovative reuse and recycling” strategy of construction waste. In spite of all its shortcomings, the shack demonstrates valuable reuse lessons that even the developed world has not as yet managed to achieve (eThekweni Online, 2005).

A comparison of the economic considerations such as operational viability, market demand processes and environmental benefits involved in recycling as opposed to government expenditure and the costs to the public when operating a landfill site must be taken into account, before establishing waste management initiatives on a national scale. The option of public-private partnerships in solid waste management also needs to be looked at in terms of socio-economic viability and best management practices (DEAT, 2002).

There are four crucial factors that can be identified as necessary for environmental sustainability through recycling. These factors are broadly noted as that of reliable availability of finance, a countrywide understanding and acceptance of the task at hand, the acknowledgement of producers accepting responsibility for their products even after its lifespan or intended use (when it becomes waste) and a controlled recycling environment (Bezuidenhout, 2007).

It is without a doubt that humankind has been able to utilise the natural resources from the environment through extraction and manufacture into useful items, and to dispose of these back into the environment as waste products. However, these waste products are often returned in a highly processed form that the environment cannot tolerate or benefit from. Therefore, the concept of recycling solid wastes into further useable forms is highly recommended except for the fact that not all solid wastes are financially viable (van den Bergh, 1999).

A more or less holistic view has been given thus far of the factors that can influence MSW management and the issues that surround this debatable field, including the formal and informal disposal paths that solid waste can follow. Nevertheless, there are other factors that play a major role in the global recognition for solid waste reduction

and its responsible management in the greater interests of environmental sustainability on earth. This will be discussed further in the following section, where the Kyoto Protocol and the Prototype Carbon Fund will be explained in the context of greenhouse gas emission reduction by responsible MSW management. These are influential focal issues which receive priority in government agendas across the world.

### **2.4.3 Considerations of municipal solid waste and climate change**

The fact that landfill sites are major producers of methane gas (as indicated in Chapter 1), hence known colloquially as ‘landfill gas’ clearly suggests that it needs to be investigated as a key global warming contributor. This comes in the wake of distinguishing between mitigating circumstances of global warming and climate change; or one of economic gain, as proposed by the Kyoto Protocol.

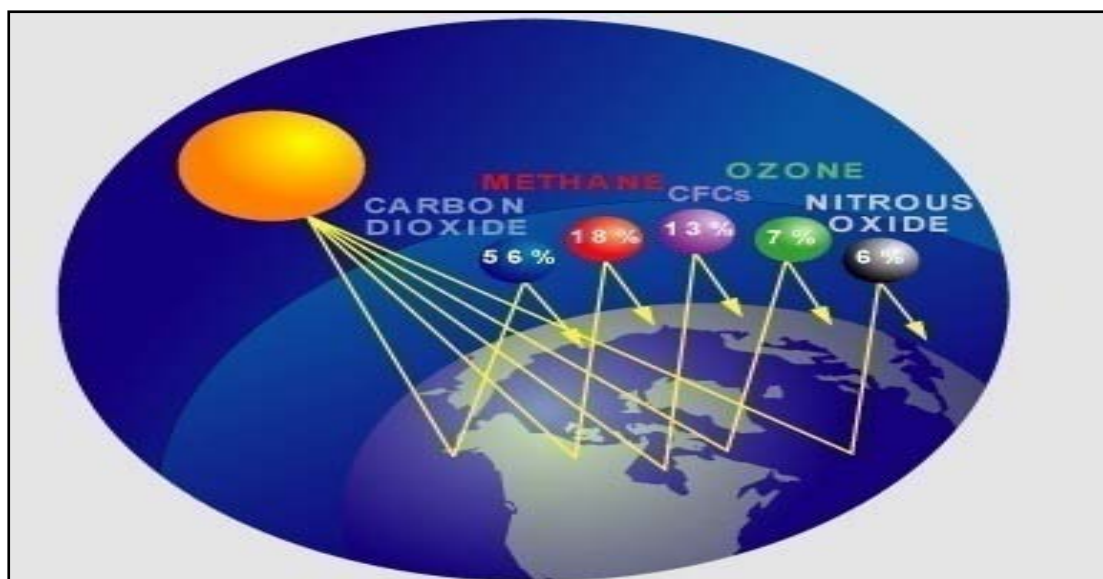
Landfill sites are the direct result of humankind’s attempt to manage solid waste, especially MSW. Therefore, the composition and quantity of solid waste once again comes under scrutiny when determining large producers of methane gas. As discussed previously, one of the key objectives for reducing global warming lies with a concerted effort to drastically reduce MSW and to stop illegal burning of biomass for fuel and as a solid waste disposal method. This can be viewed in a local, national or international context in the quest for responsible solid waste management and sustainability for the environment and mankind.

Greenhouse gases (GHG) are atmospheric gases that trap heat from radiation. This is especially noted for the heat that the earth’s surface radiates (back) into the atmosphere (terrestrial radiation), after it has been sufficiently warmed by the energy of the sun’s rays (solar radiation). The six major contributors of GHGs are methane gas (CH<sub>4</sub>), carbon dioxide (CO<sub>2</sub>), nitrous oxides (N<sub>2</sub>O), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs); where landfill gas can contain as much as 60% of CH<sub>4</sub> and 40% of generated CO<sub>2</sub> (Waugh, 2002; Blignaut *et al.*, 2004; Page, 2008).

Figure 2.7 shows CO<sub>2</sub> and CH<sub>4</sub> as the largest global warming contributors in this context. The combustion of fossil fuels such as coal, gas and oil by industries, motor vehicles and power plants are responsible for the great CO<sub>2</sub> production (Environmental Protection Agency, 2008). According to the U.S. Environmental Protection Agency (EPA), the greatest methane gas production arises from coal and oil combustion, commercial cultivation of rice fields, biomass burning, enteric digestion by animals such as cows – especially commercial farming or husbandry, and landfill sites as part of solid waste management (EPA, 2008). The levels of methane gas can vary across the globe depending on climate variances and where countries possess active volcanoes, conduct wide-scale animal husbandry or have vast wetland expanses and engage in other activities such as paddy rice farming (Griffin, 2003; EPA, 2008).

The greenhouse effect is a natural phenomenon, but when these gases trap the heat in the earth's atmosphere instead of allowing it to escape further into space, we begin to experience an enhancement of the greenhouse effect. This phenomenon is responsible for a rise in the atmospheric temperature, which is termed, *global warming* (Waugh, 2002). This greenhouse effect can be visualized as a blanket that traps heat beneath it, and in so doing, increases the temperature (McCloy, 2005). The term *carbon footprint* has been coined to reflect the amount of CO<sub>2</sub> that is emitted into the atmosphere according to the lifestyle that one leads. Activities such as travel, food consumption and energy-using appliances are taken into account for the measure of one's carbon footprint (Page, 2008). Therefore, the lifestyles that societies lead can reflect either positively or negatively on the environment.

It has been suggested that a mere three to six degrees Celsius increase in South Africa's climatic temperature can endanger the rich indigenous biodiversity which currently ranks as third worldwide (Waugh, 2002). Escalating temperatures due to global warming have already been predicted as a cause for massive droughts and heat waves in the country that has been responsible for creating large tracts of barren land and destruction in the agricultural sector (CSIR, 2006). Generally, the higher the moisture content or precipitation levels, the greater the leachate production at landfill sites (Raghunandan, 2005).



**Figure 2.7:** An indication of the concentrations of major greenhouse gases produced by humankind (Koshland Science Museum of the National Academy of Sciences, 2008).

South Africa's eastern escarpment receives a lot more rainfall than its western regions, hence the higher landfill leachate occurrence in the eastern parts of the country; resulting in geotextile liners being less common in the drier regions of the country as little leachate is being produced (Strachan, 2005). If climate change alters this rainfall pattern, the quantity and composition of landfill leachate will change and the occurrence of geotextile liners will be altered. The CSIR postulated in its *Climatic Future for Durban Report* (2006) for the eThekweni Municipality that flooding and erosion as consequences of global warming, especially the melting of icebergs, will see the devastation of South Africa's East Coast and consequently its major trade ports (McCloy, 2005; CSIR, 2006; Walters, 2007).

As noted above, CH<sub>4</sub> is a major contributor to global warming and in comparison to CO<sub>2</sub>, can absorb twenty five to sixty times more infrared radiation and can be twenty one times stronger than CO<sub>2</sub> in the GHG effect (Jacobson, 2002; Strachan *et al*, 2004; Koshland Science Museum of the National Academy of Sciences, 2008). A ton of methane gas has also been equated to being equivalent to 23 tons of CO<sub>2</sub> (Whyte, 2006). Earth Life Africa, a non-profit organisation that was founded in Johannesburg to address the needs of people without promoting environmental degradation, states that South Africa is one of the top fifteen greenhouse gas producers in the world due



to its increasing carbon footprint evaluated by oil and coal utilisation (McCloy, 2005; Page, 2008). It is clearly evident that the natural environment of fauna and flora and humankind will both bear the brunt of global warming.

The largest single contributor to global warming in South Africa is coal, which is a non-renewable resource that provides an estimated 76% of South Africa's energy supplies; mainly through the Electricity Supply Commission known as Eskom – 'a government controlled parastatal' (Blignaut *et al.*, 2004). Coal itself is a storehouse of CH<sub>4</sub>. According to the U.S. National Energy Technology Laboratory (NETL) heat can naturally convert organic matter in coal seams into methane gas under natural pressure during the coal formation process. The methane gas from coal seams used to be regularly channelled into collection areas when mining occurred and was considered as a hindrance until its energy potential was realized (Griffin, 2003).

The harvesting of methane gas from landfill sites (providing that it is of an acceptable quality) is an alternative to the use of coal for the provision of electrical energy (Blignaut *et al.*, 2004). Landfill gas to electricity projects are currently (2009) successfully running in the Johannesburg, Durban and Pietermaritzburg regions (Reddy, 2008).

Sub-Saharan Africa is still poverty-stricken, where coal and wood are still the cheapest fuel sources available (World Bank Group, 1996). This is the norm in almost all Third World countries and seems as if a catch-22 situation exists between immediate survival and long-term anthropogenic sustainability. However, the threat of global warming is exactly that – global, and as such a global concerted effort is needed. This is altogether a different aspect for debate and will not be discussed in detail here.

The debate now seems to be whether opting to control the lesser of the two evils would be better: CH<sub>4</sub> or CO<sub>2</sub>? Van den Bergh (1999) highlighted that ash from industrial coal combustion was very problematic for disposal onto a landfill site, where even fly ash was considered unsafe as almost 10% of the coal incineration

residue that is released into the atmosphere as total solid particles from the smoke stack contributed to smog, acid rain, respiratory and carcinogenic problems.

The burning of fossil fuels is the largest contributor to global warming (Reuters, 2007; Blignaut, 2004). The South African government itself has been proactive with legislation as The Constitutional Law (Act 108 of 1996) makes provision for alternate energy sources other than fossil fuel (primarily coal) resources for the improvement of the standard of living for its citizens (South Africa Government Online, 2007).

Forests are known as carbon sinks due to their natural storage of carbon, and as biomass burns, carbon dioxide and methane are released into the atmosphere. How much of these gases can be realistically utilized when produced through human activities, and converted into lesser hazards? What are the financial and sustainable implications and impacts? These are pressing questions that do not produce clear-cut answers.

It is the developing countries who do not wish to compromise their development to attain “First World” status by reducing industrial activities. Hence, they are being targeted by developed countries to reduce their greenhouse gas emissions by adopting the principles of the Kyoto Protocol (explained hereafter) as developed countries have already reached the peak of industrialisation and have seized the opportunity to provide host developing countries with incentives such as carbon trading credits to reflect their (developed countries) contribution to reducing global warming.

There are two significant international agreements or measures legislated in an attempt to alleviate the threat of global warming, namely: the Kyoto Protocol and the Prototype Carbon Fund. The failure to achieve the goals set out at the Earth Summit in Rio de Janeiro and at the United Nations Framework Convention on Climate Change (UNFCCC), led to the United Nations (UN) embarking on a veritable “mission” to ensure that countries committed to reducing GHG emissions had to have compulsory targets to reach within a particular time frame. Agreements to this effect were reached, signed and sealed by many countries in Kyoto, Japan in 1997. Hence, the *Kyoto Protocol* was born – a mechanism for developed countries to reduce GHGs

that mainly targeted CO<sub>2</sub> in a time frame that spans the years 2008 to 2012. The requirement here is a reduction of GHGs by as much as five percent below their respective 1990 levels for each country (Mitsch *et al.*, 2004). The incentive behind this mechanism was environmental initiative, recognition and status, potential national financial gain and simply an effort to reduce global warming and safeguard one's own climate (Blignaut, 2004; Mitsch *et al.*, 2004).

On our very own home front, South Africa signed the protocol on 31 August 2002, during the World Summit on Sustainable Development in Johannesburg and has been in implementation since 10 December 2007 (DEAT, 2007b). Apart from this, South Africa had already drawn "A National Climate Change Response Strategy for South Africa" in 2004 where the policies inherent to the country's White Paper on Integrated Pollution and Waste Management 1998 was included. This inevitably means that MSW policies form an important constituent of national and global environmental agendas. Further, South Africa's White Paper on Renewable Energy (2003) stipulates that from the year 2013 onwards, 10 000GWh per year of final energy demand needs to be met by renewable energy (DEAT, 2007b p60).

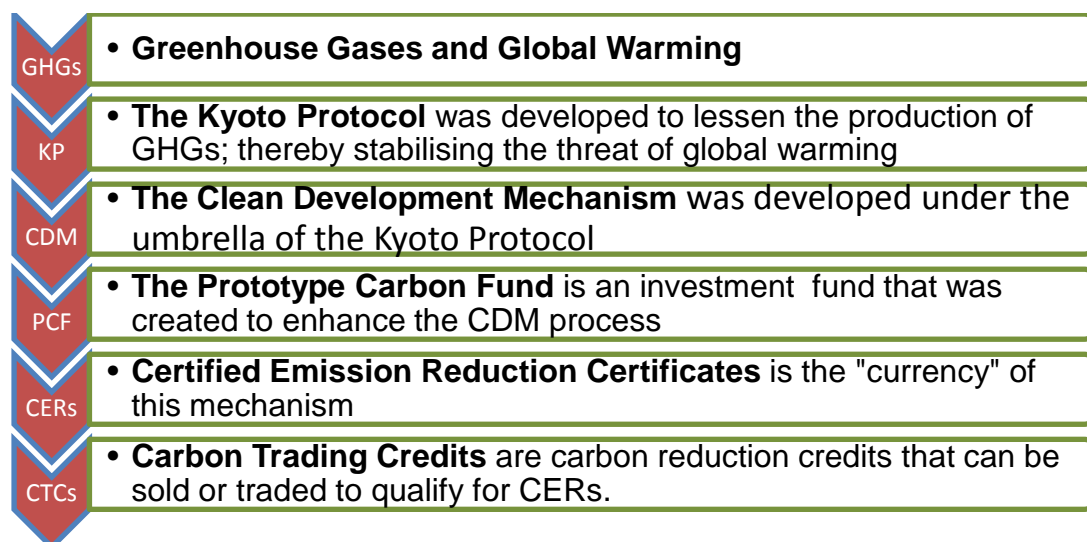
Under the umbrella of the current Kyoto Protocol and as a monetary incentive, the Clean Development Mechanism (CDM) was created. The CDM is project-based and enables a developed country to form ties with a developing country (host nation) for the reduction of GHGs. This can either involve a reduction in existing activities that produce substantial GHGs, or from a proposed activity (Blignaut *et al.*, 2004). This was further enhanced by the concept of the Prototype Carbon Fund (PCF) which was a concept created to enhance the CDM process, providing a more lucrative option towards environmental commitment (Mitsch *et al.*, 2004).

The PCF is an investment fund, incorporating approximately seventeen companies and six governments (Norway, Sweden, Japan, Finland, Canada, Netherlands) – all overseen by The World Bank, who has decided to be the negotiator and fund manager between the North and the South (hemispheres) or between the developed and developing countries. The investors (enterprises and governments) receive emission reduction certificates, formally known as "Certified Emission Reduction Certificates"

(CERs). CERs are known as the “currency of the mechanism” in the partnership between investors and the respective host country (Blignaut *et al.*, 2004).

The reasoning behind the PCF is to provide finance and enable cleaner, more environmentally friendly technologies in developing countries. In so doing, the underlying aim of reducing GHG emissions is attained. These developing countries can then sell these GHG reduction credits, colloquially referred to as “Carbon Trading Credits” (CTCs) to developed countries or industries – in aid of the latter showing a positive balance towards reaching its own emission reduction target (Blignaut *et al.*, 2004; Mitsch *et al.*, 2004).

To be a key player in the PCF business, it is recommended that landfill methane gas be harnessed and converted into electrical energy to preferably upgrade poorer, disadvantaged communities. For every ton of GHG emission reduction, one carbon credit (CC) will be earned. This could generate much needed financial aid for those undertaking the project. Africa’s energy specialist for the World Bank, Arun Sanghvi states that South Africa will illustrate the carbon finance mechanism in action (Moodie, *et al.*, 2005). Figure 2.8 gives a clear indication as to the follow-on development of the carbon trading process under the umbrella of the Kyoto Protocol.



**Figure 2.8: The sequential representation of the Carbon Trading Process (after Mitsch *et al.*, 2004).**

Methane gas is highly flammable and the risks of landfill site fires can be minimized, as well as reducing the quantity of leachate that needs to be disposed of. This will also serve as odour control for the distinctive “rotten-egg” smell that prevails on landfill sites due to the production of hydrogen sulphide (H<sub>2</sub>S). Further, the energy value of methane enhances the lives of impoverished households by its conversion into power for electricity generation. Utilising landfill gas requires enhanced waste compaction for efficiency and this alone will result in a visible reduction in the volume of solid waste (Alberts, 2007).

A United Nations Climate Change Conference (UNFCCC) was held in Bali, Indonesia from the 3<sup>rd</sup> to the 14<sup>th</sup> of December 2007 to formulate a plan of action once the Kyoto Protocol terminates in 2012 (UNFCCC, 2007). Subsequently, the “Bali Roadmap” emerged as a follow-up plan of action to the Kyoto Protocol in the continuing battle to stem global warming. The responsibility towards this environmental endeavour was argued and eventually agreed upon as belonging to both the developed and the developing countries of this world (Marshall, 2007).

South Africa’s current (2008) Minister of Environmental Affairs and Tourism, Marthinus van Schalkwyk, assured the 10 000 odd delegates from 180 countries that South Africa will be a key player in sharing the responsibility towards reducing global warming (Marshall, 2007). However, given the presently volatile nature of politics where the government has changed cabinet in 2009, the country may not continue with its strong environmental standing.

The discussions in Chapters 1 and 2 have provided a contextual background and insight into the many pertinent issues concerning solid waste management in South Africa. The review in these two chapters has set the scene for the investigation of the current MSW management approaches, policies and strategies in South Africa, and the discrepancies that may exist between legislation and policy implementation. However, prior to commencing with the investigation itself, it is pertinent to discuss the methods and approaches used to obtain the data for the study. This is the focus of Chapter 3.

# CHAPTER 3

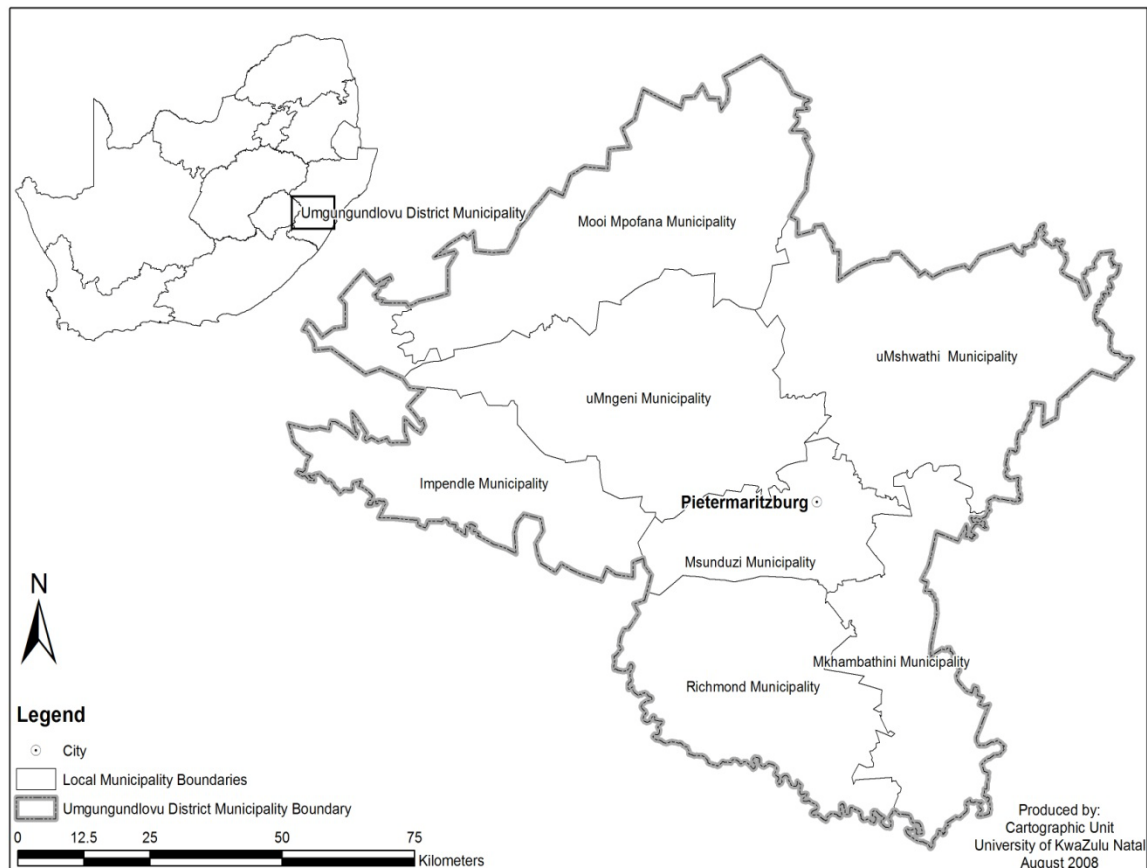
## RESEARCH METHODOLOGY

Municipal solid waste management is closely linked to the waste stream, hence reflecting the attitudes and perceptions of the general public served by the municipality. It is therefore clear that the residents (or households) of a municipality do in fact have a responsibility to practice solid waste policies conforming to environmental sustainability. The extent to which this is happening is one of the objectives of the data collection; primarily achieved through the MSW management survey of members of households in the local Msunduzi Municipality. Thus, a questionnaire survey together with semi-structured and structured interviews with key waste management personnel of the municipality was conducted to bring to the fore the pertinent MSW concepts and attitudes; both those advocated by government and those prevalent in society today.

The results of this survey will then be contrasted with a case study pertaining to the functions and management of the New England Road Landfill Site (NERLS) in the Msunduzi Municipality to investigate the levels of compliance between legislated MSW policies and the resultant practices, and as to how these are potentially impacted on by the residents.

The reason for undertaking a case study with a defined scope is to investigate the nature of the loopholes that exist between the local (in this instance the Msunduzi Municipality) and the national solid waste management strategies and practices in South Africa. The waste management functions of the local Msunduzi Municipality (Municipal Demarcation: K2225) fall under the jurisdiction of the uMgungundlovu District Municipality (District Demarcation: DC22) in the province of KwaZulu-Natal and is shown in Figure 3.1. The local and provincial governing bodies have not directly approached households to ascertain their views on solid waste and their

willingness to aid in environmental sustainability by responsibly managing their solid waste.



**Figure 3.1: The Jurisdiction of the Msunduzi Municipality (drawn by Howison, after compilation by Naidoo, 2008).**

The emphasis for adequate solid waste management has always been an environmental initiative aimed at industries and the corporate world. Although the media has been proactive in highlighting domestic MSW concerns, clearly not every household can afford to purchase the newspaper daily or understand the language of print, nor attend these environmental forum meetings. The research therefore attempted to focus on individual and household views on the subject of MSW management and the interactions with the sanitary landfill site.

### 3.1 The research design

A Life Cycle Assessment (LCA) commonly referred to as a ‘**cradle-to-grave**’ approach used to analyse MSW management practices in the Msunduzi Municipality has been modified so that the “cradle” becomes the production of MSW at a household level and the “grave” represents the disposal methods of MSW. The manufacturer and supplier of products wherefrom MSW arises will not be comprehensively discussed in this research study as it requires an independent analysis.

The reasons for adopting a LCA are mainly due to the following considerations (adapted from Williams, 2005):

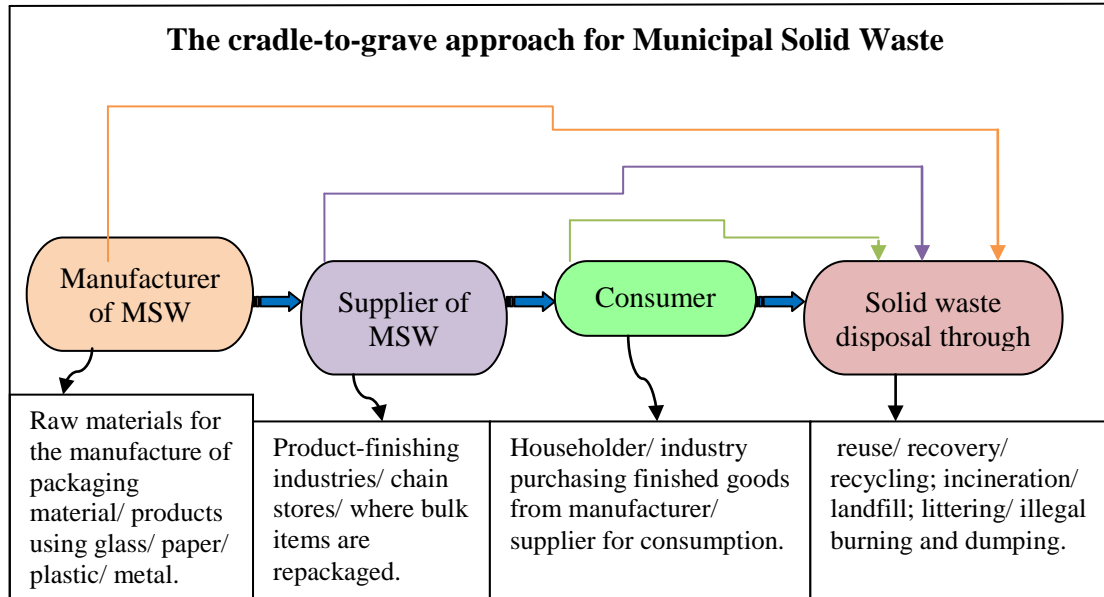
- It is holistic and analytical in its outlook.
- It is a useful environmental tool for assessing the impacts that an activity or a product can have on the environment (and vice-versa).
- It considers the use of raw materials and the subsequent products; as well as the advantages and detrimental effects to the natural and anthropogenic environments.

In this context, the LCA with reference to Figure 3.2 is applied as a progressive and interactive chain, where the key links are the manufacturer, the supplier, the consumer and the methods of municipal solid waste disposal.

The manufacturer is any industry or company that utilises raw materials for the manufacture of goods or products such as glass, paper, cardboard, polystyrene, metal and foam. The manufacturer sells or wholesales finished and/ or unfinished products to suppliers. The supplier can include any industry or commercial outlet that provides its consumer/s with goods. The consumer can be any business or person (householder) who purchases goods from the supplier. Of utmost importance to this study is the householder as a consumer. At any given stage each of these key players (manufacturer, supplier and consumer) produce and can or ultimately will dispose of their waste products in one or more of the methods listed under “waste disposal” in Figure 3.2. In the interests of this study the focus will be on the household or



individual as a consumer and the different disposal methods adopted (by households/ individuals) to manage their MSW.



**Figure 3.2: The ‘cradle-to-grave’ approach of Municipal Solid Waste in South Africa (after DEAT, 1996).**

It is imperative that the present study gauges the solid waste disposal practices of householders in the Msunduzi Municipality. The reason for this is that MSW generated for landfilling and other disposal methods is largely determined by the consumer buying-power. The invariable consequence hereof is the generation of MSW of varying composition and quantity (Marais *et al.*, 2003; Plastics Federation of South Africa, 2007).

The householder in South Africa, especially in KwaZulu-Natal is often not included in local government or foreign initiatives when determining the detrimental environmental impacts of solid waste and landfilling, and subsequently the way forward to sustainable waste management (Reddy, 2007). The reason that the household should be afforded special attention is the fact that the bulk of non-hazardous municipal waste that is landfilled is from households and light commercial industries (Naidoo, 2007).

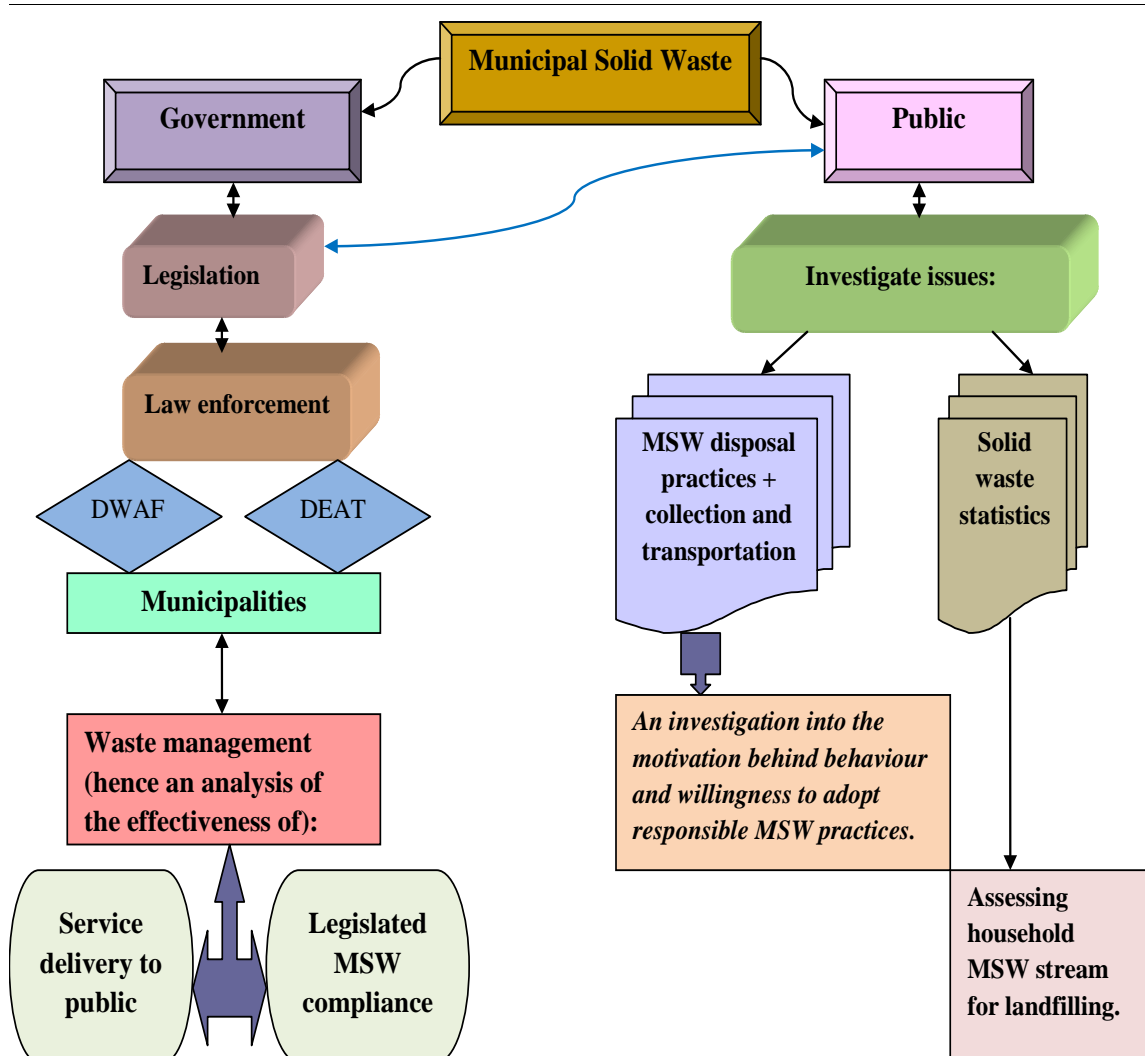
It must be borne in mind that landfilling still remains the key MSW disposal method in South Africa in contrast to Europe, where recycling and ultimately incineration dominate due to a lack of landfilling space, and greater environmental awareness that is enforced by legislation (DEAT, 1996; Williams, 2005). Nevertheless, littering, illegal burning and illegal dumping continue to occur throughout the country and in Africa as previously discussed in Chapter 2. Understanding the motivation behind such behaviour and the scale thereof remains as one of the overarching objectives of this study.

### **3.2 The conceptual framework**

The conceptual framework of the research provides a platform that enhances the reasoning behind the methodological process adopted. This will be accomplished by investigating the MSW management policies and strategies in comparison with the actual procedures and practices that do and do not occur as required by law. The government and the public as indicated in Chapter 2 are equally important stakeholders or “role-players” in the management of solid waste. Hence, the investigative process is broadly conducted from two perspectives of influence; namely: an analysis of the role of government, and of the role of the public. This is illustrated in Figure 3.3 which shows the components and the data collection management process for the investigative issues of MSW in this study.

South Africa has various government bodies and departments that are responsible for a multitude of specific functions in the country. The most notable and applicable examples in this context would be the Department of Water Affairs and Forestry (DWAF), and the Department of Environmental Affairs and Tourism (DEAT). DWAF is the “custodian” of South Africa’s water resources in accordance with the National Water Act 36 of 1998 and was responsible for the publication of The Minimum Requirements for Waste Disposal by Landfill (1998). The Minimum Requirements was an effort to stipulate strict measures and control for the protection of water resources and to safeguard the public and the environment against the

detrimental effects of irresponsible waste management, without unnecessarily jeopardising economic development in the country (DWAF, 1998a).



The discussions in Chapters 1 and 2 indicated that as a consequence of the fact that informal settlements are considered illegal in South Africa, they are not entitled to any government service delivery, including refuse removal. Therefore, informal dwellers have not been included in the information collection process, notwithstanding that they obviously contribute to the waste stream and would represent a significant research undertaking on its own.

The role of the public, be it individuals or households, have a responsibility to ensure that the MSW generated by themselves is adequately and safely disposed of to ensure environmental and anthropogenic health and safety – provided that the government has adequately allowed for this aspect. One of the key investigative issues that the questionnaire survey reports on is the willingness of individuals and households to practice MSW minimising measures such as recycling and creating a demand for recycled products.

Having highlighted the research design and the conceptual framework that the methodology incorporates, it becomes necessary to expand on the methods that will be utilised during the information collection process to ascertain the efficacy of MSW management in the Msunduzi Municipality, ultimately reflective of MSW management in South Africa.

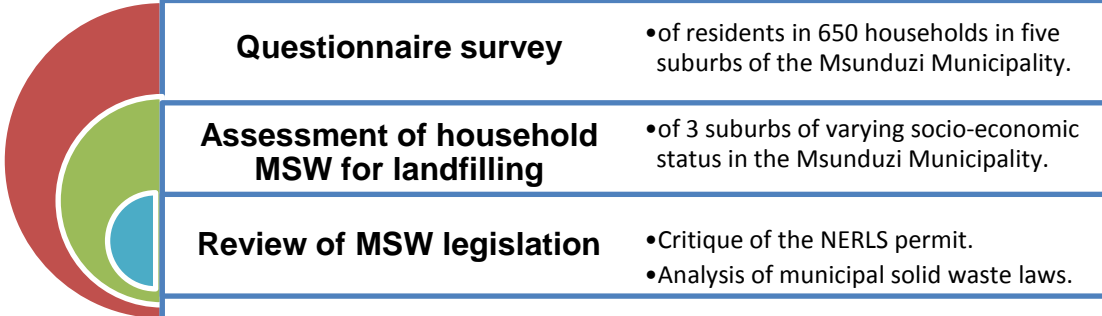
### **3.3 Information collection management**

The three-pronged approach that is outlined in Figure 3.4 indicates the objectives that the study aims to achieve as outlined in Section 1.3, in that:

1. It gauges the views of a sample (650) of Msunduzi householders across five suburbs regarding refuse removal, its disposal methods; and their willingness to practice suggested Municipal Solid Waste management strategies.
2. It investigates the efficiency and effectiveness of Msunduzi's Municipal Solid Waste management services within the context of sustainability; thereby

focusing on discrepancies between management policies and waste management practices by households / consumers in South Africa. This is achieved by an analysis that classifies the composition and quantities of the waste streams of households in three suburbs only that are of distinctly differing socio-economic status.

3. It determines and suggests reforms that could be made to local, provincial and national service delivery strategies, aiding equity, affordability and accessibility with regard to Municipal Solid Waste.



|  |  |
|--|--|
| <b>Questionnaire survey</b>                        | <ul style="list-style-type: none"> <li>•of residents in 650 households in five suburbs of the Msunduzi Municipality.</li> </ul>    |
| <b>Assessment of household MSW for landfilling</b> | <ul style="list-style-type: none"> <li>•of 3 suburbs of varying socio-economic status in the Msunduzi Municipality.</li> </ul>     |
| <b>Review of MSW legislation</b>                   | <ul style="list-style-type: none"> <li>•Critique of the NERLS permit.</li> <li>•Analysis of municipal solid waste laws.</li> </ul> |

**Figure: 3.4 The research issues for the components of data collection.**

The information collection management process mainly entails the information gathered from the primary and secondary data collection processes, as detailed hereafter. This information is then analysed according to suitable methods that would enable an examination of the data outcomes necessary for accomplishing the aims and objectives of the present study.

### **3.4 Primary data collection**

This study makes use of qualitative research which refers to non-numeric data measurement by survey approach, as well as quantitative analyses. Qualitative research allows one to gain insight into the fundamental aspects of the research being undertaken, thus enhancing the understanding of the themes and aspects being investigated (Neuman, 2000). The questionnaire survey and the assessment of

household municipal solid waste for landfilling constitute the two major primary data collection processes, which will be explained further below.

#### **3.4.1. The need for a questionnaire survey**

The survey is in the form of structured questionnaires and is of simple but essential information that is set out in a predominantly close-ended question format. The research was conducted over a timeframe of six months in five suburbs of varying socio-economic status and race group representivity in the Msunduzi Municipality as outlined in Table 3.1 on page 71. Due to the large number of people residing in Pietermaritzburg and a lack of research capacity, a sample population comprising of approximately 650 households formed the scope of the questionnaire survey.

The survey was conducted in five of the Msunduzi Municipality's suburbs; namely: Chase Valley, Scottsville, Northdale, Sobantu and Imbali. The probability sampling method that was applied for the purposes of completing the survey was stratified sampling. The households were sampled according to every second house (probability sampling) with a maximum number of ten houses per street being sampled. The streets were not preselected and field researchers had to cover as broad an area as possible in each suburb, which meant selecting approximately 10 respondents from as many streets as possible within the target range of questionnaires per suburb.

A household that was not willing to answer or unoccupied at the time of administering the questionnaire was solved by allowing the next available and willing household respondent to complete a questionnaire. The questionnaire had to be ideally completed by the head of the household, and where unavailable, the next responsible adult would have had to answer the questionnaire. The Statistical Package for the Social Sciences Version 13.0 (SPSS) software package is especially applicable to social science research that requires the analysis and management of large amounts of qualitative data. The field researchers were cautioned to exercise discretion with regard to foreigners and illegal immigrants so as not to jeopardize the accuracy of the survey. As mentioned previously, the questionnaire utilised in this

survey was sanctioned by the Ethics Committee of the academic institution of study after being subjected to an ethical and moral approval process.

A multivariate statistical analysis (Kolmogorov-Smirnov Test) was conducted on sets of data outcomes to determine whether a parametric or non-parametric analysis was necessary to indicate the commonalities and differences prevalent. This comparative analysis would then point to specific implications which would influence the hypotheses derived in line with the objectives of the questionnaire survey. The outcomes of these statistical tests will be influential in determining whether the objectives pertaining to the socio-economic (suburb of residence and income bracket of household) and cultural backgrounds (largely determined by race grouping) of individuals/ households are in fact valid or not based on the hypotheses and null hypotheses that will be constructed. This will be discussed in greater detail in Chapters 4 and 6.

### **3.4.2 The criteria utilised for the selection of households**

The statistical population of this research study focused on individuals representing households in the Msunduzi Municipality. Unfortunately, given the scope of this task as mentioned above, the accessible population was narrowed down to 650 respondents across five suburbs. The five suburbs were Chase Valley Downs (will be referred to as Chase Valley hereafter), Scottsville, Northdale, Sobantu and Imbali.

There was no actual sample frame to work with except that of the last comprehensive census which was in 2001 and the sample population census which occurred in 2006. This was conducted by Statistics South Africa and the data serves to provide information and intrinsic details of the Msunduzi Municipality and its suburbs. There would undoubtedly be changes in the population statistics given the huge timeframe between the formal 2001 census and this being the year 2008.

Table 3.1 depicts the number of households in the five selected suburbs according to the race group of the head of the household. There were 135 329 legal households in 2001 when the national census was undertaken by Statistics South Africa, with only

80 305 households receiving refuse removal services at least once a week (Statistics South Africa, 2008).

The five demarcated suburbs were of distinctive and varying socio-economic status, comprising of intrinsic socio-cultural characteristics. The primary reason for choosing these five suburbs was that they were reflective of the differing socio-economic status and possible dominant race groups, hence their possible socio-cultural differences. The main objective here was to determine if correlations did exist between the above-mentioned factors of socio-economic status, socio-cultural behaviour and solid waste management practices.

The provision of a pre-selection list in the form of income brackets was used to counteract the possibility of respondents not answering. Most of the questions were of a similar nature with a pre-selection list so that respondents would not have to ponder about their solid waste disposal actions and whether they would be ostracised for negative behaviour. The questionnaire was successfully subjected to an approval process by the Ethics Committee of the University of KwaZulu-Natal.

There were three field researchers and each field researcher was briefed before the survey concerning procedure with regards to respondents or households wary of responding to the questionnaire due to feeling threatened that it was a government survey to determine their income status or any illegal social benefits. The field researchers were trained by the principal researcher to explain the meanings of those aspects or questions not understood or heard of before by the respondents; for example, the “Kyoto Protocol.” Further, the contact details of the principal researcher was provided on every questionnaire (see Appendix A) should any participating household have any queries regarding the survey or the topic being researched.

As indicated in Figure 2.6 on page 39, socio-cultural backgrounds allude to the fact that race grouping may be an overarching factor in South Africa when determining the influence of culture on socially acceptable behaviour or norms that a particular society conforms to. It takes into consideration cultural practices and the long-term effects of structural adjustment policies that have been transferred from generation to



generation, together with traditional beliefs of acceptability and perceived rationality within the context of municipal solid waste disposal behaviour. Therefore, statistics with the race of the head of the household was requested from Statistics South Africa's census data and the race of the survey participant is requested on the questionnaire. It was decided upon to select 50, 110, 250, 60, and 180 households respectively from each of the areas as listed in Table 3.1. This was considered as a representative reflection of each race group and is based on what was attainable within the study, yet reflective of the population size of the respective suburbs, with the exception of the Indian population in the country being far lower than that of the Black population.

**Table 3.1: The number of questionnaires administered according to head of households by race (Statistics South Africa, 2001).**

| <b>Race Group</b><br><b>Suburb</b> | Black | Coloured | Indian | White | Total | No. of surveys | % surveyed |
|------------------------------------|-------|----------|--------|-------|-------|----------------|------------|
| Chase Valley                       | 288   | 55       | 105    | 1106  | 1554  | 50             | 3.2        |
| Scottsville                        | 1111  | 63       | 281    | 1469  | 2924  | 110            | 3.8        |
| Northdale                          | 1442  | 154      | 6887   | 15    | 8498  | 250            | 2.9        |
| Sobantu                            | 1589  | 3        | 0      | 0     | 1592  | 60             | 3.8        |
| Imbali                             | 3162  | 15       | 0      | 0     | 3177  | 180            | 5.7        |
| Total                              | 7592  | 290      | 7273   | 2590  | 17745 | 650            | 19.4       |

The relative percentage of citizens chosen may not have been an equal representation according to the percentage of race groups that constitutes Pietermaritzburg's population. Chase Valley and Scottsville possessed a predominantly White population. Northdale had the Indian population as its largest race group, while Sobantu and Imbali had the Black population as their predominant race group.

The selection of suburbs is considered to be a representative cross-section of the race groups that constitute the population of the Msunduzi Municipality and this should reflect the same for the country's population; as information from Statistics South Africa (2001) has revealed. Households could not be specifically targeted prior to the administering of questionnaires due to the fact that participation in the survey was on

a voluntary basis. Thus, the choice of suburbs was influenced by the predominant race group in each of them and this allowed for the stratified sampling method for the administration of the questionnaires.

The five suburbs were selected because each differed in terms of physical characteristics, population composition and size. Clearly though, there was socio-political transformation as some suburbs rapidly progressed beyond the former colonial policies of the Group Areas Act and the structural adjustment policy of Apartheid in South Africa. This transformation was most evident in Chase Valley and in Scottsville which were historically White-only suburbs. The settlements of Sobantu and Imbali showed little progress in overcoming cultural barriers as these areas still remained predominantly within the confines of the Black race group. The possible reasons for this could be that these settlements were actually satellite suburbs for those who were previously afflicted by the Group Areas Act and it had also become an alternative low-cost government housing scheme for those who had resorted to living in informal settlements.

Northdale has become increasingly accessible to all race groups, but remained predominantly Indian. In order to gain a better understanding of these aspects that manifest in the different suburbs of study, a brief description of each of the five suburbs at their current status will be given.

Chase Valley is considered as an affluent area and although it has citizens of all race groups, it is historically considered as a White area that is characterised by massive gardens and an abundance of trees and parks which give rise to a fairly large amount of garden waste. The residents in this area are conscious of maintaining neat gardens and often contract to garden services for the removal of garden waste. The drainage and verges are usually well maintained by the municipality or the residents themselves. However, although the refuse removal service is quite regular, it is often erratic in terms of collection times, where it is not unusual for garbage bags to be collected after 4pm or at midnight. Also, municipal employees in the Msunduzi Municipality often engage in waste dispute strikes which results in private contractors collecting refuse after hours if these disputes last for more than two or three days.

Scottsville possesses a fairly equal proportion of the Black and the White race groups, with a noticeably smaller Indian and Coloured population. The income groups in this suburb predominantly span across middle-to-high, with a few falling into the lower bracket. The location of universities and colleges in Scottsville sees a fairly prominent young adult population (from various regions in Africa) residing in numerous hostels and at board and lodging facilities. The surrounding areas also have numerous entertainment facilities in the form of food outlets, nightclubs and shopping malls. Hence, the potential for litter and solid waste production can be considered far greater in this suburb as compared to the others.

Scottsville also has a fairly large number of trees and gardens, though not as dense as Chase Valley and may contribute a sizeable percentage to Pietermaritzburg's garden waste. A point to note is that this suburb is adjacent to that of the New England Road Landfill Site (NERLS) and is often prone to noxious odours when there is a landfill fire or waste food to be disposed of in hot weather conditions. Also, a common occurrence is solid waste falling off moving vehicles that use the area en route to the NERLS.

The suburb of Northdale is historically an Indian area that is characterized by predominantly middle to lower income citizens, while a smaller percentage do fall into the higher income bracket. Due to the large number of households in Northdale, the substantial number of Coloured and Black households may seem insignificant when compared to the equivalent percentages in Scottsville and Chase Valley. Northdale is one of the largest suburbs in Pietermaritzburg and has within its boundaries a hive of formal and informal activities. Thus, the likelihood of increased solid waste production and litter as envisaged for Scottsville also applies to this suburb. Bulky garden waste is not as great in Northdale as compared to the previous two suburbs. The occurrence of littering, illegal dumping and illegal burning is however highly noticeable in this suburb.

Sobantu and Imbali are historically Black and Coloured areas that primarily consist of low-to-middle income households. Upon closer inspection of Table 3.1, the percentage of the Coloured race group is rather small in comparison to the predominantly Black race group in these suburbs. The absence of the other race

groups is noticeable, but is expected due to the intrinsic historic features of these suburbs. These suburbs were formed as a part of the democratic government's Reconstruction and Development (RDP) low-cost housing schemes for the poorer and informal communities in South Africa. There is not much garden waste in these suburbs as they are relatively sparse in natural vegetation.

Illegal burning and communal dumping is highly noticeable in Imbali. Sobantu has previously been the suburb of choice for numerous environmental workshops and studies; presumably owing to the fact that it is a low-cost housing settlement immediately adjacent to the NERLS. Security issues of a volatile nature at the landfill site have been previously pinpointed to the residents of Sobantu.

### **3.4.3 Conducting the interviews**

The questionnaire (Appendix A) was structured to elicit honest responses due to the close-ended format structure. The questions were phrased to provide insight into the nature of the waste generated in a household and its subsequent life cycle. Each question on the questionnaire will be discussed in Section 4.4 to give a broader insight into the structuring of the questionnaire for the purposes of the aims and objectives of this study. It further facilitates inferences about the general views and practices that households may have regarding waste management on local and national scales. The general waste stream that eventually enters the landfill site is also of profound interest for future research discussions in terms of landfill space and the contribution of landfilled waste towards global warming and climate change.

To reiterate, the following analyses are sought as the integral outcomes of the questionnaire survey and can be summarised as follows:

- Whether culture (largely determined by race groups) gives rise to attitudes and behaviour that negatively or positively influences environmental practices.

- The receptiveness of households to practice reduction, reuse and recycling of MSW with the intention of responsible environmental management.
- The influence of socio-economic status (largely determined by suburb of residence) on the quantity and composition of MSW.
- Environmental awareness among adults today.

The SPSS package was used to analyse the questionnaire survey outcomes, which was further subjected to multivariate statistical testing to validate the results. The first statistical test to be applied was the Kolmogorov-Smirnov Test to determine if the data outcomes were of a normal distribution and if parametric or non-parametric tests would be needed to analyse specific hypotheses pertaining to the objectives of the study. This will be discussed in Chapter 4.

#### **3.4.4 The criteria utilised for the structuring of the interviews**

Semi-structured and structured interviews (Appendices B<sub>1</sub> and B<sub>2</sub>) were conducted with key management personnel (on a one-to-one basis) regarding MSW management strategies and the actual practice thereof in the Msunduzi Municipality, and in the country in general. The representivity of the respondents could not be ensured as it was dependent upon the willingness and the race group of personnel in strategic waste management positions within government departments to engage in formal discussions. Further, there were questions pertaining specifically to the operation and management of the NERLS.

The crucial objective of the interviews was to gain as honest as possible and first-hand knowledge of exactly what happens in the implementation of MSW policies and guidelines by the Msunduzi Municipality as delegated by higher government authorities. The operational and management aspects of the NERLS were to be ascertained and compared to legislative policies to determine compliance. The questions were therefore of an explicit nature that required specific responses as well as subjective viewpoints regarding MSW management. As Lund (1993) suggests, there are various methods to acquire information from an audience; but nothing

proves more beneficial than direct interviews that target those who are or bound to be familiarly affected and overwhelmingly influenced by the topic at hand.

It is not only the collection of primary data that plays a vital role in the information collection management process. It is actually the secondary data collection which generally precedes the primary data collection, allowing one to make informed choices about the study at hand.

### **3.4.5 An assessment of household municipal solid waste for landfilling**

The assessment of household municipal solid waste (MSW) for landfilling functions on the same principles of a Life Cycle Assessment (LCA) due to the common elements of tracking waste from source to disposal, but differs by being narrower in focus and more concentrated in area. This investigative process was carried out at the NERLS and entailed a process of physically sorting through a load of a few tons of MSW from three varying socio-economic suburbs in the Msunduzi Municipality. The duration of this exercise spanned one working week for reasons of personal and public safety.

The process of physically separating MSW enabled the objective of determining the different types, compositions and quantities of solid waste across three different socio-economic groups in the city instead of the five suburbs comprising the scope of the study due to practical reasons. The outcome of this undertaking was expected to be reflective of the lifestyles of low, medium and high income groups that were largely determined by the suburb of residence. Each municipal truck load of refuse was from a specific area and was weighed in at the weigh bridge at the landfill site, with an invoice reflecting the tonnage and the registration number of the truck. Generally, each day of the week in the Msunduzi Municipality is allocated for refuse collection from specific suburbs or areas.

A further objective of this assessment was to determine the general percentages of the different categories or types of solid waste material that enters the landfill site. This would also be indicative of consumer buying-power and the opportunity for

potential recycling as previously mentioned. The NERLS accepts approximately five hundred tons of MSW a day. The cover material that is required to cover the working face of the landfill site on a daily basis is in the estimated region of two hundred tons (Raghunandan, 2005; Naidoo, 2007).

Relationships or correlations can be established between population groups and socio-economic status; where the analysis of the solid waste fraction linked with areas of residence can eventually indicate the MSW patterns of differing income and race groups. In assessing the South African situation, one needs to determine if the household refuse composition is indicative of differing economic levels, which then becomes a determinant of differing consumption levels of society (Cointreau *et al.*, 1985). This would then have implications about the lifestyles of different types of societies and may perhaps allow for specific MSW management planning aimed at optimal solutions without unduly compromising consumer consumption patterns.

The selected individual piles of MSW were sorted into paper, plastic, glass, metal and food compostables (including meat and vegetable off-cuts) by approximately five field researchers. Odds and ends such household items including mops, brooms and clothing was sorted into a separate miscellaneous pile. The sorted material piles were to be weighed at the landfill site.

### **3.5 Secondary data collection**

Secondary data collection has little distinction here in terms of literature review. However, it does constructively impact on the content and structure of the methodology of any research undertaking as supporting or contrasting information is sought to substantiate relevant discussions and findings.

Relevant research material gathered for the information pertaining to this study includes the different media options such as:

- Written material which includes books, magazines, journals, assessments, reports (including the Landfill Monitoring Committee Reports) and newspaper clippings;
- Searches on the internet and the reviewing of various documents found;
- Slide show presentations and talks at conferences held at various venues in the country. These were attended by the researcher and include the ECOSAN International Conference (2005), the Responsible Container Management of South Africa Workshop (2006), the ITA/Sangonet WEEE Conference (2007), eWASA strategic forum meetings (2007 and 2008), and various Pietermaritzburg Chamber of Business meetings since 2005; and
- Applicable televised documentaries and radio broadcasts.

The above research material serves to provide a broader and more current picture of the perceptions of the public as well as the status of environmental degradation and possible resolutions; with specific references to global warming and pollution (land, air and water). Across the media the role of landfill sites are being highlighted as major contributors of methane gas which greatly contributes to global warming. The nature of landfill sites alone in the containment and management of solid waste can have both positive and negative impacts on the environment and on humanity. This can be controlled and mitigated by adopting the strict and necessary measures, policies and procedures stipulated by solid waste legislation in South Africa, as well as adhering to global recommendations.

The incorporation and critical analysis of documents pertaining to the management of the NERLS and MSW laws constitute an important facet of this research methodology. This is elaborated on in Section 3.6 and will be discussed in more detail in Chapter 5.



### **3.6 Documentary analysis**

The regulations, laws and policies governing MSW will be reviewed and will be critiqued in Chapter 5 against the observations derived from the management of the New England Road Landfill Site.

The New England Road Landfill Site permit (16/2/7/U203/D3/Z1/P64) will be critiqued in terms of compliance to landfill site regulations according to the Minimum Waste Management Requirements (1998), as stipulated by DWAF; and the laws and regulations in terms of various Acts such as NEMA, The White Paper on Integrated Pollution and Waste Management and the new Waste Management Bill (2007). Available external and internal compliance and environmental reports by private and municipal consultants will also be analysed and briefly commented on where necessary.

The intention here is not to specifically target or discredit the NERLS, but to point out the discrepancies that exist between legislative policies and the actual management practices as observed in this study. This is in keeping with the theme of documenting the NERLS as a case study in the Msunduzi Municipality to show the discrepancies that subsequently exist and which occur to a greater or lesser extent on a national level. Landfill sites are governed by legislation, thus placing them directly under national government management. Therefore, a loophole at a local management level constitutes a loophole in the national theoretical framework setting for the solid waste division of governance.

The possibility of retrieving and processing samples of soil, air, and water from boreholes on the landfill site itself to investigate groundwater contamination was considered. However, this did not seem practical under the current circumstances given the fact that external and internal chemical analyses are already being conducted by Umgeni Water as a requirement by DWAF, and such analyses were previously outsourced to private contractors. These audits include recommendations and have improved in the last two years with regard to frequency as compared to the ad hoc basis on which they were being carried out. It was also felt that permission

and access to data were likely to prove problematic, based on previous experience to acquire solid waste information from the relevant municipal authorities.

A closer look at the organisation and management of the administrative functioning of the NERLS would enhance the understanding and verification of facts and figures in the quest for the sustainable management of MSW in the Msunduzi Municipality, which will then hopefully point the way for implementation of the same elsewhere in the country.

Chapter 4 refers to the analysis of the primary data collected, which pertains to the information collection procedure of the questionnaire survey and the assessment of a sample of municipal solid waste from households destined for landfilling, as elaborated upon in the methodology. The principal methods of gauging valuable information from data collection pertaining to population are of both qualitative and quantitative analyses.

Chapter 5 refers to the analysis of secondary data collected (documentary analysis). The waste management policy in review which incorporates the critique of the New England Road Landfill Site Permit will be presented here, together with supporting arguments based on the findings of internal and external audit reports on this landfill site.

Chapter 6 will entail a comprehensive discussion on the collective findings of the data results presented in Chapters 4 and 5. Chapter 7 will form the concluding chapter that will provide a concise summation of the preceding chapters which have detailed the scope and progression of this research undertaking, and suggestions for policy improvements as well scope for future research initiatives.

# CHAPTER 4

## RESULTS AND ANALYSIS OF THE PRIMARY DATA COLLECTION

### 4.1 Introduction

The questionnaire survey was administered to 650 households with a respondent from each household answering a single questionnaire (Appendix A) comprising questions pertaining to the various aspects of MSW as described in Section 3.4.1. However, only 622 households were willing to participate in the survey after initially being interviewed, and the balance were classed as non-respondents. The Statistical Package for the Social Sciences (SPSS) software was used to capture the data outcomes of the questionnaire survey and to generate information in a useful format of excel tables and graphs according to the inputs of criteria selection.

Tan (2005) argues that data collection utilising questionnaires with close-ended questions by means of a pre-selection list is an ideal survey method to engage a sample of a large population. The two most important survey types employed in this research study are questionnaires and interviews. The questionnaires were analysed according to the quantitative social science statistics package called SPSS (version 13.0). According to Trochim (2006), there are numerous “issues” to consider when selecting a survey method. These issues have been incorporated as a checklist in this instance and are as follows:

- *The enumeration of the population study.*

This was achieved through the latest available census data (2001) from Statistics South Africa (Statistics South Africa, 2005).

- *The literacy level of the sample population.*

The simplicity and use of close-ended questions facilitated the answering of the questionnaires by respondents when direct or face-to-face interviews were conducted.

- *The issue of language.*

Language being a barrier to understanding a questionnaire is an important issue. The questionnaire was printed in English (an official language in South Africa) as South Africa is very much a multi-linguistic country, with eleven official languages. The decision to have the questionnaire printed in English was the outcome of a discussion held prior to the survey between the principal researcher and the field researchers. All of the field researchers were able to converse fluently in English and in IsiZulu, as well as efficiently translate the questionnaire from English into IsiZulu. It was found that to translate the English questionnaire into IsiZulu would be easier for the respondents who may not be proficient in English.

- *The cooperation of the population.*

Respondents had the right to refuse participation or selectively answer the questions and were duly informed thereof.

- *The geographic restrictions.*

This aspect was largely overcome by the use of field researchers and was further aided by the delineation of the five suburbs in the Msunduzi Municipality as discussed below, according to socio-economic status and race-group representivity.

- *The data on hand.*

The availability of useful data with regard to the population numbers and distribution were primarily obtained from Statistics South Africa prior to commencement of the survey. This was combined with intrinsic suburb knowledge already possessed by the researcher, together giving insight into the education levels, employment and financial status of households, as well as gender and age factors.

- *Who is the respondent?*

The respondents in this study needed to ideally be the “heads of households.” Unfortunately, this was not always feasible due to any number of circumstances. The rule of thumb is that if the head of household is not available, the next responsible adult would fill in the questionnaire.

- *The response rates.*

Response rates were not seen to be a problem. The nature of the questionnaire and the increased public interest in MSW management did not indicate that the majority of the population sample would not respond. This interest also aided the issue of respondents possessing some sort of knowledge regarding the topic at hand.

- *The avoidance of false respondents.*

In a survey of this nature, questions may not have been answered as truthfully as possible. This was the reason as to why the questionnaire contained mainly close-ended questions with no definite sequence to the topics covered. It was not meant to mislead people, but rather to gauge their honesty. Confidentiality was stressed upon to facilitate this process.

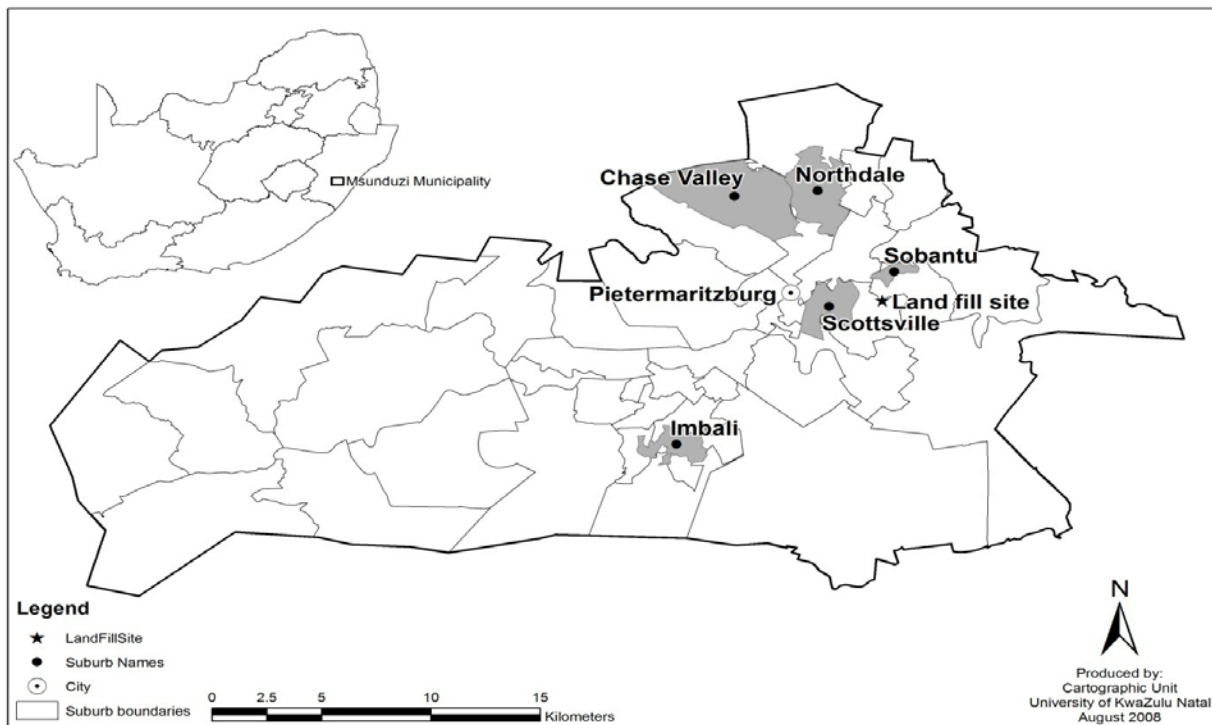
Taking the above issues into consideration, the questionnaire was structured to effectively gauge the views and attitudes of the respondents and their households toward municipal solid waste. It is likely that many aspects arising from this study are indicative of the effectiveness and efficiency of MSW management of all levels of governance in South Africa. This can be verified by future analyses.

## **4.2 The intrinsic characteristics of the survey areas**

The underlying premise was to work towards sustainable solid waste management by isolating and addressing problem areas. With this in mind, the scope of the study was determined. The five suburbs together with the landfill site as indicated in Figure 4.1 completed the scope of the questionnaire survey and is discussed further in addition to the information provided in Section 3.4 (according to the number of questionnaires administered in each suburb).

The number of households that were selected was 50 from Chase Valley, 60 from Sobantu, 110 from Scottsville, 180 from Imbali, and 250 from Northdale, with a total of 650 households. This was considered as a fair reflection of each suburb and of each race group. The actual numbers of

respondents to the questionnaire from each suburb were 50 from Chase Valley, 236 from Northdale, 56 from Sobantu, 177 from Imbali, and 103 from Scottsville.



**Figure 4.1: The Jurisdiction of the Msunduzi Municipality showing the suburbs targeted in the study (drawn by Howison, after compilation by Naidoo, 2008).**

The percentage of the number of people in each race group in each of the five suburbs in comparison to the total population of that suburb is shown in Table 4.1; and is reflective of the demographic characteristics of each suburb as discussed in Chapter 3. It must however, be remembered that the actual population figures within brackets in Table 4.1 would have increased due to the fact that the data supplied was from the last formal national census in 2001 (Statistics South Africa, 2001). Data from the mid-year population estimates for 2005/6 from Statistics South Africa was also used. It can be seen that Sobantu and Imbali are almost entirely Black suburbs. Northdale has a predominant Indian population while Chase Valley has the White population as its majority. However, these suburbs also contain households from other race

groups. Further, the implication here is that race grouping leads to socio-cultural inferences and one can safely link the outcomes of MSW behavioural tendencies on a suburb level to socio-cultural tendencies if a particular suburb has a dominant population group. The reader is once more reminded that race grouping in this context is applied as a means of determining socio-cultural influences on behaviour.

Scottsville has more White households, followed by Black households and to a lesser degree, Indian and Coloured households. Thus, Scottsville cannot be truly classified as having any one predominant or fairly homogenous race group that can classify it accordingly. One must be mindful of the fact that the race group of the questionnaire respondents have not been pre-selected and it is therefore not practical at this stage to make MSW behavioural inferences about a particular suburb.

**Table 4.1: Race group distribution per person per suburb (Statistics South Africa, 2001)**

| <b>Race group \ Suburb</b> | <b>Chase Valley</b> | <b>Northdale</b> | <b>Sobantu</b>  | <b>Imbali</b>    | <b>Scottsville</b> | <b>Total</b>     |
|----------------------------|---------------------|------------------|-----------------|------------------|--------------------|------------------|
| <b>Black</b>               | 13.8%<br>(613)      | 15.9%<br>(5238)  | 99.7%<br>(8124) | 99.6%<br>(78839) | 28.4%<br>(2280)    | 71.7%<br>(95094) |
| <b>Coloured</b>            | 4.4%<br>(197)       | 2.3%<br>(766)    | 0.3%<br>(24)    | 0.3%<br>(221)    | 3.4%<br>(272)      | 1.1%<br>(1480)   |
| <b>Indian</b>              | 11.3%<br>(502)      | 81.6%<br>(26838) | 0%<br>(0)       | 0.0%<br>(3)      | 11.4%<br>(918)     | 21.3%<br>(28261) |
| <b>White</b>               | 70.4%<br>(3125)     | 0.1%<br>(46)     | 0%<br>(0)       | 0.1%<br>(59)     | 56.9%<br>(4571)    | 5.9%<br>(7801)   |
| <b>Total</b>               | 100%<br>(4437)      | 100%<br>(32888)  | 100%<br>(8148)  | 100%<br>(79122)  | 100%<br>(8041)     | 100%<br>(132636) |

The Msunduzi Municipality serves approximately half a million people in KwaZulu-Natal's administrative and legislative capital, the city of Pietermaritzburg and its surrounding areas (Msunduzi Online, 2006). According to the Umgungundlovu District Municipality, statistics by Statistics South Africa indicate that there are approximately 77% of Blacks, 12% of Indians, 12%

of Whites and 3% of Coloureds that make up the population of the Msunduzi Municipality; where 40% do not have access to refuse removal services (Umgungundlovu Municipality Online, 2008).

### **4.3 Further considerations of the survey areas**

It is important to note that not all of the municipal areas in Pietermaritzburg receive the same levels of refuse removal (or other municipal) services. This is in keeping with the classification of suburbs and housing that range from informal settlements to low cost housing and middle income to high income areas. Rates are commensurate with the class of suburb or type of housing category that one falls into (Reddy, 2007). Simply stated, the higher the status of the suburb that one lives in, the higher the refuse removal rates, hence the greater the levels of refuse removal service provided by the municipality.

The focal concern in determining the effective MSW management in the Msunduzi Municipality, was to analyse the views of the households with regard to sustainable waste management and to determine their satisfaction with the municipality's refuse removal service. The data from the questionnaire survey will now be presented, and the results that arise thereof will be analysed and discussed further.

### **4.4 A qualitative analysis of the questionnaire responses**

The results stemming from the survey are a representation of the responses to the questions on the questionnaire (Appendix A) and are presented below in edited and formatted excel tables and graphs generated by the SPSS programme Version 13.0. The only discrepancy that may result is that respondents did not answer all of the questions in every instance, hence influencing the reflections or data outcomes to specific correlations and cross tabulations.



The Kolmogorov Smirnov Test will be conducted once the questionnaire survey data outcomes have been analysed to determine whether the multivariate statistics are of a normal distribution or not, thus indicating whether a parametric or non-parametric test will be applied to further analyse the specific responses to the questionnaires (as discussed in Chapter 3). An appropriate multivariate test will then be chosen ascertain or verify any correlations between socio-economic and cultural influences on MSW practices by households or individuals within the Msunduzi Municipality. The outcomes hereof are also meant to be reflective of such MSW practices at a greater national level.

#### **4.4.1 Establishing the socio-economic status of suburbs**

The statistics presented below serve to substantiate the classification of the five suburbs of study according to socio-economic status, as explained in Section 4.2. Figure 4.2 depicts the monthly income bracket per household in each of the five suburbs. The income brackets varied widely and were not a true reflection, because 36% of the respondents chose not to divulge this personal detail, especially in Scottsville's where only 0.5% responded (there were 622 respondents).

The census 2001 data by Statistics South Africa given in Figure 4.3 reveals that out of the five suburbs of study, Sobantu and Imbali have the highest unemployment rates. The suburbs of Scottsville and Chase Valley have the higher percentages of economically active people and are followed closely by Northdale. This would be a more accurate reflection of the socio-economic status of the five suburbs of study. Thus, we can adequately conclude that the socio-economic categorising of the suburbs of study is more or less correct.

The fact that most households withheld their income status and education levels meant that accurate representation of socio-economic status, the nature of waste and educational influences could not be projected by models.

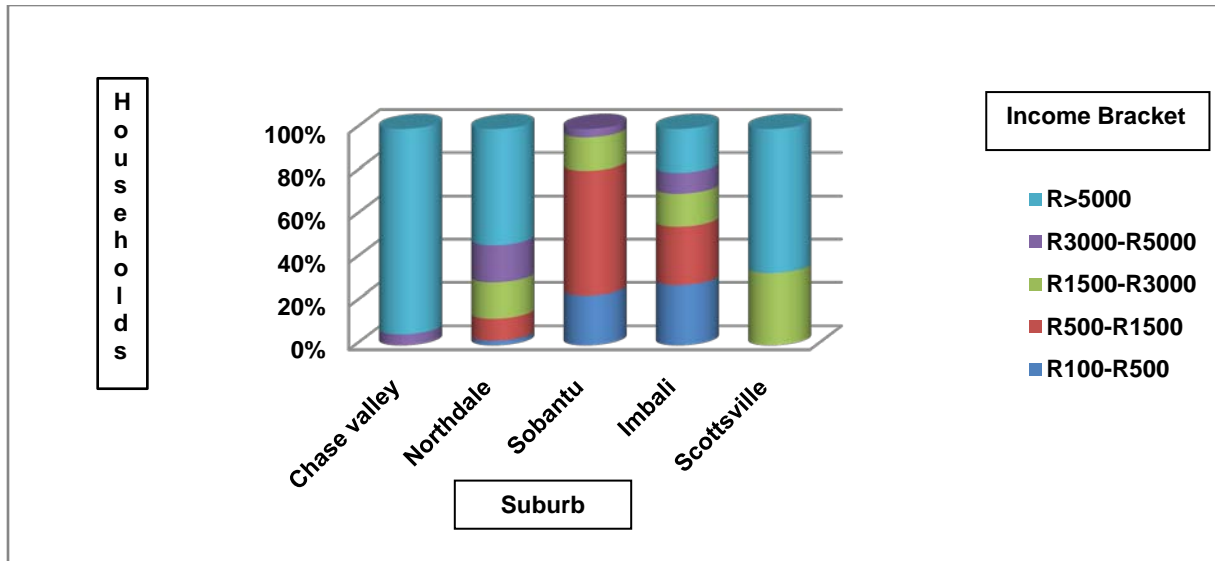


Figure 4.2: An indication of the monthly income brackets of household respondents.

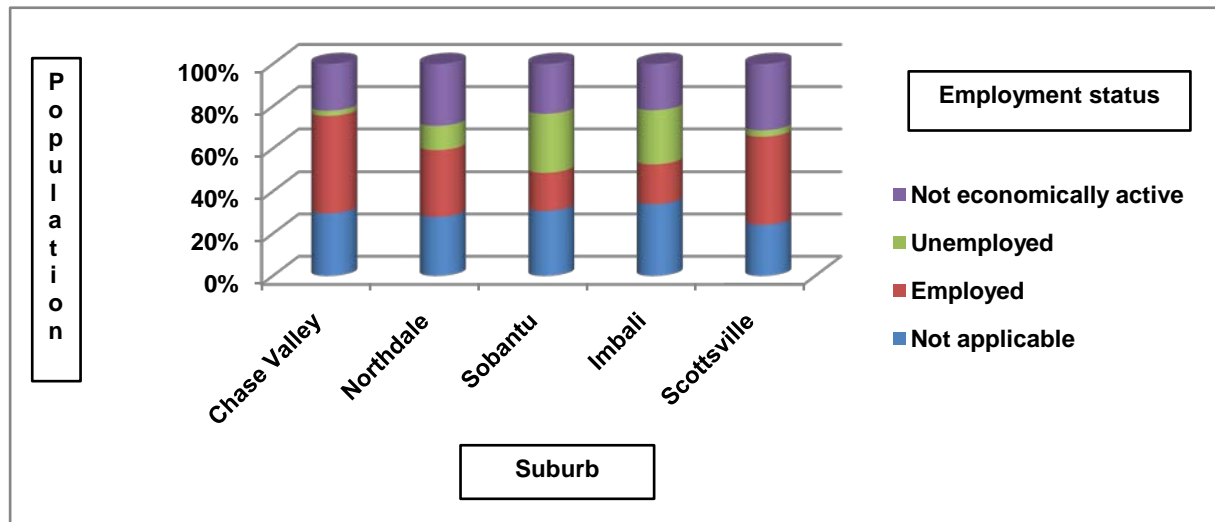


Figure 4.3: The employment status per person weighted per suburb (Statistics South Africa, 2001).

#### 4.4.2 Determining the household solid waste disposal methods

It is assumed that nature of solid waste produced by households across various suburbs would differ according to lifestyle and income availability. Of importance to strategic solid waste

management planning are the predominant methods of disposal that are practiced by households. The following analyses give the MSW outcomes of households that participated in the questionnaire survey. This was mainly derived from the information yielded in response to questions 1 and 4 on the questionnaire which looks into how household solid waste and garden waste are generally disposed of.

**TABLE 4.2 Methods used for the disposal of Municipal Solid Waste**

| A. Per Race Group | burning | abandon on a street | municipality picks up | take to landfill | dump it |
|-------------------|---------|---------------------|-----------------------|------------------|---------|
| Black             | 31%     | 1%                  | 60%                   | 4%               | 4%      |
| White             | 3%      | 3%                  | 94%                   | 0%               | 0%      |
| Indian            | 0.40%   | 0.40%               | 96%                   | 0.40%            | 3%      |
| Coloured          | 0%      | 0%                  | 100%                  | 0%               | 0%      |
| Total             | 15%     | 1%                  | 79%                   | 2%               | 3%      |
| B. Per Suburb     | burning | abandon on a street | municipality picks up | take to landfill | dump it |
| Chase Valley      | 0%      | 4%                  | 96%                   | 0%               | 0%      |
| Scottsville       | 3%      | 1%                  | 96%                   | 0%               | 0%      |
| Northdale         | 4%      | 0.40%               | 92%                   | 0.80%            | 3%      |
| Imbali            | 30%     | 1%                  | 56%                   | 7%               | 6%      |
| Sobantu           | 53%     | 0%                  | 47%                   | 0%               | 0%      |
| Total             | 15%     | 1%                  | 79%                   | 2%               | 3%      |

Table 4.2 reflects the different disposal methods that people adopt for their household waste in response to Question 1. The majority of the respondents (99.5%) chose to reveal their method of disposal. It was established that the bulk (79%) MSW from households are picked up by the municipality. Households that admitted to practicing the burning of MSW amounted to 15% while those households that admitted to dumping MSW tabulated to 3%. The settlement of Imbali shows that 53 out of 175 respondents (30%) burn their MSW; while 29 out of Sobantu's 55 respondents (53%) choose to follow the same practice.

It is evident that the burning of solid waste is most noticeable amongst the Black race group, where 31% of Black households burn their MSW. The reasons for this could be many. The most noticeable fact here is that none of the respondents in Chase Valley indicated that they burn their solid waste, whilst 3 households (3%) in Scottsville and 9 in Northdale (4%) indicated this practice. The reasons usually given for poorer communities such as Sobantu burning their solid waste (Naidoo, 2007; Reddy, 2007) are:

- Irregular or no refuse removal collection services.
- Difficulty in the handling and disposal of bulky solid waste such as garden waste.
- Vector control in terms of the prevention of rats, flies, worms and other insects or animals that may find refuge and breed in municipal solid waste.
- The method worked well for their forefathers and they saw no wrongdoing in such a practice.
- The Msunduzi Municipality does not provide bin bags to its residents and this creates an added expense to poor households.
- Security risk, where municipal vehicles are frequently hijacked or municipal staff are threatened.

The areas that formed part of the questionnaire survey are all regularly serviced by the municipality in terms of refuse removal, which leaves one questioning the fact that 18.1% still dump and burn their household waste. The implication that households or suburbs of higher socio-economic status are less prone to unfavourable MSW disposal practices now becomes clearer.

Table 4.3 indicates that out of the 492 respondents (many indicated that they had no gardens), 24% of the sample population still burn their garden waste, while 24% practice illegal dumping. Only 1% of the respondents indicated that they bury their garden waste, and this was practiced by the Black and Indian race groups. Black and Indian households are also largely responsible for burning solid waste as compared to the other race groups. However, it is encouraging to note that 28% of the total sampled population is practicing composting. An analysis by race (for the combined disposal methods) showed that 65% of the Coloured population and 36% of the Black population engage in composting garden waste.

**Table: 4.3 Methods used for the disposal of garden waste**

| <b>A. Per Race Group</b>         | burn       | compost    | bury      | dump       | landfill   |
|----------------------------------|------------|------------|-----------|------------|------------|
| Black                            | 44%        | 48%        | 20%       | 36%        | 24%        |
| White                            | 9%         | 24%        | 0%        | 8%         | 18%        |
| Indian                           | 46%        | 22%        | 80%       | 55%        | 57%        |
| Coloured                         | 2%         | 6%         | 0%        | 2%         | 1%         |
| <b>B. Per Suburb</b>             | burn       | compost    | bury      | dump       | landfill   |
| Chase Valley                     | 10%        | 12%        | 0%        | 15%        | 63%        |
| Scottsville                      | 9%         | 69%        | 0%        | 15%        | 7%         |
| Northdale                        | 30%        | 11%        | 2%        | 28%        | 29%        |
| Imbali                           | 40%        | 19%        | 0%        | 27%        | 14%        |
| Sobantu                          | 13%        | 54%        | 0%        | 26%        | 7%         |
| <i>Total per disposal method</i> | <i>24%</i> | <i>28%</i> | <i>1%</i> | <i>24%</i> | <i>23%</i> |

Of great concern is the fact that 47% of the households (respondent households) still collectively practice illegal burning and illegal dumping of garden waste. The Indian population accounts for 55% of dumping. A plausible reason for this even though these areas regularly have their household refuse picked up by the municipality, their bulky garden waste is not permissible during this collection as there are garden refuse sites placed in or near most suburbs in the municipality. The NERLS usually charges its customers a fee for the disposal of bulky garden waste, which would obviously serve as a deterrent among other factors.

The greater the distance of a suburb from the landfill site or garden waste facilities, and high transport costs serve as deterrents to residents disposing of their bulky garden waste in the recommended manner. The landfill site manager, Cyril Naidoo has recently allowed residents to drop off bulky garden waste at no cost. Unfortunately, most residents are unaware of this arrangement. Further to this is the restriction on the number of bin bags to be collected per household (3 per household), and bulky garden waste is usually not suitable for disposable in recommended municipal-sized bin bags and are often not collected if garden waste is contained within (Dhlamini, 2008a).

There have been numerous complaints directed at the Msunduzi Municipality's Waste Management Division regarding the closure of garden refuse sites in the city and the fact that the

sites are inoperable for three months or more due to insufficient space as large volumes of garden waste are not timeously removed (Dhlamini, 2008b). Therefore, the fact that there are too few and inadequately controlled or manned garden sites in Pietermaritzburg warrants additional investigation, especially since garden waste will not be collected from households – either with normal household refuse or on its own.

#### **4.4.3 Determining the nature of municipal solid waste**

The purpose of analysing Questions 2, 3 and 6 which looks at the general “backyard” refuse types, the average number of bin bags per week and the bulk constituents of household solid waste respectively, is to give a general indication as to the quantity and predominant types of MSW that is generated in a domestic environment.

The average number of municipal-sized bin bags per household will allow us to determine if the quantity of MSW being produced by most households is within the recommended 3-bag limit. The assessment of household MSW for landfilling will provide a more comprehensive analysis of the composition of MSW across suburbs of varying socio-economic status. There were 84% (507) of respondents who indicated that they did not exceed 3 bin bags a week. However, 16% of households did indicate that they had more than the recommended three bin bags per household limit. This was most prevalent in the suburbs of Scottsville, Imbali and Northdale.

It was found that leaves and grass formed the bulk of the MSW type prone to backyard storage, across all suburbs and race groups. Most households also had a considerable portion (29%) of old items as solid waste, especially in Scottsville, Northdale and Sobantu. In terms of relative percentages, the suburb of Chase Valley had a remarkable 90% of households indicating that leaves and grass formed their bulk MSW component. This is not surprising, given the fact that this suburb is noted for its dense foliage and large property sizes.

Table 4.4 clearly shows that paper and plastic formed the bulk of the different categories of MSW as listed in Question 6 on the questionnaire. Collectively, across all race groups in all five

suburbs, paper and plastic accounted for 76% of the household MSW fraction. This was followed by perishables which occupied 18% of the MSW fraction for disposal.

**Table: 4.4 Bulk constituents of Municipal Solid Waste**

| <b>A. Per Race Group</b> | <b>paper/plastic</b> | <b>glass/metal</b> | <b>perishables</b> | <b>cardboard</b> |
|--------------------------|----------------------|--------------------|--------------------|------------------|
| Black                    | 84.5%                | 6.8%               | 6.4%               | 2.4%             |
| White                    | 70.3%                | 2.7%               | 27%                | 0%               |
| Indian                   | 66.8%                | 1.8%               | 30.6%              | 0.9%             |
| Coloured                 | 84.6%                | 0%                 | 15.4%              | 0%               |
| <i>Total</i>             | <i>76.1%</i>         | <i>4.3%</i>        | <i>18.1%</i>       | <i>1.5%</i>      |
| <b>B. Per Suburb</b>     | <b>paper/plastic</b> | <b>glass/metal</b> | <b>perishables</b> | <b>cardboard</b> |
| Chase Valley             | 52%                  | 4%                 | 42.0%              | 2%               |
| Scottsville              | 91%                  | 0%                 | 8%                 | 1%               |
| Northdale                | 65%                  | 3%                 | 31.2%              | 0.9%             |
| Imbali                   | 82.4%                | 9.7%               | 5.1%               | 2.8%             |
| Sobantu                  | 100%                 | 0%                 | 0%                 | 0%               |

The Indian and White population had the larger percentage of perishables, being 30.6% and 27% respectively. This is further highlighted by the fact that Chase Valley (predominantly White and of high economic status) and Northdale (predominantly Indian and low-to-middle income status with a smaller percentage of high income earners) indicated perishables as one of the bulk household solid wastes. This may be attributed to increasing consumer-buying power due to higher available incomes. This analysis merely serves to provide statistics that show the constituents of the municipal solid waste stream at the household level and how they differ across societies of varying socio-economic status.

#### **4.4.4 Assessing the Msunduzi Municipality's refuse removal service**

The Msunduzi Municipality, like most municipalities in the country provide a weekly refuse removal service to suburbs in their jurisdiction, with the exception of informal settlements and possible outlying rural areas.

If there are any additional bin bags (more than 3) when refuse is collected by the municipality, then the ratepayer involved is liable to pay an extra fee per bag. Unfortunately this municipal policy is highly sporadic and almost non-existent in most suburbs. A lack of proper control, skills and resources can be cited as possible reasons for this. The landfill site manager, Mr Cyril Naidoo, maintains that this rule is not enforced by the MSW employees collecting refuse bags from suburbs on a regular basis and proper monitoring becomes an arduous task. A suggested solution would be to allocate such monitoring to the drivers of municipal vehicles who can keep a watch on the number of bin bags collected per household. But, as witnessed by the principal researcher on numerous occasions, to facilitate the collection of refuse (in bin bags) and possibly save time and fuel, municipal employees create heaps of refuse bags from six or more households for collection.

Questions 7 and 8 pertain to the levels of satisfaction for refuse removal and the need for greater frequency of refuse removal respectively. The majority of respondents indicated that they were satisfied with the current once-a-week refuse removal service in their suburbs, as indicated in Table 4.5 and in Figure 4.4. But, there were a large number of people who were dissatisfied with the frequency of this service (201 respondents). There were 69.5% of households who did indicate that they would prefer their refuse to be collected more than once a week by the municipality as shown in Figure 4.4.

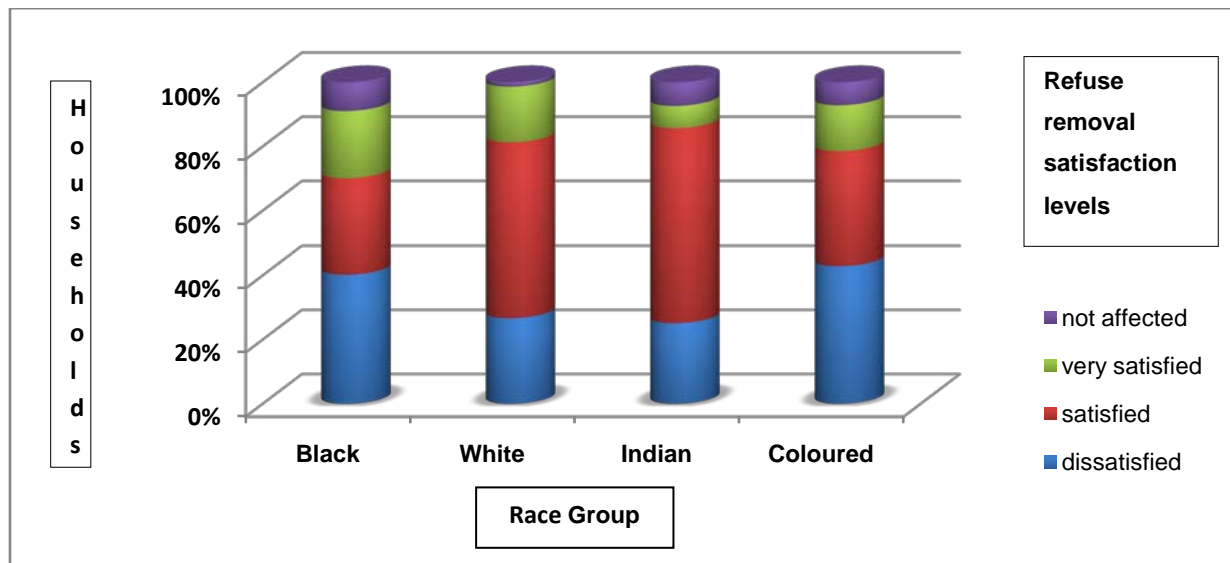
There were 606 responses to Question 8 and all of the 52 respondents from Sobantu indicated a need for increased refuse removal. The reason for this probably can be pinpointed to the fact that this low-income suburb may not have all of its households receiving regular refuse removal services due to security issues, and private contractors often replace municipal workers here (Naidoo, 2007). However, to increase the frequency of this service may not be possible given the



lack of human capacity, financial viability and the number of operating vehicles at present (Naidoo, 2007).

**Table: 4.5 Household opinions on refuse removal services in suburbs**

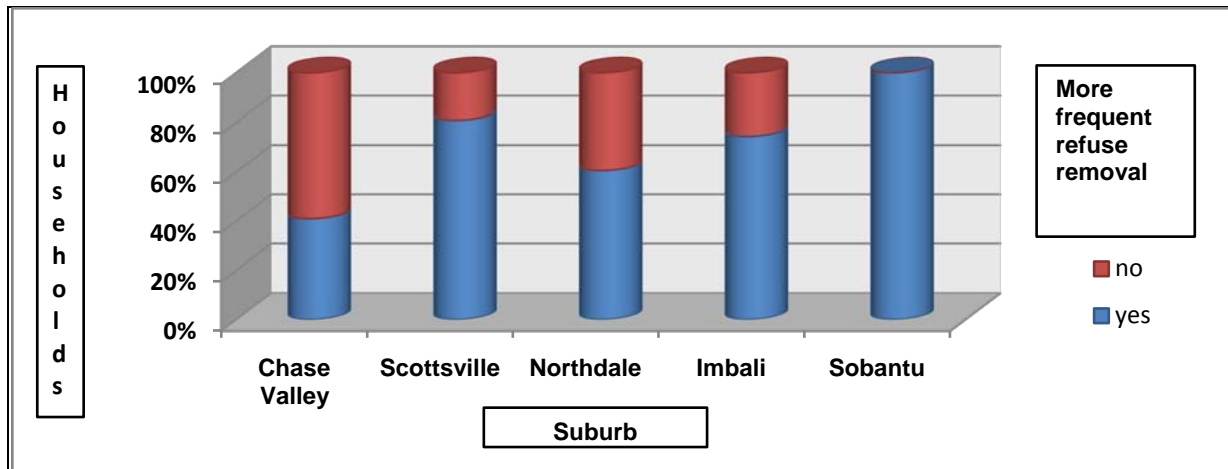
| Suburb                               | dissatisfied | satisfied | very satisfied | not affected |
|--------------------------------------|--------------|-----------|----------------|--------------|
| Chase Valley                         | 8%           | 84%       | 4%             | 4%           |
| Scottsville                          | 37.6%        | 33.7%     | 26.7%          | 2%           |
| Northdale                            | 23%          | 62.1%     | 7.2%           | 7.7%         |
| Imbali                               | 33%          | 27.8%     | 26%            | 13.3%        |
| Sobantu                              | 92.3%        | 5.8%      | 1.9%           | 0%           |
| <i>Total</i><br><i>(all suburbs)</i> | 32.9%        | 44.7%     | 15.1%          | 7.4%         |



**Figure 4.4: Satisfaction levels of residents concerning municipal refuse removal in Pietermaritzburg.**

Whether or not households are aware of possible increases in refuse removal rates should a new municipal landfill site be located on the outskirts of the city is indicated by the responses to Question 18. There were 40.5% of respondents who were aware of refuse removal rates increasing while the majority (59.5%) said that they were unaware. According to the current

(2008) NERLS manager, Cyril Naidoo, refuse removal rates will definitely increase by approximately R50.00 per household if a new landfill site is to be found on the outskirts of Pietermaritzburg.



**Figure 4.5: Responses per suburb regarding the adequacy of refuse removal frequency by the Msunduzi Municipality.**

#### 4.4.5 Assessing household views on solid waste management

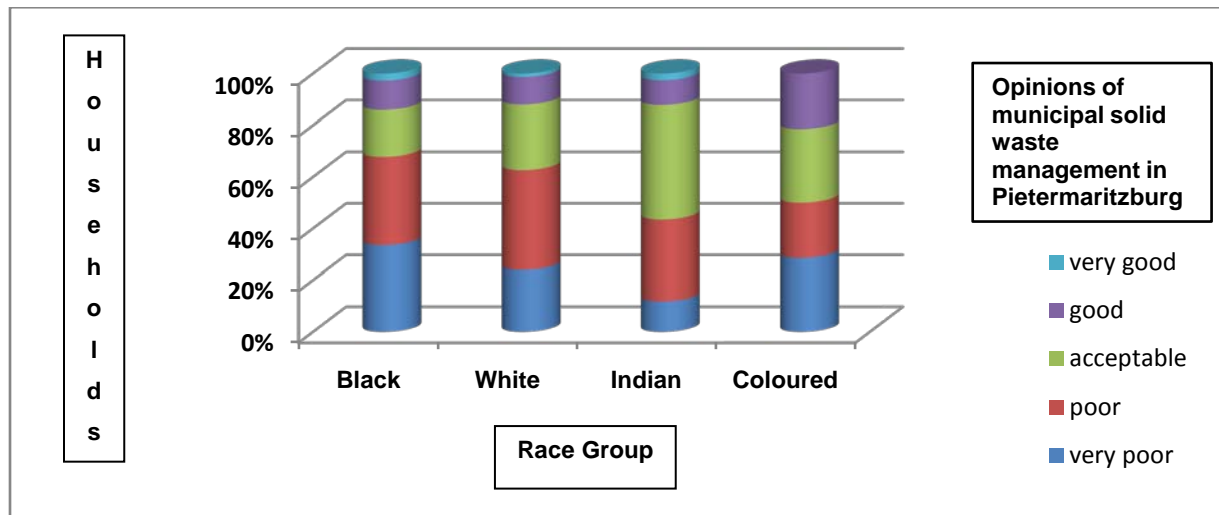
Respondents were asked to rate the current solid waste management practices in Pietermaritzburg and nationally by answering Questions 9 and 10 respectively. Question 11 dealt with respondents' views on littering and illegal dumping in the country, whilst Question 12 sought opinions on how the respondents would feel if the government introduced fines for public littering. These responses were then viewed against those of Question 21 which looked at the frequency of littering.

Table 4.6 and Figure 4.6 reflect the opinions of the respondents about MSW management on the local level (Question 9), whilst Table 4.7 examines opinions of MSW management at the national level (Question 10). While 42% of households thought that the current MSW management practices are acceptable or good in South Africa, between 58% and 59% of the respondents were of the opinion that MSW is of a poor to very poor standard locally and

nationally. Therefore, it is evident that the majority of the surveyed population do believe that MSW management in the Msunduzi Municipality and in South Africa are of an unacceptable standard. This warrants an investigation into why such an opinion exists and will be discussed further in the forthcoming chapters.

**Table: 4.6 Ratings of Municipal Solid Waste management in Pietermaritzburg**

| Suburb                            | very poor  | poor       | acceptable | good       | very good |
|-----------------------------------|------------|------------|------------|------------|-----------|
| Chase Valley                      | 28.6%      | 34.7%      | 26.5%      | 10.2%      | 0%        |
| Scottsville                       | 24.3%      | 30.1%      | 30.1%      | 12.6%      | 2.9%      |
| Northdale                         | 7.7%       | 31.8%      | 48.9%      | 9.4%       | 2.2%      |
| Imbali                            | 45.4%      | 32.8%      | 7.5%       | 10.3%      | 4%        |
| Sobantu                           | 21.2%      | 50%        | 13.5%      | 15.4%      | 0%        |
| <i>Total (collective suburbs)</i> | <i>24%</i> | <i>34%</i> | <i>29%</i> | <i>11%</i> | <i>2%</i> |



**Figure 4.6: The opinions of the different race groups regarding Municipal Solid Waste management in Pietermaritzburg.**

**Table: 4.7 Ratings of Municipal Solid Waste management in South Africa**

| <b>Race Group</b> | <b>very poor</b> | <b>poor</b>      | <b>acceptable</b> | <b>good</b>     | <b>very good</b> |
|-------------------|------------------|------------------|-------------------|-----------------|------------------|
| Black             | 72               | 113              | 51                | 36              | 22               |
| White             | 13               | 38               | 16                | 7               | 1                |
| Indian            | 33               | 81               | 93                | 21              | 0                |
| Coloured          | 0                | 10               | 1                 | 2               | 1                |
| <i>Total</i>      | <i>19% (118)</i> | <i>40% (242)</i> | <i>26% (161)</i>  | <i>11% (66)</i> | <i>4% (24)</i>   |

The responses to Question 19 gave an indication of people's views regarding air, water and ground pollution in South Africa. It was found that only 15.8% of respondents thought that air, water and ground pollution in South Africa was acceptable, whilst 42.1% thought that it was poor and very poor; with 41.3% indicating that it was bad and very bad. These responses clearly indicate that households are aware of the high pollution levels in South Africa and regard it with disfavour. Therefore, one can assume that the majority of the population would be receptive to information and will practice measures to reduce environmental pollution based on the health and safety of humankind.

Most households are also unaware that their solid waste produces methane gas at the landfill site, thereby contributing to air pollution and global warming. The same is applicable to illegal burning and backyard dumping, albeit of a far smaller magnitude. However, when these practices are carried out collectively in a geographical area, then the potency of the effect is far greater. This is what households need to understand. These are environmental aspects that need to be clearly highlighted so that the public is made aware and can begin initiatives toward responsibly managing their solid waste.

The responses to Question 11 indicate that the majority of households (64% collectively) across all suburbs are of the opinion that illegal dumping and littering should stop and that the offenders should be fined. This is reflected in Table 4.8. It is apparent that South Africans are aware of the unsightly effects of illegal dumping and littering in South Africa and their responses indicate that they are at least conscious about negative solid waste disposal practices.

It was interesting to note that even though the majority of the respondents indicated that illegal dumping and littering should stop, a relatively smaller percentage than expected believed that offenders should be fined. The fact that litter and dumping offenders should be fined may be viewed as a triviality by the public in comparison to the major crimes that occur in the country; or it is possible that most people are litter offenders at some point in time in their lives. This could account for the nature of the responses received (Table 4.8).

**Table: 4.8 Household opinions on illegal dumping and littering in South Africa**

| <b>A. Race Group</b> | <b>should stop</b> | <b>makes no difference</b> | <b>fine people</b> | <b>it's up to the person</b> |
|----------------------|--------------------|----------------------------|--------------------|------------------------------|
| Black                | 65.40%             | 8.10%                      | 16.80%             | 9.70%                        |
| White                | 54%                | 6.60%                      | 35.50%             | 4%                           |
| Indian               | 64.50%             | 2.60%                      | 29.90%             | 3%                           |
| Coloured             | 64.30%             | 7.10%                      | 28.60%             | 0%                           |
| <b>B. Suburb</b>     | <b>should stop</b> | <b>makes no difference</b> | <b>fine people</b> | <b>it's up to the person</b> |
| Chase Valley         | 64%                | 2%                         | 34%                | 0%                           |
| Scottsville          | 50.50%             | 7.80%                      | 37.90%             | 3.90%                        |
| Northdale            | 67.40%             | 1.70%                      | 26.30%             | 4.70%                        |
| Imbali               | 62.70%             | 11.30%                     | 13%                | 13%                          |
| Sobantu              | 75.50%             | 5.70%                      | 17%                | 1.90%                        |

It was the majority of the respondents though that did indicate that they would be happy and welcome a decision by the South African government to impose fines on littering and illegal dumping, which is in line with the above analysis that these practices should stop. The opinions of the respondents demonstrate this as shown in Table 4.9. Only 7.8% indicated that they would be most irritated if the South African government introduced fines for illegal dumping and littering and were mainly from the Black and Indian households – corresponding with the race groups that accounted for the larger percentage of dumping their garden waste (Table 4.3).

**Table: 4.9 Household views on fines for environmental offences**

| <b>Suburb</b> | <b>irritated</b> | <b>indifferent</b> | <b>happy</b> | <b>relieved</b> | <b>welcome it</b> |
|---------------|------------------|--------------------|--------------|-----------------|-------------------|
| Chase Valley  | 4%               | 4%                 | 2%           | 4%              | 68%               |
| Scottsville   | 6.9%             | 4%                 | 71.3%        | 5%              | 12.9%             |
| Northdale     | 6.8%             | 3.8%               | 26%          | 19.2%           | 44.3%             |
| Imbali        | 12%              | 10.3%              | 48%          | 8.6%            | 21.1%             |
| Sobantu       | 3.8%             | 11.3%              | 64.2%        | 5.7%            | 15.1%             |

Even though most of the respondents approved of introducing laws to fine litter and dumping offenders, Table 4.10 indicates that the majority of the respondents do in fact litter in some form or another as stated above. Statistics regarding the illegal dumping of solid waste was presented in Section 4.4.2. The analysis shows that littering is more prevalent among Black and Indian households as compared to White and Coloured households.

From a total of 606 respondents per suburb analysis, 45.5% said that they do not litter. However, 54.5% of the respondents indicated that they do litter in one form or another; and in some instances they are guilty of all of the given options. It is evident that littering is still carried out by the majority of the population. This in turn allows one to debate whether the litter and unlawful dumping of MSW is construed by the general public as just another ordinary occurrence that does not pose any real harm and therefore does not warrant further attention. It is also evident that littering is more prevalent among households of lower socio-economic circumstances than those of higher ones. This can be seen by the minority percentages reflected above for the households of Northdale, Imbali and Sobantu for not littering.

The above analyses also bring to the fore the suggestion that socio-economic and cultural factors do influence solid waste disposal practices. This further alludes to the fact that households of higher socio-economic status (indicated by suburb of residence) would generally possess higher levels of education and would therefore be more aware of the harmful environmental consequences of negative solid waste disposal practices. This argument leads to the serious consideration of the discussion in section 2.4.1, where high levels of litter and environmental

degradation in neighbourhoods corresponded with moral decline and a loss of values and ethics (Skogan, 1990). This would then also hold true for the conclusion that a decline in accepted norms and values would affect even behavioural aspects of attitudes toward MSW and the environment (notwithstanding the specific socio-cultural differences arising from South Africa's historic past).

Different cultures give rise to varying attitudes that influence people's behaviour as to what they feel is acceptable or not. For the purposes of this study, we cannot exclude the fact that culture bears influence on solid waste disposal behaviour. The statement is made in light of the fact that Northdale is historically an Indian area; and Imbali and Sobantu are almost all-Black housing settlements that were originally constructed to accommodate informal dwellers. A more quantitative and scientific analysis to support or reject this statement will be carried out towards the latter part of this discussion when the data outcomes of the questionnaire survey has been presented.

**Table: 4.10 Patterns of littering across suburbs and race groups**

| How often or where does one litter? |        |        |        |            |       |
|-------------------------------------|--------|--------|--------|------------|-------|
| A. Race Group                       | no     | seldom | often  | travelling | beach |
| Black                               | 35.70% | 30.20% | 19.20% | 10.70%     | 4.10% |
| White                               | 76%    | 20%    | 1.30%  | 2.70%      | 0%    |
| Indian                              | 46.50% | 45.10% | 5.30%  | 2.70%      | 0.40% |
| Coloured                            | 71.40% | 28.60% | 0%     | 0%         | 0%    |
| B. Suburb                           | no     | seldom | often  | travelling | beach |
| Chase Valley                        | 82%    | 14%    | 0%     | 2%         | 2%    |
| Scottsville                         | 71.70% | 24.20% | 2%     | 2%         | 0%    |
| Northdale                           | 38.50% | 48.90% | 9.50%  | 3%         | 0%    |
| Imbali                              | 32.40% | 23.70% | 24.90% | 13.30%     | 5.80% |
| Sobantu                             | 35.90% | 45.30% | 3.80%  | 11.30%     | 3.80% |

Responsible environmental management and practices can only be achieved through educating communities and convincing them to change mindsets and attitudes towards positive behaviour;

which could be simply stated as, “the right thing to do for the environment and for one’s own self.” The key lies in the method in which the message is conveyed and in the subsequent impact that it has on households and communities alike.

#### **4.4.6 Determining household environmental awareness**

With specific reference to environmental awareness, questions such as knowledge of the Kyoto Protocol and the harmful effects of littering were posed by Questions 17 and 20. These are questions pertaining to current and general knowledge environmental issues. The general public usually acquires environmental knowledge either from an educational career, social circles of family and friends, or from the media. Politics have also been known to incite or motivate people into civil action, especially where the issue of improved service delivery for the poor has been advocated by politicians (Pacione, 2001). This is seen in developing countries throughout the world and in South Africa. Issues such as potable water, safe sanitation and refuse removal are important considerations for the well-being of any community.

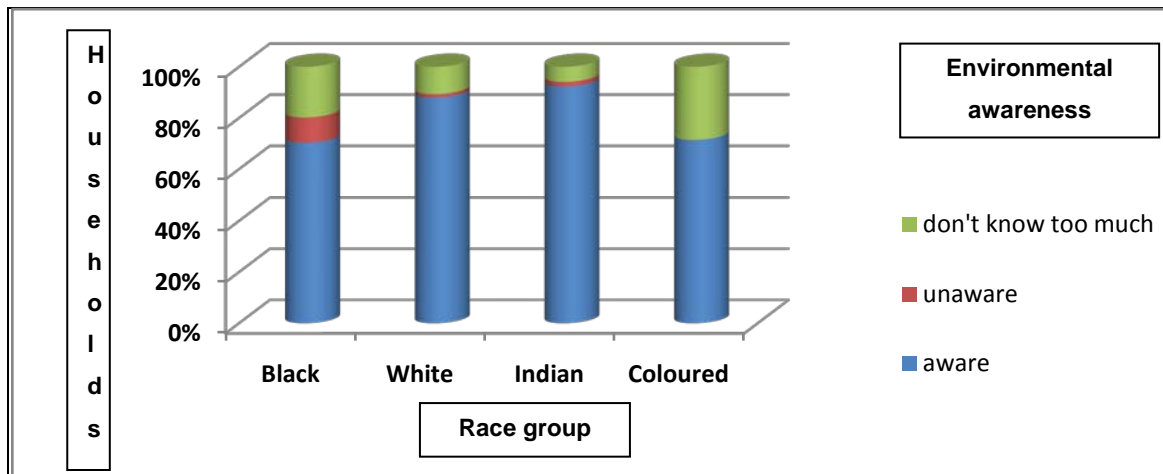
Water and sanitation are well published issues with an abundance of informative literature. However, the same cannot be said for the advocacy of responsible MSW practices. The data concerning environmental awareness of households in the Msunduzi Municipality is presented in the discussions below.

The extent of basic environmental awareness of Msunduzi’s households was determined by the responses given to Question 17 on the questionnaire. This question made inferences to the environmental damage that littering can cause to soil, water sources and fauna. Figure 4.7 reflects the responses according to each race group.

From the 594 households that responded 5.6% claimed that they were unaware, while 13.6% indicated that they did not know too much about the environmental degradation that littering can cause. A suburb analysis indicated the following with regard to households who were environmentally unaware and didn’t know too much:



- 4% of households in Chase Valley
- 26% of households in Scottsville
- 7.1% of households in Northdale
- 32.7% of households in Imbali
- 30.8% of households in Sobantu.

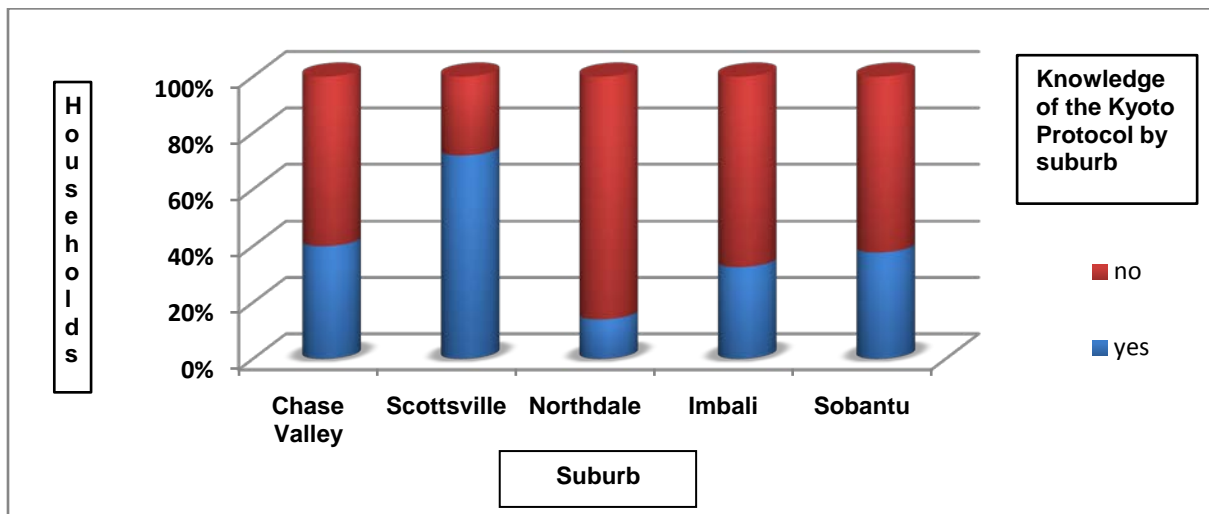


**Figure 4.7: The levels of environmental awareness according to race groups in Pietermaritzburg.**

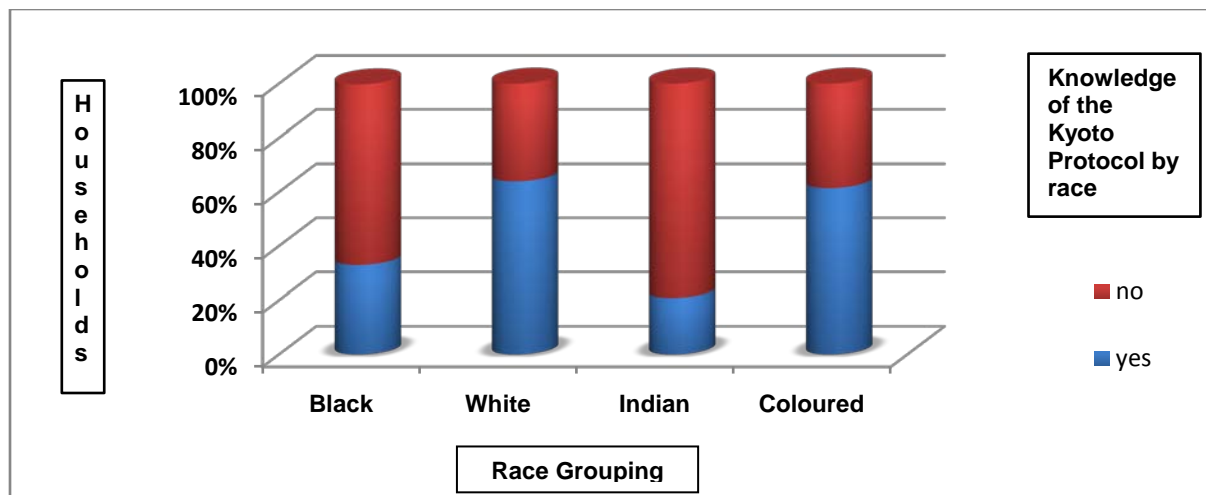
It is evident from the responses to Question 17, that households in Sobantu and Imbali were the least environmentally aware. Nevertheless, almost 81% of the sample population did indicate that they were aware of litter being able to pollute soil and rivers, threatening birds and fish, and aiding the proliferation of disease-causing agents. It can be deduced from the above analysis that with the exception of Scottsville (which has a greater range of race groups and socio-economic households) environmental awareness seems to be greater in suburbs of higher socio-economic status and this may be due to higher levels of education or exposure to the media based on access and affordability. People still continue to litter and dump solid waste though, in the wake of this knowledge, and this is what actually prompted former Minister Valli Moosa to begin the process for the plastic bag legislation in 2001 (discussed in Section 2.4.1).

Figure 4.8 shows the responses to Question 20, where environmental knowledge was further determined by means of reference to the Kyoto Protocol, which has been widely publicised as an international mechanism to combat global warming.

The number of respondents who possessed some knowledge of the Kyoto Protocol accounted for only 33.1% as indicated in Figure 4.9, while the majority of the households (66.9%) had not heard about it at all. Also indicated in this table is the fact that 64% of the White population and 61.5% of the Coloured population said that they did possess knowledge about the Kyoto Protocol. Of concern was that 66.7% of the Black population and 79.1% of the Indian population indicated that they had no knowledge of the Kyoto Protocol.



**Figure 4.8: The knowledge possessed by households per suburb about the Kyoto Protocol.**



**Figure 4.9: The knowledge possessed by households per race about the Kyoto Protocol.**

The question that this analysis raises is whether socio-cultural attitudes influence complacency towards environmental issues and if the affordability to access the different media options due to socio-economic status actually influences degrees of environmental knowledge that one may possess. The above analyses clearly suggest that current environmental issues are not reaching the public at large even though it does appear in the media. Climate change due to global warming has been synonymous with the Kyoto Protocol and carbon trading credits. This environmental challenge affects the global population – across all colour, caste and creed!

#### **4.4.7 Determining the receptiveness of households to manage their solid waste**

It would be a falsehood at this stage to rely on moral ethics and values to motivate all households and communities to engage in recommended solid waste disposal practices and the management thereof. There are those concerned individuals, households and communities who do engage in such practices, but the larger percentage of the population simply do not as has been established thus far. This can be attributed to various socio-cultural and socio-economic reasons.

The aim here is to determine if households would actually engage in responsible solid waste management at a “household level” if prompted to do so by government, if educated about the

positive outcomes of such endeavours, or if incentives were given. Questions 13 to 16 and 25 were analysed to determine these objectives.

It was surprising to note that 29.4% of households (182) indicated that they might consider (“maybe”) utilising organic waste or vegetable off-cuts as compost as recorded in Table 4.11; while 14.4% or 89 households were not willing to at all. However, it is pleasing to note that in contrast to this apathetic response to recycling; 38% or 235 households agreed to practice composting and 18.1% or 112 households were already practicing this method. If 38% of the population is keen on using vegetable waste for composting and 29.4% are undecided, then it would not be a mammoth task to encourage these households to engage in the practice.

The greatest percentages of those already practicing composting were in Chase Valley, Scottsville and Imbali, whilst the least was in Northdale and Sobantu. As mentioned previously, residents in Sobantu either did not have perishables to compost or simply did not want to. However, the 64.2% of Sobantu’s sample population said that they would be willing to practice composting. Northdale and Imbali displayed the least enthusiasm for this initiative with 36.6% and 23.2% respectively.

**Table: 4.11 Composting household organic waste**

| <b>A. Race Group</b> | yes    | no     | maybe  | practicing |
|----------------------|--------|--------|--------|------------|
| Black                | 37.60% | 14.10% | 28.50% | 19.80%     |
| White                | 46.10% | 10.50% | 27.60% | 15.80%     |
| Indian               | 34.80% | 17%    | 31.30% | 17%        |
| Coloured             | 57.10% | 0%     | 28.60% | 14.30%     |
| <b>B. Suburb</b>     | yes    | no     | maybe  | practicing |
| Chase Valley         | 42%    | 16%    | 22%    | 20%        |
| Scottsville          | 51.50% | 2.90%  | 25.20% | 20.40%     |
| Northdale            | 36.60% | 17.50% | 30.60% | 15.30%     |
| Imbali               | 23.20% | 18.60% | 34.50% | 23.70%     |
| Sobantu              | 64.20% | 7.60%  | 22.60% | 5.70%      |

One needs to understand though, that practice is not always as feasible as might have been envisaged. The lifestyles led by career-orientated societies today view time as a precious commodity and as such are not willing to engage in household recycling or reduced packaging purchases. With reference to gender, women are also very much career-driven and convenience packaged meals may be viewed as a solution to balancing the roles of housewife and employer/e (Smith, 1992).

The incentive for encouraging households to compost their vegetable waste would probably be through actual “practice and showcase” demonstrations to indicate the ease of composting and the resultant healthy crop produce expected. Also, the need for purchasing fertilizer would be eliminated and serve as an additional draw-card. Storage facilities may be an issue of contention for those who live in complexes or do not have the garden space to do so. Odour and vector control should not be a problem, especially if a soil cover is used. Nevertheless, of greater contention is the separation of solid waste from the source of generation, which is the household in this instance.

Table 4.12 gives an analysis of the willingness of households to practice waste separation; where glass, metal, paper, plastics and perishables would be disposed of in different refuse bags. There were 182 households that were happy to recycle and 174 households that were willing to practice household waste separation. This is further classified according to the race groups that participated, and calculations were done according to the percentages of the 611 households that responded to Question 14. The majority of households are willing or happy to recycle, or would consider it as shown in Table 4.12. Only 14.2% of the population was against it. The most receptive to household waste separation were Black and White households.

Some of the important considerations for household solid waste separation are actually deterrents and include one or more of the following:

- Storage space for different solid waste types.
- The cost of storage material.
- Aesthetic appearance of storage facilities in the home.
- A lack of or inadequate recycling collection facilities.

- The cost of transport and time consumption to personally deliver separated household waste where there is no collection on a door to door basis by a municipality.

**Table: 4.12 Willingness of residents to separate waste at a household level**

| <b>Race Group</b> | <b>against it</b> | <b>willing</b> | <b>will consider</b> | <b>happy to recycle</b> |
|-------------------|-------------------|----------------|----------------------|-------------------------|
| Black             | 21.7%             | 26.4%          | 17%                  | 34.9%                   |
| White             | 2.6%              | 40.8%          | 25%                  | 31.6%                   |
| Indian            | 8.4%              | 26.6%          | 41.5%                | 23.5%                   |
| Coloured          | 14.3%             | 35.7%          | 35.7%                | 14.3%                   |

It therefore stands to reason that any municipality or company which decides to embark on a household separation of solid waste for recycling should actually weigh the above considerations and ensure that they are adequately addressed to facilitate the mission.

Tables 4.13 A and B show an overwhelming response by households, either by suburb or by race distinction, that are willing to recycle if the municipality offered incentives in the form of a rates reduction, money back or certificates of recognition. Those households who will practice recycling based on incentives account for 53.4% and those who will consider it are in the region of 40.9%. Only 35 respondents out of 612 respondents (5.7%) chose to ignore recycling initiatives if incentives were provided.

The status of a country's economy and inflation rate, as well as the municipal service's fee structure would influence the decision of ratepayers if incentives in the form of rebates were offered for managing (or reducing) their MSW. South Africa is currently experiencing an economic lag due to a global recession associated with volatile political platforms across the globe (including Europe) and rising crude oil prices.

Therefore, based on the statistics available, local and national governments should consider the option of offering incentives such as achievement awards and a rebate in rates to promote recycling at a household level. Financial losses from the collection of rates can be offset by the monetary gain from recycling at a municipal level as it is easier to work with waste that has been separated at a household level. This would mean savings in time and labour costs.

**Table: 4.13A Willingness of suburb residents to recycle based on incentives**

| <b>Suburb</b> | <b>will consider it</b> | <b>will practice it</b> | <b>will ignore it</b> |
|---------------|-------------------------|-------------------------|-----------------------|
| Chase Valley  | 42%                     | 58%                     | 0%                    |
| Scottsville   | 31.1%                   | 67%                     | 1.9%                  |
| Northdale     | 44.2%                   | 51.5%                   | 4.3%                  |
| Imbali        | 30.1%                   | 56.6%                   | 13.3%                 |
| Sobantu       | 79.2%                   | 20.8%                   | 0%                    |
| <i>Total</i>  | <i>40.9%</i>            | <i>53.4%</i>            | <i>5.7%</i>           |

**Table: 4.13B Willingness of residents of different race groups to recycle based on incentives**

| <b>Race Group</b> | <b>will consider it</b> | <b>will practice it</b> | <b>will ignore it</b> |
|-------------------|-------------------------|-------------------------|-----------------------|
| Black             | 40.8%                   | 50%                     | 9.3%                  |
| White             | 39.5%                   | 57.9%                   | 2.6%                  |
| Indian            | 40.9%                   | 56.5%                   | 2.6%                  |
| Coloured          | 50%                     | 50%                     | 0%                    |
| <i>Total</i>      | <i>40.9%</i>            | <i>53.4%</i>            | <i>5.7%</i>           |

Further, the need for landfill space and the funds to design a new landfill site will be staggered as recycling reduces the need for landfill space, thus extending the lifespan of a landfill site. Most medium and large leachate producing landfill sites have a lifespan of fifteen to thirty years (Reddy, 2007).

In terms of employment losses, if any in the actual refuse collection division, this can be offset by employment being created at the landfill site itself for recycling endeavours. It is envisaged though that if waste separation is to occur at a household level, it is highly likely that more employees would be needed to collect and sort the various bags of waste types into common piles or onto municipal trucks.

The views of households with regard to Question 16 which pertains to recycling for cash are noted in Table 4.14. It is clear from this analysis that households from low to medium income suburbs such as Sobantu are more likely to practice recycling for cash than high income areas such as Chase Valley. The majority of Scottsville’s households also indicated that they would like to recycle for cash. This is just one option that can alleviate poverty-stricken communities while simultaneously promoting environmental sustainability. However, the statistics above indicate that households across all socio-economic suburbs and race groups are willing to recycle or cash.

**Table: 4.14 Willingness of households to recycle for cash returns**

| <b>A. Race Group</b> | yes    | no     |
|----------------------|--------|--------|
| Black                | 91.80% | 8.20%  |
| White                | 74%    | 26%    |
| Indian               | 78.90% | 21.10% |
| Coloured             | 92.90% | 7.10%  |
| <b>B. Suburb</b>     | yes    | no     |
| Chase Valley         | 53.10% | 46.90% |
| Scottsville          | 96.80% | 3.20%  |
| Northdale            | 80.50% | 19.50% |
| Imbali               | 89.90% | 10.10% |
| Sobantu              | 94.20% | 5.80%  |

The fact that recycling is encouraged would also mean that a viable market for recycled products should exist, so that the process becomes financially sustainable. The public at large must be willing to purchase manufactured goods that are largely composed of recycled material, albeit



the initial costs may not differ much to the original products as the industry gains momentum. A point worthy to note is that most of the markets for recycled or recovered goods that exist today are in the arts and crafts sector, where workmanship by hand is what makes the difference in the authenticity of the item and the price for painstaking and time-consuming labour.

Table 4.15 gives the responses to Question 25 which looks into the willingness of Msunduzi's households to utilise recycled products. There were 611 respondents to this question and an overwhelming 72.2% indicated that they would use books and paper made from recycled material. Only 3.9% said that they would not utilise recycled material, while 23.9% indicated that they "may" use recycled material.

Recycling needs to be a cost-effective scheme that allows recyclers or reclamation companies to earn a profit, while viable markets need to exist for the public to purchase recycled items. Metal is widely recycled as waste re-claimers pay the most for this as compared to glass, plastic or paper. One of the major problems that South Africa faces with regard to the recycling of e-waste, is the fact that there is an inefficient take-back scheme for recyclers and the financial constraints faced by collectors are quite high (EMPA, 2007). There are obviously many considerations to take into account and not just the concept of recycling or encouraging people to recycle.

**Table: 4.15 Willingness of households to use recycled material**

| <b>A. Race Group</b> | yes    | no    | maybe  |
|----------------------|--------|-------|--------|
| Black                | 72%    | 3%    | 25%    |
| White                | 85.50% | 2.60% | 11.80% |
| Indian               | 68%    | 5.80% | 26.20% |
| Coloured             | 71.40% | 0%    | 28.60% |
| <b>B. Suburb</b>     | yes    | no    | maybe  |
| Chase Valley         | 94%    | 0%    | 6%     |
| Scottsville          | 76.50% | 2%    | 21.60% |
| Northdale            | 62.60% | 7%    | 30.40% |
| Imbali               | 71.60% | 1.70% | 26.70% |
| Sobantu              | 86.80% | 5.70% | 7.50%  |

It is interesting to note that the statistics in Table 4.15 indicate that households in the medium-to-high socio-economic suburbs of Chase Valley and Scottsville have 94% and 76.5% respectively that are willing to use recycled material. Sobantu and Imbali are low-to-medium socio-economic suburbs where 86.8% and 71.6% respectively are willing to use recycled material. The households of Northdale which accounted for 62.6% showed the least interest in using recycled material. However, the above analysis clearly indicates that suburbs of varying socio-economic status have more than half of their households who are willing to use recycled material.

The residents most likely to purchase recycled products are Whites, followed by Blacks, Coloured and Indians as indicated in Table 4.15. The issues of contention are the fact that Whites and those households belonging to the higher socio-economic areas are the most receptive to recycling, yet they are not financially compromised. The most plausible explanation seems to stem from the fact that these households possess higher education levels and are therefore environmentally aware (instead of financially-driven).

Slightly more than three quarters of the Black and the Coloured population predominantly from the low-to-medium income areas indicated that they are willing to recycle and use recycled material. Could this be due to higher environmental awareness and education or a means of saving money? This is an investigative issue of contention. Just below three quarters of the Indian population indicated that they would use recycled material. Again, it is possible that the larger Indian community views the use of recycled material as a sign of poverty. This would then account for them being the least receptive to recycling (Smith, 1992).

It is encouraging to note that the larger percentage of households is prepared to recycle and use recycled material. The important question is: what stops all of them from doing so now? Is it a lack of technical know-how? Is it a lack of economically viable markets or buy-back systems? Is it merely apathy? The questions are numerous and the answers vague. This aspect calls for further research in its entirety. However, in terms of current management of MSW, sanitary landfill sites are the recommended disposal route. As such, the following section pertains to questions posed to the questionnaire respondents regarding NERLS which services the Msunduzi Municipality and its surrounding areas.

#### **4.4.8 The New England Road Landfill Site**

The NERLS services the Msunduzi Municipality and includes areas such as Edendale and Vulindlela which do not fall within the jurisdiction of Pietermaritzburg itself. It is a large leachate-bearing landfill site and is allowed to accept only general sanitary or municipal solid waste, and not medical or other hazardous waste. With regard to the location of the NERLS and the most common negative effects associated with landfill sites in general, the responses of households on the questionnaire survey were noted and tabulated as given in Table 4.16.

There were 282 respondents (45.3%) who indicated that the NERLS should be located away from residential areas. A total of 95% of the sampled households in Scottsville indicated that the NERLS should be located away from residential areas. This is understandable given the fact that this suburb is adjacent to that of the landfill site (Hayfields). Scottsville itself has often been the bearer of noxious odours when extremely hot weather persists, and toxic fumes each time a fire had broken out on the NERLS.

Sobantu had 86% of its sampled households indicating that the NERLS should be located away from residential areas. This suburb actually borders the landfill site and its residents have often been cited for being responsible for destroying several metres of security fencing on the western border. Residents from Sobantu have formed pathways across the landfill site as hideouts for crime-related activities and can often be found salvaging on the workface of the site itself (Raghunandan, 2005; Naidoo, 2007; Reddy, 2007). This is in direct violation of the rules and regulations of the operating permit for the landfill site. Sobantu is also subjected to noxious odours and toxic fumes from the landfill site. The area may also be prone to litter arising from the landfill site when high wind speeds occur.

More than half of Chase Valley's sampled households indicated that the NERLS should be located away from residential areas, with Northdale and Imbali having fewer households in favour of the relocation. The suburbs in the vicinity of the landfill site have strongly suggested its relocation and this could be due to factors such as aesthetic appearance, emanating odour, and vector production. The considerable devaluation of property in the vicinity of the landfill site is

due to the presence of the site, albeit most of the homes and businesses immediately bordering the landfill site were built after its establishment (Pather, 2008).

**Table: 4.16 Responses to the question of the landfill be re-sited away from residential areas**

| <b>Suburb</b> | <b>yes</b> | <b>no</b> |
|---------------|------------|-----------|
| Chase Valley  | 54%        | 46%       |
| Scottsville   | 95%        | 5%        |
| Northdale     | 38%        | 62%       |
| Imbali        | 11%        | 89%       |
| Sobantu       | 86%        | 14%       |

As shown in Table 4.17, 64% of Sobantu’s sample population indicated that the landfill site emitted unpleasant odours in the area of Hayfields. However, only 35% of Scottsville’s sample population indicated the same. Chase Valley which is located further away had 46% of its sample population indicate the same, while Northdale and Imbali who are not directly in the vicinity of the landfill site had no real cause to complain of unpleasant odours emanating from the site itself. This could account for the low percentages vindicating the site of causing unpleasant odours. However, there are those households who dump their bulky waste at the landfill site and can comment in this instance, even if they are located further away.

**Table: 4.17 The question of whether the landfill is the cause of unpleasant odours**

| <b>Suburb</b> | <b>yes</b> | <b>no</b> |
|---------------|------------|-----------|
| Chase Valley  | 46%        | 54%       |
| Scottsville   | 35%        | 65%       |
| Northdale     | 20%        | 80%       |
| Imbali        | 9%         | 91%       |
| Sobantu       | 64%        | 36%       |

Relatively few households believed that the NERLS was responsible for producing flies and rats as indicated in Table 4.18; and yet the majority of the respondents from the two suburbs closest to the landfill site (Scottsville and Sobantu) indicated that it should be located away from residential areas. Only 29% of Sobantu’s households and 13% of Scottsville’s households agreed with the same.

**Table: 4.18 The question of whether the landfill is a breeding ground for flies and rats**

| <b>Suburb</b> | <b>yes</b> | <b>no</b> |
|---------------|------------|-----------|
| Chase Valley  | 28%        | 72%       |
| Scottsville   | 13%        | 87%       |
| Northdale     | 13%        | 87%       |
| Imbali        | 6%         | 94%       |
| Sobantu       | 29%        | 71%       |

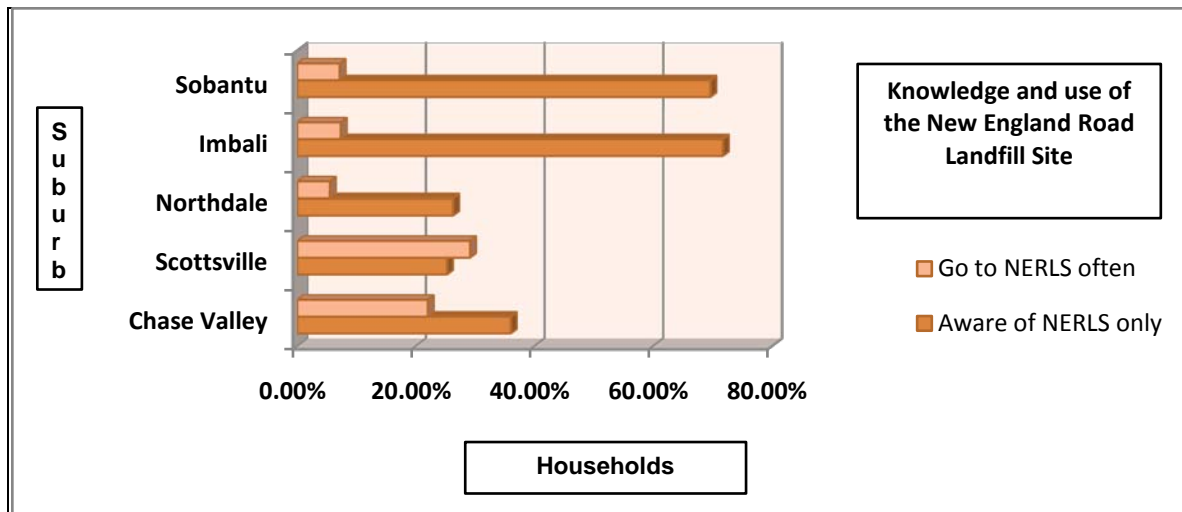
There could be other reasons apart from aesthetic appearance, such as suspecting the landfill site for contamination of soil and water in the area, which was indicated by Professor Laing and Mr Moon who live in Woodhouse Road opposite the landfill site (Laing, 2005). There were respondents who did mention to the principal researcher that one of the reasons for supporting the relocation of the site pertained to the low property valuation in the area – where the NERLS was said to be the main cause of this.

Out of 622 respondents, 29.6% (184) households as indicated in a suburb analysis in Table 4.19 believe that the NERLS is necessary for treating MSW. Although 73% of Sobantu’s population and 66% of Scottsville’s agreed with the need for the NERLS, the responses of the two large suburbs of Northdale (19%) and Imbali (7%) served to further dispute the need for a landfill site in Pietermaritzburg to treat MSW. Only 36% of Chase Valley’s households supported the landfill site in its role for the treatment of MSW. This outcome did result in an attempt to understand whether a lack of knowledge (about the function of the NERLS) actually influenced households to respond as they did regarding the necessity of a landfill site.

**Table: 4.19 The question of whether the landfill is needed to safely dispose of solid waste**

| Suburb       | yes | no  |
|--------------|-----|-----|
| Chase Valley | 36% | 64% |
| Scottsville  | 66% | 34% |
| Northdale    | 19% | 81% |
| Imbali       | 7%  | 93% |
| Sobantu      | 73% | 27% |

As indicated by Figure 4.10, the highest awareness of the existence of the landfill site arose from the predominantly Black suburbs of Sobantu and Imbali, but it was the households from the predominantly White areas of Scottsville and Chase Valley who visited the landfill site often to dump or collect waste.



**Figure 4.10: The levels of awareness and usage of the New England Road Landfill Site.**

The management of the landfill site usually employs casual or temporary staff from Sobantu and Imbali for positions such as litter-picking, general cleaning and maintenance (Naidoo, 2007). This could be a reason for Imbali displaying such a high level of awareness although it is located the furthest away from the landfill site. These suburbs have also been the hosts to pilot

environmental projects and other green initiatives by government and private bodies in underprivileged areas. The schools in these suburbs also participate in several environmental competitions and clean-up campaigns.

There are two issues of contention with the above survey analysis. The first is the fact that the levels of awareness and use of the NERLS are so low in Scottsville, especially since the suburb is adjacent to that of the landfill site. Secondly, Sobantu shows an expected high level of awareness but a very low level of use of the landfill site which contra-indicates the majority response in this suburb for more frequent refuse removal. This could be due to a lack of funds for refuse disposal fees or transport, although the recycling bay is available at no fee for garden waste, furniture, appliances and recyclable material. Also, there are usually about 150 residents from Sobantu who walk through the site daily or scavenge for recyclables or items to reuse (Naidoo, 2007).

The data outcomes will be discussed further in Section 4.6 once the application necessary for multivariate statistical testing has been established, to ascertain whether the quantitative correlations actually correspond to and enhances the qualitative findings of the questionnaire survey results presented in this chapter.

## **4.5 A quantitative analysis of the data**

In order to quantify and verify the aforementioned qualitative data analyses and to ascertain whether socio-economic and cultural factors do in fact influence household solid waste management behaviour and practices, statistical testing was applied to the results yielded by the questionnaire survey.

The Kolmogorov-Smirnov Test was first applied to the original data set from the questionnaire survey to determine if the variables used were in keeping with that of a Normal distributive range. The result of which is presented below. The Null Hypothesis ( $H_0$ ) stated that the variables analysed in the SPSS data input are of a Normal distribution and would require parametric tests.

The alternative ( $H_1$ ) hypothesis stated that the variables used are not from a Normal distribution and would require non-parametric tests. The variables were the questions from the questionnaire that have been shortened to facilitate processing on the SPSS software package. The close-ended options for each question were assigned numeral values beginning with the number 1. For example, the first question (1) on the questionnaire (Appendix A) under “research statistics” pertains to information on the methods used by households to get rid of their MSW. The first option of “burn it” was assigned the number 1 and the second option of “leave on street” was assigned the number 2.

#### 4.5.1 The Kolmogorov-Smirnov Test

$H_0$ : The tested variables come from a Normal distribution.

$H_1$ : The tested variables do not come from a Normal distribution.

**Table: 4.20 The One-Sample Kolmogorov-Smirnov Test (to determine if the variables are of a normal distribution)**

| <i>Tested variables</i> | <i>Normal Parameters (a,b)</i> |         | <i>Kolmogorov-Smirnov Z</i> | <i>Asymp. Sig. (2-tailed)</i> |
|-------------------------|--------------------------------|---------|-----------------------------|-------------------------------|
| Area of residence       | 3.1383                         | 1.05570 | 5.036                       | .000                          |
| Race of respondent      | 1.9325                         | .97072  | 7.870                       | .000                          |
| Income of household     | 3.5327                         | 1.48974 | 5.183                       | .000                          |
| Get rid of MSW          | 2.7674                         | .83850  | 11.139                      | .000                          |
| General MSW type        | 2.3531                         | 1.79025 | 8.964                       | .000                          |
| No of bin bags          | 1.1967                         | .49433  | 12.118                      | .000                          |
| Garden waste            | 2.9451                         | 1.54730 | 5.538                       | .000                          |
| NERLS existence         | 1.0346                         | .39651  | 10.513                      | .000                          |
| Bulk of MSW             | 1.4551                         | .84793  | 11.500                      | .000                          |
| Level of satisfaction   | 1.9689                         | .88002  | 6.468                       | .000                          |
| Removal frequency       | 1.3153                         | .48237  | 10.725                      | .000                          |
| MSW management in PMB   | 2.3404                         | 1.03480 | 5.068                       | .000                          |
| MSW management in SA    | 2.4043                         | 1.03951 | 5.945                       | .000                          |



|                         |        |           |        |      |
|-------------------------|--------|-----------|--------|------|
| Littering and dumping   | 1.7318 | 1.02988   | 9.898  | .000 |
| Impose fines            | 3.5480 | 1.27641   | 5.753  | .000 |
| Composting veg waste    | 2.2811 | 1.15546   | 6.117  | .000 |
| Waste separation        | 2.7468 | 1.05499   | 4.620  | .000 |
| Recycling incentive     | 1.6803 | .97630    | 7.747  | .000 |
| Cash for recycling      | 1.1560 | .36780    | 12.449 | .000 |
| Enviro awareness        | 1.3283 | .70290    | 11.890 | .000 |
| Rates increase          | 1.5954 | .49122    | 9.625  | .000 |
| Pollution               | 3.0183 | 1.39693   | 4.716  | .000 |
| Kyoto Protocol          | 1.6749 | .48269    | 10.330 | .000 |
| Do you litter           | 1.8515 | .99970    | 6.358  | .000 |
| Using recycled books    | 1.5172 | .85370    | 11.110 | .000 |
| Visited NERLS           | 1.0137 | .11664    | 6.441  | .000 |
| Go often to NERLS       | 1.0278 | .23570    | 4.523  | .000 |
| Aware of NERLS only     | 1.0000 | .00000(c) |        |      |
| Odours by NERLS         | 1.0000 | .00000(c) |        |      |
| Flies and rats by NERLS | 1.0000 | .00000(c) |        |      |
| NERLS is necessary      | .9946  | .07352    | 7.126  | .000 |
| NERLS located away      | 1.0000 | .00000(c) |        |      |

a: Test distribution is Normal.

b: Calculated from data.

c: The distribution has no variance for this variable. One-Sample Kolmogorov-Smirnov Test cannot be performed.

At the 5% significance level, we rejected  $H_0$  for all of the questions and concluded that the tested variables did not come from a Normal distribution due to the p-values all being less than 0.05. The implication for this was that as far as the scores/responses were concerned was that Non-parametric statistics were required. The Mann-Whitney U Test and the Kruskal Wallis Test were therefore used.

#### 4.5.2 The Kruskal Wallis Test

The Kruskal Wallis Test was used to determine if the correlations deduced from the qualitative and semi-quantitative analysis of the questionnaire survey outcomes regarding socio-economic and cultural influences were in fact true by pure quantitative testing. It was found during the presentation of the survey results that attitudes and behaviour toward MSW in South Africa and the nature of solid waste itself, were influenced by practices and beliefs that arose from cultural tendencies (determined by race grouping and politically historic backgrounds) and socio-economic status (determined by area of residence).

$H_0$ : there are no differences in the area of residence of the population groups with respect to the solid waste management practices.

$H_1$ : there are differences in the area of residence of the population groups with respect to the solid waste management practices.

**Table: 4.21 The Kruskal Wallis Test 1 – whether the area of residence (social status) influences solid waste practices**

| <i>Tested variables</i> | <i>Chi-Square</i> | <i>df</i> | <i>Test Statistics (a,b)</i> |
|-------------------------|-------------------|-----------|------------------------------|
|                         |                   |           | <i>Asymp. Sig.</i>           |
| Area of residence       | 373.914           | 4         | .000                         |
| Income of household     | 137.372           | 4         | .000                         |
| Get rid of MSW          | 78.606            | 4         | .000                         |
| General MSW type        | 29.588            | 4         | .000                         |
| No of bin bags          | 13.605            | 4         | .009                         |
| Garden waste            | 42.185            | 4         | .000                         |
| NERLS existence         | 6.109             | 4         | .191                         |
| Bulk of MSW             | 65.338            | 4         | .000                         |
| Level of satisfaction   | 74.614            | 4         | .000                         |
| Removal frequency       | 56.347            | 4         | .000                         |
| MSW management in PMB   | 66.337            | 4         | .000                         |
| MSW management in SA    | 16.039            | 4         | .003                         |
| Littering and dumping   | 10.617            | 4         | .031                         |

|                         |         |   |       |
|-------------------------|---------|---|-------|
| Impose fines            | 81.361  | 4 | .000  |
| Composting veg waste    | 28.781  | 4 | .000  |
| Waste separation        | 19.086  | 4 | .001  |
| Recycling incentive     | 49.431  | 4 | .000  |
| Recycling for cash      | 56.282  | 4 | .000  |
| Enviro awareness        | 54.314  | 4 | .000  |
| Rates increase          | 69.755  | 4 | .000  |
| Pollution               | 51.068  | 4 | .000  |
| Kyoto Protocol          | 102.326 | 4 | .000  |
| Do you litter           | 89.536  | 4 | .000  |
| Recycled books          | 28.071  | 4 | .000  |
| Visited NERLS only      | 4.824   | 4 | .306  |
| Go often to NERLS       | 5.000   | 4 | .287  |
| Aware of NERLS          | .000    | 4 | 1.000 |
| Odours by NERLS         | .000    | 4 | 1.000 |
| Flies and rats by NERLS | .000    | 4 | 1.000 |
| NERLS is necessary      | 8.737   | 4 | .068  |
| NERLS located away      | .000    | 4 | 1.000 |

a: Kruskal Wallis Test

b: Grouping Variable: area

At the 5% level we reject  $H_0$  only for those questions where the p-values (shaded above) are less than 0.05. In this case there were only 23 of them in the table above implying that for these questions we had enough statistical evidence to conclude that there were differences in the area of residence group with respect to the solid waste management practices whilst for the questions with p-values greater than 0.05, we accepted  $H_0$  s and concluded that there were no differences in the area of residence group with respect to the solid waste management practices (8 questions). There was sufficient statistical evidence to indicate that the area of residence or social status does in fact influence the solid waste practices of households. Therefore, the deduction based on the outcomes of the survey hold true in terms of socio-economic status influencing solid waste management and its disposal practices.

H<sub>0</sub>: there are no differences in the race group with respect to the solid waste management practices.

H<sub>1</sub>: there are differences in the race group with respect to the solid waste management practices.

**Table: 4.22 The Kruskal Wallis Test 2 – whether socio-cultural (race grouping) factors influence solid waste practices**

| <i>Tested variables</i> | <i>Chi-Square</i> | <i>df</i> | <i>Test Statistics (a,b)</i> |
|-------------------------|-------------------|-----------|------------------------------|
|                         |                   |           | <i>Asymp. Sig.</i>           |
| Income of household     | 96.669            | 3         | .000                         |
| Get rid of MSW          | 50.633            | 3         | .000                         |
| General MSW type        | 5.859             | 3         | .119                         |
| No of bin bags          | 14.366            | 3         | .002                         |
| Garden waste            | 16.505            | 3         | .001                         |
| NERLS existence         | 7.930             | 3         | .047                         |
| Bulk of MSW             | 26.060            | 3         | .000                         |
| Level of satisfaction   | .560              | 3         | .906                         |
| Removal frequency       | 25.109            | 3         | .000                         |
| MSW management in PMB   | 31.090            | 3         | .000                         |
| MSW management in SA    | 5.136             | 3         | .162                         |
| Littering and dumping   | 2.738             | 3         | .434                         |
| Impose fines            | 39.651            | 3         | .000                         |
| Composting veg waste    | 2.599             | 3         | .458                         |
| Waste separation        | 4.452             | 3         | .217                         |
| Recycling incentive     | 1.482             | 3         | .687                         |
| Cash for recycling      | 25.193            | 3         | .000                         |
| Enviro awareness        | 40.775            | 3         | .000                         |
| Rates increase          | 20.535            | 3         | .000                         |
| Pollution               | 36.405            | 3         | .000                         |
| Kyoto Protocol          | 48.433            | 3         | .000                         |
| Do you litter           | 61.603            | 3         | .000                         |
| Recycled books          | 8.484             | 3         | .037                         |
| Visited NERLS only      | 3.867             | 3         | .276                         |
| Go often to NERLS       | 2.789             | 3         | .425                         |

|                         |       |   |       |
|-------------------------|-------|---|-------|
| Aware of NERLS          | .000  | 3 | 1.000 |
| Odours by NERLS         | .000  | 3 | 1.000 |
| Flies and rats by NERLS | .000  | 3 | 1.000 |
| NERLS is necessary      | 3.022 | 3 | .388  |
| NERLS located away      | .000  | 3 | 1.000 |

a: Kruskal Wallis Test

b: Grouping Variable: race

At the 5% level we reject  $H_0$  s only for those questions where the p-values (shaded above) are less than 0.05. In this case there were 16 such variables in the table above implying that for these questions we had enough statistical evidence to conclude that there were differences in the race group with respect to the municipal solid waste management practices whilst for the questions with p-values greater than 0.05, we accepted  $H_0$  and concluded that there were no differences in the race group with respect to the solid waste management practices (14 questions). Therefore, the outcomes of the survey with regard to socio-cultural factors as determined by race grouping do influence the solid waste management practices and its disposal by households.

$H_0$ : there are no differences in the household income group with respect to the municipal solid waste management practices

$H_1$ : there are differences in the household income group with respect to the municipal solid waste management practices.

**Table: 4.23 The Kruskal Wallis Test 3 – whether income (economic factor) influences solid waste practices**

| <i>Tested variables</i> | <i>Chi-Square</i> | <i>df</i> | <i>Test Statistics (a,b)</i> |
|-------------------------|-------------------|-----------|------------------------------|
|                         |                   |           | <i>Asymp. Sig.</i>           |
| Get rid of MSW          | 24.258            | 4         | .000                         |
| General MSW type        | 3.392             | 4         | .495                         |
| No of bin bags          | 2.926             | 4         | .570                         |
| Garden waste            | 13.678            | 4         | .008                         |
| NERLS existence         | 6.588             | 4         | .159                         |

|                         |        |   |       |
|-------------------------|--------|---|-------|
| Bulk of MSW             | 11.192 | 4 | .024  |
| Level of satisfaction   | 14.428 | 4 | .006  |
| Removal frequency       | 23.000 | 4 | .000  |
| MSW managemt in PMB     | 17.658 | 4 | .001  |
| MSW managemt in SA      | 4.607  | 4 | .330  |
| Littering and dumping   | 11.453 | 4 | .022  |
| Impose fines            | 20.859 | 4 | .000  |
| Composting veg waste    | 3.970  | 4 | .410  |
| Waste separation        | 6.232  | 4 | .182  |
| Recycling incentive     | 2.483  | 4 | .648  |
| Recycling for cash      | 14.681 | 4 | .005  |
| Enviro awareness        | 29.403 | 4 | .000  |
| Rates increase          | 10.649 | 4 | .031  |
| Pollution               | 1.008  | 4 | .909  |
| Kyoto Protocol          | 18.406 | 4 | .001  |
| Do you litter           | 11.537 | 4 | .021  |
| Recycled books          | 8.870  | 4 | .064  |
| Visited NERLS only      | 5.395  | 4 | .249  |
| Go often to NERLS       | 11.333 | 4 | .023  |
| Aware of NERLS          | .000   | 4 | 1.000 |
| Odours by NERLS         | .000   | 4 | 1.000 |
| Flies and rats by NERLS | .000   | 4 | 1.000 |
| NERLS is necessary      | 9.625  | 4 | .047  |
| NERLS located away      | .000   | 4 | 1.000 |

a: Kruskal Wallis Test

b: Grouping Variable: income

At the 5% level we reject  $H_0$  s only for those questions where the p-values (shaded above) are less than 0.05. In this case there were only 15 such questions in the table above implying that for these questions we had enough statistical evidence to conclude that there were differences in the household income group with respect to the solid waste management practices whilst for the questions with p-values greater than 0.05, we accepted  $H_0$  and concluded that there were no differences in the household income group with respect to the solid waste management practices

(14 questions). It can therefore be stated that the socio-economic status of households do influence solid waste management practices.

It can thus be concluded from the results of the above statistical tests that cultural and socio-economic factors do in fact exert an influence on the attitudes and behaviour of individuals and households toward municipal solid waste management as might have been expected. Future studies can be undertaken to determine if income levels and equivalent levels of education can be used to determine solid waste management practices of individuals and heads of households. These determinant factors and influences become important considerations when deciding on the best available techniques and approaches to be implemented for enforcing responsible solid waste management on the way forward for environmental sustainability. A discussion pertaining to the outcomes and implications of the questionnaire survey will be discussed in Section 4.6.

#### **4.6 Synthesis of the questionnaire survey outcomes**

The expected outcomes of the questionnaire survey were intended to provide answers to the following objectives as stated in Chapters 1, and can be reiterated as follows:

To ascertain the efficiency and effectiveness of the Msunduzi's Municipal Solid Waste management services within the context of sustainability; thereby focusing on South Africa's discrepancies between management policies and practices. This can be achieved by gauging the views of responsible members of households in the Msunduzi Municipality regarding refuse removal, their disposal methods; and their willingness to practice suggested Municipal Solid Waste management strategies. It can be further investigated if socio-economic status exerts an influence on the nature (quantity and composition) of Municipal Solid Waste, whilst looking into the correlations that exist between culture (race group) and historic backgrounds, and the attitudes and behaviour of people with regard to solid waste disposal practices. Further objectives pertain to whether the New England Road Landfill Site is viewed by the public as a positive or a negative instrument in the management of Municipal Solid Waste. The outcomes of these objectives can then be used to determine and suggest

reforms that can be made to local, provincial and national service delivery strategies, aiding equity, affordability and accessibility with regard to Municipal Solid Waste.

To facilitate the process of determining the above objectives, the questions from the questionnaire were grouped into similar or consistent themes as reflected in this chapter. The layout of the questions was intentional and did not follow any particular order so that dishonest responses stemming from moral discrimination by the respondents could be avoided.

The majority of Msunduzi's households receive a refuse removal service at least once a week from the municipality and are satisfied with this service – albeit there was a general consensus for greater frequency of refuse removal. However, there was even greater consensus that MSW is poorly managed in Pietermaritzburg and in South Africa. Also, soil water and air pollution levels in the country were considered as unacceptable.

Although most of the household solid waste is collected by the municipality, a fair percentage of the population (15%) still burns their solid waste, whilst 3% of households are inclined to dump it. The prevalence of such irresponsible MSW disposal practices are more pronounced among poorer households, and those of the Black and Indian populations. More than half of Sobantu's households and almost a third of Imbali's households burn their solid waste. Although illegal dumping was not rife, it was carried out primarily by households in Northdale and in Imbali. Almost a quarter of the sampled households burn their garden waste and still another quarter illegally dumps it. Again, this was most noticeable in the poorer socio-economic communities that were predominantly of Black and Indian origins. However, it was encouraging to note that just over a quarter of the sampled households engaged in composting of garden waste, where the Black and Coloured populations were the most proactive.

Most households indicated that illegal dumping and littering should stop and government fines for such offences would be welcome. Ironically, more than half of the survey respondents admitted to littering at some stage or the other. Littering was more prevalent among the Black and Indian race groups and was more common among the lower socio-economic suburbs.



The nature of household MSW in terms of quantity and composition will be discussed only briefly here as outcomes of the questionnaire survey. This aspect of solid waste will be critically analysed in a more comprehensive discussion of the outcomes of the household MSW assessment presented in Section 4.7. It would suffice at this point to acknowledge that most of the sampled households (84%) have the municipal recommended refuse bags of between one and three per bags a household per week. Generally, this quantity of refuse does not include garden waste, but it is not exclusive to “kitchen” waste as some households do get rid of leaves and grass by including them in refuse bags that are picked up by the municipality’s waste department. One wonders whether this “black bag syndrome” is perceived by households as an “out of sight, out of mind” concept when dealing with the issue of managing household solid waste.

With reference to the composition of household MSW, the most prevalent types of solid waste were found to be paper and plastic, followed by perishables. Although paper and plastic tend to be lighter than perishable waste, they occupy greater volume and do not degrade as easily. It was found that paper and plastic formed the bulk of household solid waste among all race groups and across all socio-economic suburbs. However, it was noticeable that perishables were of a far lesser quantity in the Black households and in the poorer suburbs. The Indian and White households, especially in Northdale and in Chase Valley, had the higher percentages of perishables as a solid waste constituent.

The level of environmental awareness among households today was largely determined by the respondents’ knowledge of environmental measures to combat climate change and the impacts of littering on water bodies and animals. Although most of the households were aware of the negative impacts of littering and pollution on the environment, it was the White and Indian populations who were more environmentally aware. As far as the Kyoto Protocol was concerned, most households were unaware of this climate change mitigating mechanism, with the Black and the Indian populations being the least aware. This further highlights the finding that suburbs of lower socio-economic status are the least aware of environmental initiatives, and is possibly due to a lack of funds inhibiting the purchase of media aids such as the daily newspaper or television.

One of the most important objectives of the questionnaire survey, apart from socio-economic influences, was to determine if a correlation did exist between historic backgrounds and culture, which exerted substantial influence over attitudes and behaviour toward MSW and its disposal. Suburbs of lower socio-economic status which comprised predominantly of Black and Indian households were more prone to littering. It was also found that the Black and Indian households were more inclined to illegally dump and burn solid waste which included garden refuse.

Of important consequence to the above findings were the additional factors of education levels and employment status. Education is an important determinant of employment today, hence a determinant of poverty and household income. Education is by no means crucial to income-earned or employment, but is generally accepted as an influential factor, especially where it incorporates environmental sustainability as a lesson to be taught.

In order to promote environmental sustainability, government can enforce solid waste legislation through the passing of laws, but without the capacity to adequately monitor all sectors of society, it would be difficult to achieve the intended goal. To aid responsible solid waste management, the public should be encouraged to actively participate in practices such as solid waste reduction, recovery, reuse and recycling.

The data outcomes yielded by the survey with regard to mitigating negative MSW disposal methods and reducing MSW for landfilling, revealed that the majority of households across all suburbs and race groups were more than willing to recycle and separate their MSW. The Indian and Coloured households were the least in favour of recycling and household waste separation. Also, Chase Valley being the suburb of the highest socio-economic status in the study, was the least inclined to recycle for cash. This stands to reason as there are mainly high income earners in this suburb who may not be willing to sacrifice their time for a small amount of cash. Further, households displayed more enthusiasm to adopt these methods if cash values and incentives such as a rebate in rates were offered for their solid waste management efforts. The majority of households were also willing to use recycled material, thus indicating that the potential for a supply and demand market incorporating recycled products would be of a sustainable nature.

The NERLS is envisaged as having less than a decade before it is due for closure. It would be in the best interests of the public to actually increase the lifespan of the landfill site so that increased transport, fuel and staffing costs would not be additional costs to ratepayers. The municipality itself would benefit as the siting and engineering of a suitable landfill site is a lengthy and costly process which will have to be subjected to public approval. There were thirteen potential landfill sites selected by the Msunduzi Municipality in 2006, and to date all of these sites were met with strong public opposition which eventually resulted in the decision to try and continue extending the lifespan of the NERLS (Reddy, 2006; Naidoo, 2007).

The majority of the respondents, especially from those suburbs closest to the NERLS did indicate that the landfill site should be located away from residential areas. With the exception of households from neighbouring Sobantu, there was general consensus that the landfill site was not responsible for producing noxious odours or aiding vector proliferation. However, this does not absolve the NERLS from responsibly managing MSW in accordance with the permit regulations or the stipulated legislation for minimal harmful environmental effects. It was only the majority of the households in the suburbs adjacent to the landfill site that acknowledged its need, while others further away did not think that the site was a necessity.

The contradictory element to this investigation was the fact that the predominantly Black suburbs were more aware of the landfill site although they made the least use of it. The obvious question would then be: how else do the public envisage managing municipal solid waste? Incineration of MSW in South Africa is not a widely practiced method for refuse management. The majority of household respondents who believed that the landfill site was necessary for treating MSW were from the suburbs in the vicinity of the landfill site, namely: Scottsville and Sobantu. This serves to show that the public needs to be educated about the landfill site and its role in MSW management.

A further question that arises from an analysis of these responses is whether the households serviced by the Msunduzi Municipality fully aware of and properly understand what the New England Road Landfill Site is all about? There were only 272 (43.7%) out of the 622 households

surveyed, who admitted to at least being aware of the NERLS, and only 71 (11.4%) respondents who made use of the landfill site often to dump or collect solid waste.

A more in-depth analysis of the actual nature of MSW for landfilling from households in suburbs of differing socio-economic status will be discussed in Section 4.7. The objective here is to establish if there is a noticeable difference in the quantity and/ or composition of household MSW for suburbs of low, medium and high socio-economic status.

#### **4.7 Assessment of household municipal solid waste for landfilling**

The results and analysis of the assessment of household MSW for landfilling was conducted at the New England Road Landfill Site (NERLS) as a municipal solid waste qualitative assessment. All inferences made toward solid waste and the NERLS will pertain to the scope of the Msunduzi Municipality. This assessment as explained in the methodology is simply narrower in focus and more concentrated in area as opposed to a Life Cycle Assessment (LCA), though it does operate on the same principles of tracking waste from source to disposal, still allowing for comprehensive results even if the cycle is at any stage of the ‘cradle-to-grave’ approach.

The MSW analysed for this assessment is solid waste which is generated at the household level and results in its disposal onto the landfill site. This would include the general solid wastes such as meat and vegetable off-cuts, spoilt food, all types of oil, paper, plastic, cardboard, glass and metal. Together with these and possible garden waste; unwanted household items such as crockery, batteries, electrical appliances, toiletries and cleaning liquids become fractions of MSW as they are disposed of onto a landfill site.

It can therefore be said that MSW in this context includes hazardous and toxic household, commercial and industrial waste that is disposed of at a landfill site; either knowingly or unknowingly by the general public. The scope of this assessment has been limited to the MSW generated on a household level, hence focusing on the objectives of household solid waste management.

The MSW assessment in this context is the process of physically sorting household solid waste or refuse into specific categories or types. The quantity of solid waste is of importance, but to a lesser extent here as greater emphasis is placed on the types of solid waste prevalent in various households, hence the reason for trying to establish the general percentages of the different categories of solid waste material that enters the landfill site. This objective also allows for future investigative procedures into recycling opportunities by waste type. The NERLS accepts approximately five hundred tons of MSW a day and a further two hundred tons of cover material that is required to cover the working face of the landfill site on a daily basis (Raghunandan, 2005; Naidoo, 2007).

The primary outcome of this undertaking was expected to be reflective of the lifestyles of the differing socio-economic groups, thus allowing for correlations to be made between socio-economic status and the types of solid waste produced. There were three suburbs in the Msunduzi Municipality which formed the scope of this aspect of the study and were indicative of solid waste produced in households of low, medium and high socio-economic status. MSW is collected per suburb, and often involves more than one municipal truck load of refuse collection from large suburbs for disposal onto the landfill site. This enhanced the process for logical inferences to be made with regard to MSW disposal practices for suburbs of varying socio-economic status.

Together with the questionnaire survey analysis presented above, the results of the assessment of household MSW for landfilling will be indicative of the quantity and composition of solid waste produced by Msunduzi's households, thus allowing for logical deductions to be made about recycling incentives and initiatives that can be suburb-specific for greater viability in the effort to soundly manage solid waste, thereby reducing the need for natural resources, aiding environmental protection and lessening the contribution towards global warming. The assessment of household MSW for landfilling will hereafter be referred to as "HAMSW" as indicated above.

#### **4.7.1 The operational characteristics and associated constraints of the landfill site**

At the very outset, it becomes necessary to explain the operational characteristics and constraints that governed this investigative research process, where public health and safety in keeping with stipulated landfill legislation formed the key consideration.

The HAMS<sub>W</sub> was conducted over a timeframe of one working week at the NERLS. This almost exclusively entailed physically sorting through MSW at the landfill site. Five unemployed persons from the neighbouring Sobantu settlement were employed by the researcher to physically sort the waste into different solid waste components of glass, metal, paper and cardboard, plastics, and perishables. These employees known as research field workers were briefed on what was expected of them and the reasons for the project. Hereafter, they were supervised by the researcher and the NERLS manager. The research was carried out in the recycling bay of the NERLS as shown in Figure 4.11 and the suburbs under analysis for the nature of MSW for suburbs of varying socio-economic status were Westgate, Northdale and Chase Valley.



**Figure 4.11: Municipal Solid Waste at the New England Road Landfill Site’s recycling bay for the assessment of household solid waste (Govender, 2006).**

Westgate is considered a low income suburb. Northdale and Chase Valley are middle to high income suburbs respectively, with the former also containing a substantial number of low income households. The preference for analysing Sobantu’s MSW could not be achieved as each day in the week is allocated to specific suburbs in the Msunduzi Municipality for refuse collection. The fact that the MSW of the other suburbs were already lying uncovered at the recycling bay of the NERLS posed as a health hazard to the general public in its vicinity. Also, the landfill site manager himself did not know when to expect a MSW load from Sobantu, due to its waste collection being privately contracted out for safety and security reasons, given the volatile nature of and high criminal activities in the area. The low socio-economic suburb of Westgate was then chosen for the analysis of MSW. Table 4.24 gives an account of the waste tonnage and weigh bridge details for each of the suburbs of study.

**TABLE 4.24: Weigh bridge details reporting on the solid waste tonnages for assessment**

| <b>Suburb</b> | <b>Tonnage</b> | <b>Date and transaction records</b>               |
|---------------|----------------|---|
| Westgate      | 9 460kg        | 10 July 2006<br><i>transaction number: 460744</i> |
| Chase Valley  | 8 530kg        | 11 July 2006<br><i>transaction number: 460932</i> |
| Northdale     | 7 530kg        | 12 July 2006<br><i>transaction number: 461082</i> |

There were various constraints that governed the nature of such an assessment. Due to the volume of solid waste and the legal requirements for the handling of such waste (including public health and litter hazards), considerations such as human capacity, financial constraints and the safety of field workers were restrictive factors that need to be acknowledged. However, the necessary health and safety precautions were complied with as proper working gear was provided to those tasked with the physical sorting of the waste; with the exception being that MSW was left uncovered for a week at the landfill site. The fact that the waste analysis was being conducted at the recycling bay instead of the work-face of the landfill site alleviated a considerable amount of safety and security issues for those involved in the physical analysis. The

landfill site manager did however find himself answerable to DWAF when a nearby resident complained that MSW left uncovered for more than a day at the site defies the landfill site permit regulations and does pose as a health risk to the general public.

An attempt to verify at least two years of the daily MSW tonnage figures and that of the cover material as stated above proved futile. There is no electronic administrative system that records weigh bridge transaction numbers and respective tonnages that can be easily accessed at the landfill site or at the municipality itself. Hard copies are simply filed into lever arch files and archived. The administration offices at the NERLS collect approximately a month and a half's of weigh bridge bills at any given time.

To reiterate, an absolutely important point to note is that there is no proper filing system or Information Technological administrative system at the NERLS. It was quite clear that there are no checks in place to ensure that the weigh bridge bills are being correctly filed, or that there are none missing. Sarupen's Transport is the contractor who provides the cover material on a daily basis and because this company needs to be compensated for the supply of cover material, its weigh bridge bills are filed separately. Furthermore, the office operating hours and landfill site times are from 07h00 to 16h00 on weekdays; and from 08h00 to 15h00 on weekends and public holidays. As a resident of the Msunduzi Municipality, the researcher has observed that there are not odd, but frequent occasions where the refuse bags have been collected well after 16h00. Needless to mention, that the dogs merely exacerbate the problem of litter when this occurs by tearing bin bags left on pavements for collection.

Valerie Skinner of Lincoln Meade had her problem highlighted in *The Mirror* (16 July 2008 p3) by reporter S. Dhlamini where the Waste Department does not collect her refuse bags for weeks on end until she telephones them or disposes of it herself. The article further includes a response by the Msunduzi Municipality's spokesperson, stating that they apologise and will collect Ms Skinner's rubbish, adding that her gate not being very visible from the road as the reason for not collecting her MSW each week.



The NERLS does not comply with its permit as MSW is brought to the landfill site after 16h00 daily (discussed further in Chapter 5). There are no formal records of these waste tonnages except for the reflection of overtime pay on time sheets that municipal staff may claim. This has frequently been cited as an incentive to work late (Naidoo, 2007). The weigh bridge is not operational outside of the given working hours of the landfill site on weekdays or on weekends and public holidays, which would account for discrepancies in accurate waste tonnage reflections. Nevertheless, analyses based on the nature of MSW can still be conducted to facilitate correlations that may or may not exist within this context. A discussion on the HAMSWS follows below. All percentage estimations of the varying solid waste types will be expressed according to the volume occupied and not by weight or mass. This is mainly due to the fact that the municipal vehicles that could have assisted with this task were inoperable at the time and that it would have been impractical to transport MSW out of the landfill site to weigh it elsewhere.

#### **4.7.2 The qualitative assessment of municipal solid waste for landfilling**

As mentioned above the HAMSWS incorporates quantifying and classifying various types of household solid waste for three suburbs of varying socio-economic status in the Msunduzi Municipality. These suburbs of study are Westgate, Northdale and Chase Valley that comprise mainly of low, medium and high income households respectively. The tonnages of MSW for each suburb received at the landfill site did result in time and financial constraints, as willing human resources were few and employed at the same rate that the local municipality offered for temporary landfill site staff at the ground level. The primary reason for choosing three suburbs for this analysis instead of the five suburb areas of study for the survey was to highlight the relationship (if any) between the socio-economic status of suburbs and the nature of the MSW stream produced. It is for this reason that the three suburbs of distinctly varying socio-economic status were chosen.

The total quantity of MSW that was received for Westgate on the 10<sup>th</sup> of July 2006 was 9 460kg. It was observed that garden waste in the form of leaves and small branches contributed to the solid waste stream for this suburb and did not account for sufficient quantities to be included as a separate solid waste type. Further, a sizeable quantity of soiled baby diapers was observed with both urine and faecal matter. The quantity of miscellaneous items such as beauty products and perfume aerosol cans was of a negligible quantity.

In contrast to the above, miscellaneous solid waste such as brooms, mats and buckets (Figure 4.12) were found in Chase Valley's MSW, where the total tonnage received at the landfill site on the 11<sup>th</sup> of July 2006 amounted to 8 530kg. The garden waste for this suburb was barely perceptible, whilst the quantity of baby diapers was very noticeable – although it was estimated to be almost half of the diaper quantity found during Westgate's analysis. There were general household items such as detergents and cleaning material, beauty products and cutlery in Northdale's miscellaneous MSW, and was inclusive of the total of 7 530kg that was received at the landfill site on the 12<sup>th</sup> of July 2006.



**Figure 4.12: The miscellaneous household items inherent to Chase Valley's refuse (Govender, 2006).**





The garden waste that was observed in household bin bags in the form of leaves and grass from Westgate and Northdale was a small fraction and as such was included with the perishable waste fraction. Due to the large amount of garden waste that is prevalent in Chase Valley because of its vast greenery and expansive gardens and the fact that this is a suburb of high socio-economic status, it would be safe to assume that householders take their garden refuse to proper disposal sites or hire contractors to do so as no garden waste was present in the suburb's MSW.

The above discussion pertains to miscellaneous and garden household solid waste. However, the analysis for this assessment was predominantly based on the four major types of MSW at a household level, namely: glass and metal; polystyrene and plastic; cardboard and paper, and perishables which are listed in a comparative table format in Table 4.25. These waste types are usually found in bulk in MSW for disposal at the South African landfill sites, and are also more importantly, recyclable.

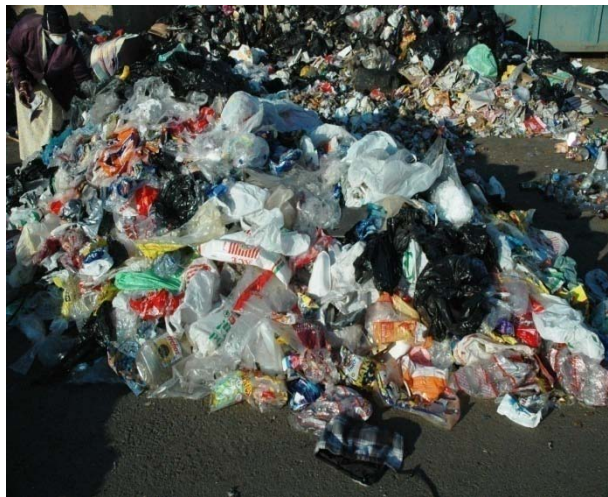
Although perishables, glass and metal occupy the most weight, it is the volume of solid waste which affects the capacity or lifespan of a landfill site. Therefore, the quantities of polystyrene, plastic, cardboard and paper are important when determining the volume that they would occupy on the landfill site. These items together with glass and metal are also extremely slow to degrade in comparison to perishables (Page, 2008). It was recently found that the print on newspaper found at the NERLS dating back to sixty years was still legible (Pather, 2007).

The results of the HAMS as depicted in Table 4.25 (and shown in Figure 4.13) clearly indicate that plastic and polystyrene form the bulk of household solid waste across the scope of the study, with an average figure of 55%. The volume of this solid waste fraction was considerably lower in the suburb of higher socio-economic status, Chase Valley. The smaller solid waste fraction of glass and metal amounted to an average of 10% and does not occupy a high volume here. This waste type is also highly recyclable and metal holds the most demand, and fetches the highest price from recyclers.

**TABLE 4.25: Results of the analysis of household solid waste for landfilling**

| Solid waste type   | Westgate  | Northdale  | Chase Valley   |
|--|---|--|--|
|  <p><b>Glass/ Metal</b></p>             | <p>10% = mainly glass alcohol bottles and tinned food. This MSW fraction was equivalent to that of Chase Valley's but lesser than Northdale's, except that the contents differed.</p>                     | <p>15% = mainly glass alcohol and sauce/ pickle bottles, and tinned food and perfume. The MSW here was one a half times greater than the others.</p>                               | <p>10% = mainly glass alcohol bottles and food sauces. Metal cans were that of animal food and infant milk and of a lesser percentage than Westgate.</p>   |
|  <p><b>Polystyrene and Plastic</b></p> | <p>60% = bulk of MSW volume. Consisted largely of crisp packets and shopping bags used to discard food. Many surgical gloves were noticeable. Polystyrene was mainly from packaging of meat products.</p> | <p>60% = bulk of MSW volume, comprising mostly crisp packets and juice bottles as well as consumer shopping bags used as bin bags. Polystyrene was far lesser than Westgate's.</p> | <p>45% = bulk of MSW but considerably lesser in volume than that of Westgate and Northdale. Comprised mainly of general plastic waste and not any noticeable bulk of a particular group of products.</p> |
|  <p><b>Cardboard and paper</b></p>    | <p>7% = MSW fraction of general unmarked cardboard packaging. Minimal quantity of actual white/news paper was observed.</p>   | <p>15% = MSW fraction mainly of fast foods and appliance boxes. More newspaper than white paper was observed.</p>  | <p>28% = MSW fraction mainly of fast foods such as pizza boxes. A minimal quantity of white/news paper was observed.</p>   |
|  <p><b>Perishables</b></p>            | <p>23% = mainly large quantities of spoilt cooked maize meal and a lesser quantity of meat off-cuts.</p>  | <p>10% = mainly meat off-cuts and vegetable waste, with a lesser quantity of cooked spoilt food.</p>   | <p>17% = mainly meat off-cuts and vegetable waste. The quantity of spoilt food was almost imperceptible.</p>   |

Cardboard and white or news paper averaged 14% but was seen to almost double in quantity each time as the waste from the lowest to the highest socio-economic suburb was analysed. This is indicative of the affordability of higher income households to purchase small luxuries like the daily mail or utilise white paper for personal or business use in their homes. Perishables which are usually compostable averaged 16% and consisted mainly of spoilt food (mainly Westgate) and meat off-cuts. There were not much vegetable off-cuts noticed except for those predominantly in Northdale's waste.



**Figure 4.13: An indication of the volume of plastic waste produced by Northdale's residents (Govender, 2006).**

It is evident from the results derived from this analysis that there is not much of a distinctive correlation between the quantity of MSW produced and the socio-economic status of a suburb. However, there is evidence of a conclusive link between the composition or type of MSW produced and the socio-economic status of households. This can be summarised as the finding that plastic is more prevalent in the low and medium income suburbs, whilst glass, metal, cardboard and paper are to be found in greater quantities in the medium to high income suburbs. The quantity of perishables varied across the suburbs, but one needs to be mindful of the type or nature of the perishables.

The results indicated in Table 4.26 showed that the metal cans in Chase Valley consisted almost exclusively of animal food and infant milk. The fact that most low to medium income households struggle to actually buy infant milk, let alone afford canned animal food points to the availability of consumer purchasing power accorded by higher disposable incomes. The metal food cans in Westgate's waste (Figure 4.14) could possibly be linked to affordability as lower income households do not have excessive amounts of disposable income to purchase bulk quantities of meat or other produce throughout any given month.



**Figure 4.14: The photograph on the left depicts glass bottles while the photograph on the right shows empty food tins during Westgate's refuse analysis on 10 July 2006 (Govender, 2006).**

The sauce and pickle bottles of glass origin in Northdale and Chase Valley once again indicate that the higher income bracket households are able to afford these items which are condiments and can be classified as consumer luxuries. The presence of alcohol bottles were found in the glass waste type across all suburbs but those found in Chase Valley's waste were observed as belonging to the more expensive categories and were greater in number of individual concentrated liquor bottles.

The large volume of plastic waste could not be discerned into any specific type or value except for the fact that consumer shopping bags were often used as refuse disposal bags in the low to medium income suburbs. The presence of crisp packets was highly noticeable in Westgate's and Northdale's wastes, with plastic juice bottles increasing this waste type for the latter suburb (see

Figure 4.15). The packaging of crisps and juice bottles indicate small luxuries for the consumer or households, where affordability need not be compromised as the cost of these items are usually low.

A considerable quantity of polystyrene packaging was noticed in Westgate's waste as compared to the other suburbs, and was mainly the packaging of meat products as meat off-cuts were found wrapped in them. A possible explanation could be that as mentioned previously, the predominantly lower income households in this suburb would find it difficult to purchase meat in bulk quantities and would therefore prefer to buy smaller quantities which are generally packaged in polystyrene and plastic at affordable prices at local supermarkets and butcheries.

The percentage of cardboard ranged considerably in quantity and composition across all suburbs. The most distinguishable point here is that the cardboard found in Chase Valley's waste was mainly pizza boxes – a luxury afforded mainly to households of higher disposable incomes.



**Figure 4.15: The photograph on the left shows the volume of plastic waste and the photograph on the right depicts the glass bottles and metal cans found in Northdale's refuse (Govender, 2006).**

The most astonishing and unexpected observation was that the largest fraction of perishables belonged to Westgate. However, it consisted largely of discarded maize meal which is a staple diet of the Black population and is also used as a cheap component of food for animal pets. Although perishables occupy mass, the volume occupied is usually lesser due to its high

decomposition rate. There were more meat and vegetable off-cuts found in the solid waste of Northdale and Chase Valley.

The results are more or less in keeping with the findings of the questionnaire survey. As depicted in Table 4.4, households indicated that paper and plastic formed the bulk of their MSW followed by perishables. Of further consideration is the fact that households in Chase Valley may not have much paper waste as paper collection recycling bins have been placed in the area at convenient points, such as those near the Cascades Shopping Centre and at the Pick and Pay service entrance at the Midlands Liberty Mall. One has to be mindful of such influences when correlating data outcomes.

According to DEAT's Report on the State of the Environment (2007 p261), an analysis of the waste produced per person per day for the year/s 2004/2005 indicated that domestic waste increased as the levels of income increased due to higher consumption patterns of affordability. Unfortunately, an equivalent correlation cannot be made here due to the fact that a suburb analysis was conducted based on the generalisation that each suburb is classified according to the socio-economic criteria of the predominant households that occupy it; that is: a greater number of low, middle or high income households. However, future follow-up studies in KwaZulu-Natal would be an excellent reflection of the actual state of MSW management here as most studies are generally conducted in Gauteng or Cape Town due to readily available statistics. In December 2004, the Gauteng Department of Agriculture Conservation and Environmental Affairs published a report noting that the average South African generated at least 480 kilograms of waste per annum. The Msunduzi Municipality was said to generate approximately 400 tons of MSW per day (Templehoff, 2005). There is no doubt that these figures have definitely increased in the past two years.

One of the most limiting factors for this assessment was that the tonnages of household refuse for each suburb of study could not be easily verified as it was not recorded on the weigh bridge invoices or bills which suburb a load was from each time it was brought in by a municipal vehicle, and there could be two or more loads for large suburbs. The landfill site manager usually has an idea as to which suburbs will have their MSW collected on a specific day of the week due



to the municipal arrangement of allocating each day of the working week for refuse collection from specific suburbs. Private vehicles are also contracted to collect refuse from difficult or hard to access areas (as mentioned previously) and these are usually recorded as payments requested for these contractors. Further conclusions are based on the municipal trucks (by number plate) that frequent a particular suburb. As can be seen there is really no conclusive or accurate statistics to work with in this instance, hence the tonnages reflected in Table 4.24 cannot be considered as the final figures for any particular suburb, especially since large suburbs like Northdale would require more than two trips for refuse removal.

It would suffice to conclude that the correlations drawn between the socio-economic status of suburbs (or the households therein) and the composition of MSW is reasonably more conclusive than the correlations between the quantity of MSW and the socio-economic status of suburbs. The outcomes of the assessment for household solid waste destined for landfilling have served to enforce the fact that MSW composition is dependent on the socio-economic status of households. It cannot be proven with certainty as an outcome of this assessment whether culture influences the nature of MSW generated at the household level. A more plausible explanation would be that the nature of household MSW is more dependent on the availability of disposable incomes which determine consumer spending (Cointreau *et al.*, 1985). The type of consumer purchases would then be dependent on lifestyles adopted and cultural tendencies.

Alternate sampling methods with equivalent representation of race groups and households per suburb can be implemented to further enhance future research. The study can be extended to include all sectors of society such as informal settlements and rural areas to enhance the investigation into solid waste management in the country. However, the study does reflect on the attitudes and behaviour of people from differing socio-economic and cultural backgrounds toward MSW that is more or less in keeping with representivity of the race groups constituting South Africa's population. If the NERLS and the Msunduzi municipal solid waste division had proper record keeping and made these statistics available, it would have greatly enhanced the study by indicating whether the quantity of MSW is directly proportional or not to socio-economic status. The sampling criteria for the survey were purposively selected for the objectives of this study based on the knowledge that MSW was being increasingly poorly

managed (comparative to previous years) in the Msunduzi Municipality and the fact that most households openly practiced dumping and illegal burning of MSW.

Chapter 5 will entail an analysis of the secondary data collected for the study, namely waste management policies in review, focusing on the legislation that governs landfill sites in South Africa; and presenting a critique of the New England Road Landfill Site to highlight MSW management policies in review from a local perspective. Analyses from the findings of available audit reports and the outcomes of the interviews with key MSW management personnel will also be used. Chapter 6 will be a comprehensive discussion of the collective outcomes of the research methodology, and the concluding Chapter 7 will report on whether the aims and objectives of this research study have been determined and adequately substantiated, preceded by a concise summary of the study in its entirety.

# CHAPTER 5

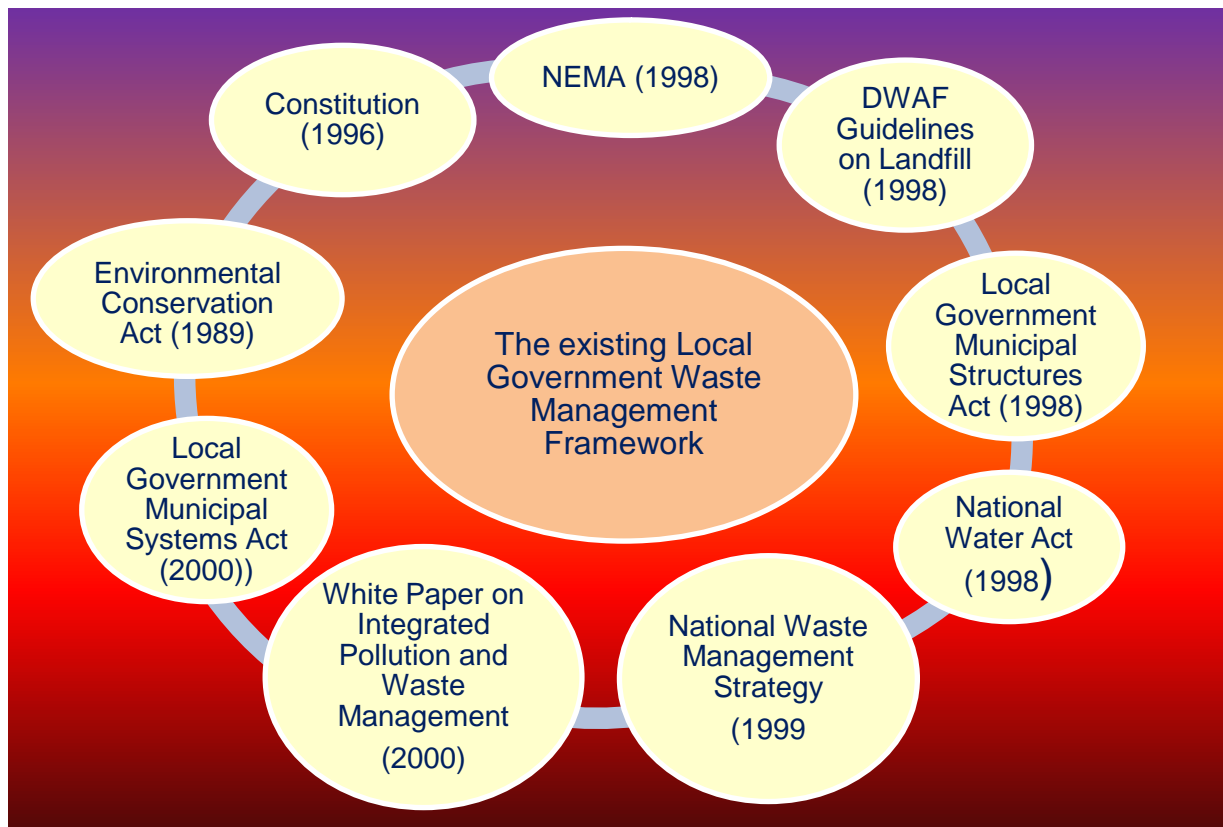
## WASTE MANAGEMENT POLICIES IN REVIEW: A CRITIQUE OF IMPLEMENTATION AT A LOCAL LEVEL

### 5.1 Existing legislation and policies pertinent to municipal solid waste

MSW impacts both directly and indirectly on human and environmental welfare and can have detrimental consequences on human health when poorly managed through the proliferation of vectors such as rats and flies, and the spread of disease through the contamination of natural sources such as air, soil and groundwater. The continually increasing volumes of MSW further compounds environmental problems such as global warming and climate change through the release of methane gas upon its decomposition, especially at landfill sites. However, through the responsible management of MSW including recycling, mechanisms for poverty alleviation can be created for the poverty-stricken. Service delivery can be improved by converting landfill gas (methane gas) to augment the electricity network, and other positives include composting organic waste into a saleable product.

The question which arises is how the South African government policy is transposed into legislation, and how this is then applied and enforced so that the compliance necessary for responsible MSW management can be achieved. This aspect is particularly important in that, while compliance can be enforced within the private sector, it is much more complex within the public sector – all the more so in that most sanitary landfill sites are administered by the public sector domain. Legislation needs continual monitoring, thus advocating the need for stringent control measures for on-going assessments and revision. At the same time, threatening the only sanitary landfill site in a metropolitan region with closure (as has been done in the past) is clearly not a viable solution.

South Africa has made great strides in terms of environmental legislation since the 1980's by placing increasing emphasis on environmental sustainability and the subsequent introduction of comprehensive environmental laws and regulations to simultaneously protect the environment and the public (Paralegal Advice, 2002; Visser, 2005). The most influential and widely referred to MSW legislation thus far has been the Environment Conservation Act No 73 of 1989, the National Environmental Management Act No 107 of 1998 (NEMA) and the Municipal Services Act No 32 of 2000. These are augmented by DWAF's guidelines for The Minimum Requirements for Waste Disposal by Landfill (1998) together with the White Paper on Integrated Pollution and Waste Management for South Africa (2000), which still continue to exert considerable influence on MSW as a waste management policy (DEAT, 2000). The yet to be formally legislated Waste Management Bill of 2007 is envisaged as legislation that will have a tremendous influence on the generation and management of MSW in the country.



**Figure 5.1: Existing Local Government Legal Framework for Waste Management (after Du Plessis, 2008).**

The existing legal framework for solid waste management at the local government level can be reviewed according to the components given in Figure 5.1, which detail the specific impacts of legislation on MSW in South Africa, but will be analysed here predominantly from the perspectives of NEMA (1998), the Minimum Requirements for Landfill (1998), and The White Paper on Integrated Pollution and Waste Management (2000) as this study does not focus on a comprehensive discussion from a legal perspective. These are the most pertinent MSW policies and practices that will be discussed along with other policies and laws, highlighting the key areas of concern in terms of environmental legislative frameworks.

The Environmental Conservation Act (1989) specifically stipulates the guidelines governing litter removal, the issuing of landfill site permits by DWAF for waste disposal, and the general duty of care to prevent pollution. Prior to 2006, the responsibility of issuing landfill site permits lay with DWAF, and this responsibility was transferred in 2006 to DEAT. The National Water Act (1998) outlines the implications for negligent local governing authorities who allow solid waste to contaminate surface or ground water. NEMA (1998) is a comprehensive environmental law detailing aspects relevant to MSW such as the polluter-pays principle; and preventative and remediation methods for pollution and environmental degradation. NEMA also deals with issues of co-operative governance, including the new EIA regulations which it promulgates. The EIA process for new landfill sites often forms part of the application procedure. One of the most widely used and publicized national MSW guidelines is DWAF's Waste Management and The Minimum Requirements for Waste Disposal by Landfill (1998), which specifies the legal routes to be followed for municipal solid waste disposal by government authorities, industries, and commercial outlets. The Minimum Requirements for Landfill (1998) also provides an informative background on solid waste and suggests responsible behaviour that individuals and households can practice to manage their MSW in the interests of human and environmental health and safety. This is further enforced by the White Paper on Integrated Pollution and Waste Management (2000) which clearly outlines the integrated general waste management plans for municipalities, advocating adherence to solid waste minimization policies; while creating public awareness and maintaining a waste information system that fosters recycling initiatives with voluntary industries. This White Paper is a subsidiary policy of the overarching national environmental policy supported by NEMA. The Local Government Municipal Systems Act

(2000) further enforces policies that require municipalities to provide equitable solid waste services in a financially and environmentally sustainable manner. It also incorporates guidelines for incentives and penalties regarding the recycling of solid waste (du Plessis 2007).

It must be reiterated that the roles of DWAF and DEAT in the co-operative governance and management of landfill sites relative to the protection of water and environmental resources in South Africa are imperative for environmental sustainability and for the well-being of the country's citizens. The responsibility of DWAF in this context lies in ensuring that MSW is responsibly managed so that it has minimal impact on the national water resources, of which it is the custodian (see the National Water Act 36 of 1998; DWAF, 2005; Reddy, 2007). The Minister of Environmental Affairs and Tourism is responsible for the issuing of a landfill site permit (concurrent with the Minister of Water Affairs and Forestry), thus allowing it to be the body of authority for specified guidelines for solid waste disposal (DWAF, 2005; Reddy, 2007). Therefore, compliance with legislation such as the Minimum Requirements for Waste Disposal by Landfill (1998) becomes imperative when managing MSW at a provincial and local government level.

The aim here is not to provide a legal treatise of existing MSW legislation, but rather to provide a brief overview of those laws and policies that have a greater degree of influence on MSW and its management predominantly at the local level; as also to review their effectiveness in the light of the data outcomes presented in Chapter 4.

The Polokwane Declaration on Waste Management in 2001 saw the South African government adopt a serious stance to reinforce solid waste management systems in addition to existing legislation that incorporate aggressive recycling for environmental protection and human welfare (DEAT, 2007d). One of the key decisions taken by the South African government departments at all levels was to try and reduce solid waste generation by 50% by 2012 through encouraging efforts in terms of re-use and recycling of waste. Unfortunately, nothing constructive in terms of implementation resulted from the pledges made at the Polokwane Declaration (DEAT, 2001).

The United Nations Framework Convention on Climate Change (UNFCCC) formed at the Earth Summit in Rio de Janeiro in 1992, is an international pledge to mitigate climate change and environmental degradation signed by 154 countries. Although it did not by virtue of its existence initiate change, it was the precursor to the Tokyo Summit which saw the ratification of the Kyoto Protocol to reduce global warming through greenhouse gas reductions, and set the scene for the subsequent decisions taken at the World Summit on Sustainable Development in Johannesburg during August 2002 that propelled the governments of the world into more notable action.

South Africa has one of the best environmental and solid waste legislative frameworks in the world. Unfortunately this is not the case in terms of policy implementation and practice as shown by the data outcomes in Chapter 4, due to a lack of compliance, enforcement, and monitoring. The reasons are many, some of which include human resources through a shortage of skilled staff, insufficient or inappropriately allocated operating budgets from national and provincial government, apathy towards non-compliance by local government, and so forth (Costley, 2007). Therefore, the critical issue in this regard pertains to the measures and checks that are currently in place to ensure that legislation is being correctly implemented and that policies are being effectively practiced at the local levels of MSW management.

The New Waste Management Bill (2007) was formulated with the intention to rectify these shortcomings and implement more control and monitoring measures, while stipulating stricter law enforcement and sustainable solid waste management practices that are applicable to both government and public. This will be discussed briefly below. This Bill together with NEMA (1998) will serve as the most influential legislation governing MSW at the local and national levels. The basic principles of NEMA (1998) also include environmental education as a priority, not just for the public, but also for government officials and state corporations such as Eskom (Paralegal, 2002). In conjunction with NEMA (1998), the Environment Conservation Act 73 of 1989 still serves to enforce legislation pertaining specifically to aspects such as littering and waste management (Paralegal, 2002).

## 5.2 The new Waste Management Bill (2007)

The New Waste Management Bill (2007) which is yet to be gazetted after public comment is the envisaged legislative measure that will have a direct influence on municipal solid waste management. For the sake of brevity it will hereafter be referred to as “the Bill.”

The Bill encourages public participation in solid waste decision-making processes, with additional attention focused on the reduction of solid waste generation by the public through recovery, reuse and recycling. It makes provision for aspects such as litter management and waste management through the suggestion of the appointment of environmental officers to ensure compliance (Costley, 2007; du Plessis, 2007). The Bill has been structured to include set tariffs and profit structures, placing greater responsibility on *producers* of solid waste so that management does not become a mere end-of-pipe solution.

The controversy that surrounds the Bill essentially points to the fact that, although it comprehensively advocates MSW minimization measures such as recovery and recycling, it lacks clarity and hinders public/ private management initiatives by imposing stringent rules for mitigating measures. This creates doubt and allows for concerned individuals and organizations to be wary of wanting to practice or promulgate MSW recovery and recycling initiatives on local and national platforms (Muir, 2007).

The issue of contention here is not whether the Bill makes provision for sound or sustainable MSW management, but whether it has enough evaluative, control and monitoring measures in place to ensure that its implementation by local municipalities will be according to strict adherence and enforcement to result in a significant change in the way MSW has been and is currently being managed in the country. The argument is that new waste legislation should adequately address issues of non-compliance and the violation of MSW laws and policies by having checks in place together with supportive legal structures so that the lack of prosecution for non-compliance offenders in the past does not repeat itself into the future.



The Bill also needs to be clearer with definitions and clauses. For example, on page 11 of the Bill, waste emanating from healthcare institution has been included in the definition of “domestic waste.” Healthcare waste is generally classified as hazardous waste that is managed through incineration or at a hazardous waste site. The Bill states that the “Minister must establish mechanisms, systems and procedures for giving effect to the Republic’s obligations in terms of international agreements” as well as formulating national norms for service delivery whilst promoting co-operative governance and public awareness, which is fundamental in ensuring continual compliance (DEAT, 2007e). At this stage it is not transparent as to how or when the Minister of Environmental Affairs intends to achieve this as the Bill has been in discussion and review for almost two years already.

One of the most important objectives of this Bill is the formulation of a process to identify and effectively handle the ill-effects of poor waste management practices on the health of the country’s citizens and on the environment. Furthermore, in Part 4 of the Bill, a suggestion is made though not binding, that a tracking system for the transportation of waste be instituted to prevent illegal dumping. The fact that municipalities don’t have enough vehicles at present or sufficient operating budgets to timeously repair inoperative vehicles (as was shown to be the case for the Msunduzi Municipality), leaves the success of the process of tracking transported waste open to debate.

In terms of the general powers and duties of municipalities in section 16 (e) of the Bill, which states that each municipality must provide for the management and collection of litter, there is no clear prescription – it is assumed that the frequency of such measures will be determined by the municipal authority and it is assumed that the collection of litter on national highways and roadsides will also be the responsibility of the municipality it services.

The Bill clearly states in Section 15 (e) that waste disposal should be the last resort where the recovery, reuse and recycling of solid waste would receive preference. One needs to understand that unless legislation is seriously enforced in the next five years, the policies stipulated by the Bill will not be adhered to for at least a few decades to come as the results from the questionnaire survey given in Chapter 4 indicate that the public will not voluntarily follow these measures.

This can be attributed to socio-economic and cultural influences that still suffuse the attitudes and behaviour of people toward MSW practices. In this regard, it is also incumbent upon government to ensure that adequate waste facilities exist in terms of engineering design, equipment and human resources so that solid waste management strategies can function optimally.

Section 21 (2) of the Bill states that a person is not allowed to recycle, reuse, recover or treat waste unless it is in accordance with the measures prescribed by the Bill itself. This may be misconstrued by the ordinary citizen through a lack of understanding as solid waste measures that may lead to prosecution if incorrectly practiced. Also, the Bill advocates equitable waste removal services to everyone and this therefore includes informal settlements which do not currently receive regular or adequate refuse removal services as previously outlined. It is envisaged that once the Bill has been formalized and legislated, a further analysis can be done to determine if the controversy has been eliminated or minimized and whether a greater degree of clarity and division of duty can be noted.

### **5.3 The case study of the New England Road Landfill Site**

Every municipality or city should ideally have at least one major sanitary landfill site to safely dispose of its MSW. The New England Road Landfill Site serves the Msunduzi Municipality and the surrounding areas of Hilton, Greytown, Ashburton and Vulindlela; and is considered to be a regional site. This landfill site situated in the residential suburb of Hayfields has been viewed as an economic benefit to the city and to the ratepayers of Pietermaritzburg due to its centrality and location within the city boundaries (Raghunandan, 2005). The site itself is 33 hectares with actual landfilling currently occurring on 25 hectares of the site. There are 4 weigh bridges operating at the site since 1995, generating income for the municipality by virtue of its tariff structure for the different types of solid waste disposed of by households, light commercial and industrial businesses. Section 84 of the Local Government Municipal Structures Act (No 117 of 1998) explains that district municipalities are responsible for local solid waste management functions, and this would then be the responsibility of the Umgungundlovu District Municipality

who has been at loggerheads with the local Msunduzi Municipality over the management and responsibility of the New England Road Landfill Site (Reddy, 2007). However, under such controversial circumstances, the Local Government Municipal Structures Act allows for the Minister of the Executive Council to adjust the division of functions and powers between district and local authorities.

The insight gained from the data presented in Chapter 4 enables the New England Road Landfill Site (NERLS) to be assessed in terms of the legislation that governs it and to be contextualized in accordance with the views of Pietermaritzburg's residents. The critique will be based directly on the contents of the NERLS permit 16/2/7/U203/D3/Z1/P64 which was amended in 1989 in accordance with the Environment Conservation Act 73 of 1989 by the Department of Water Affairs and Forestry (DWAf). The former Pietermaritzburg-Msunduzi Transitional Council remains the permit holder for this landfill site. The intention here is to highlight the discrepancies that may and do exist between national Municipal Solid Waste legislation and the actual implementation of policies and practices at local government managerial levels.

The NERLS is classified as **G:L:B +** which indicates that it is a large landfill site that is allowed to accept **General** municipal waste only, and that it is a **Leachate-Bearing** landfill (Ragunandan, 2005). Section 2 of the permit (which deals with permissible waste) clearly states that no toxic, organic or inorganic waste that is harmful to human and environmental health should be accepted onto this landfill site. This is in itself a problem as most of the waste arrives in black 'garbage bags' and no mechanism currently exists to verify the contents. Further, according to the Medical and Related Substances Control Act (No 101 of 1965), medical waste and pharmaceutical products are not permitted in the NERLS and this is not the case as demonstrated by the dumping of medical waste in the recycling bay at the site by a private medical vehicle (witnessed by the principal researcher during the household MSW assessment). Thus, it is clearly evident from this incident alone that monitoring at the landfill site, which includes the recycling bay, is either lacking or inefficient. This is suggestive of a lack of control and compliance by municipal authorities and authorities including DEAT and DWAf irrespective of whether the recycling facilities have been privately contracted out (as is the situation currently).

The disposal of medical waste, toxic pesticides and animal carcasses at the Caledon Municipal Dump in Cape Town has contravened legislation and is said to be responsible for a resident troupe of eighty baboons contracting tuberculosis. The site is also not covered with a mandatory layer of soil as per DWAF's Minimum Requirements for Landfill regulations and rubbish is illegally burnt at the site (Gosling, 2004). This clearly illustrates that this problem is not confined to just one municipality, but is occurring throughout the country.



**Figure: 5.2 Aerial view of the New England Road Landfill Site (after Siyenza Engineering, 2008).**

The objective of the Msunduzi Municipality's waste management division is to manage the landfill site effectively enough by decreasing the volume of waste landfilled so that the lifespan of the site can be increased. This would subsequently result in lowered operating costs to the municipality and the cost for refuse removal to the ratepayer can remain minimal. This is in accordance with the fact that a new landfill site would cost millions of rand to construct and that the location would most probably be on the outskirts of the city, thereby incrementing the current refuse removal charges to ratepayers because of greater operating costs related to increased transport and staffing issues for MSW (Reddy, 2007; Naidoo, 2007).

According to Mr Ramu Raghunandan, the landfill site manager in 2005, the solid waste fractions received from the different sectors of society at the landfill site can be roughly divided into:

- 30-40% domestic or household waste;
- 15-20% garden refuse;
- 15% commercial waste; and
- 25% industrial waste.

It is clear from the above that household solid waste fractions form the bulk of the MSW stream entering the landfill site and is equivalent to that of the commercial and industrial waste fractions combined. Garden waste also utilises a sizeable portion of landfill space, especially where it is bulky and does not compact easily. This includes tree branches from households, city centres, and other areas that the municipality is responsible for. The responses received regarding the nature of garden waste from the questionnaire survey (Section 4.4) revealed that leaves and grass formed the bulk of backyard solid waste for households, whilst bulky garden waste was removed by private garden services. However, 47% of households either illegally dumped or burnt their garden waste.

The domestic MSW fraction can be further sub-divided into solid waste types (glass, paper, plastic, metal, and perishables) as shown in the analysis of household MSW for landfilling (Section 4.7). The bulky garden refuse which accounts for 15-20% of all waste at the NERLS, signals a need for chipping and composting to be implemented on a daily basis. According to the current landfill site manager, a chipper was bought a few years ago but does not operate to its full potential due to a lack of proper control and monitoring to facilitate such a project that requires manpower and responsibility along with some sort of administration for record purposes (Naidoo, 2007). If it is the municipality's decision to extend the lifespan of the landfill site for a further fifteen years, then the quick operational utilisation of the chipping process would greatly enhance this goal. However, due consideration would be needed with regard to the location of the wood chipper, as this process with its noise and associated disruptions (public sales and traffic) would impact on the surrounding residents.

The assessment of household MSW at the landfill site in Section 4.7.2 revealed that paper and plastic, followed by perishables formed the bulk of the constituents of this waste stream. These waste types are recyclable (with organic waste being compostable) and if adequately practiced, would increase the lifespan of the landfill site by reducing the volume of the disposed waste stream. However, the fact that methane gas is now being piped and converted into energy to feed ESKOM's power grid, simultaneously earning foreign revenue in the form of carbon trading credits by mere virtue of this practice may pose a problem for wanting to compost organic waste. This is apart from the fact that a large landfill site like the NERLS is able to generate methane gas 30 years post closure (see New England Road Landfill Site permit 16/2/7/U203/D3/Z1/P64; Reddy, 2007). Composting does however represent a more immediate source of revenue and of maintaining the landfill site, while the harvesting of methane gas still continues, albeit at a slower rate than without composting.

Industrial and commercial wastes have always been considered as more complex than municipal solid waste, partly due to their potentially hazardous nature. Industries have often been targeted with regard to their environmental responsibility to conform to ISO 14000 standards, and have been specifically excluded from this study, despite their obvious contribution to the solid waste stream and to the waste entering the NERLS.

One would assume that in terms of the monetary contributions by means of tariffs to the maintenance costs of the landfill site and policing, that landfilling waste from industries and commercial businesses would be more viable than that of households. Unfortunately, given the fact that an equal fraction of waste is derived from households for sanitary landfilling, the municipality needs review its policies on empowering and motivating households to responsibly manage their solid waste, in the interests of personal and environmental safety. Simply stated, it is household refuse that comprises volume on a landfill site, and in this instance at the NERLS. It is also household waste that contains large amounts of organic waste that give rise to methane gas upon decomposition which contributes to global warming. Regrettably, industries are often offered special rates for solid waste disposal by municipalities in the attempt to attract them to the city for job creation or employment, but no incentives are given to households to reduce the quantity of their solid waste.

The NERLS services a large area, even those outlying areas beyond the Msunduzi Municipality's boundaries. How does one actually evaluate the seriousness of any of the permit violation? DEAT and DWAF are government institutions and whether one division of government will oppose another cannot be verified in this instance since the impact of not safely disposing of MSW will pose a tremendous health hazardous to citizens and further create a public outcry. There is undoubtedly a need for policy review. If one considers the responses to the questionnaire survey (Section 4.5.5), it is evident that the majority of the citizens of the Msunduzi Municipality are of the opinion that MSW is very poorly managed in the city and in the country.

### **5.3.1 Security**

One of the major problems faced by the management of the landfill site is that security is severely lacking and inefficient when provided. Figure 5.3 shows how the landfill site entrance is continuously strewn with litter as street vendors who have obtained street trading licences return even when evicted by the South African Police Services. According to Cyril Naidoo, the NERLS manager, street trading at the entrance of the landfill site is merely a "smokescreen" for salvaging scrap metal and copper from the landfill site workface.

Security personnel at the landfill site are threatened and overpowered by vagrants and street traders when they try to combat security violations of the NERLS permit. The signs at the entrance of the landfill site and at the administration office are blatantly ignored as informal salvagers openly explore the workface of the site for recyclables. The residents of Sobantu and criminals use the site as a shortcut into surrounding areas (Raghunandan, 2005; Naidoo, 2007). Section 4.5.7 of the permit states that notices of unauthorised entry onto the landfill site which results in the person/s being prosecuted, should be posted 100m apart along the boundary of the site. This has not been followed through as the fence is being continually repaired due to the residents from Sobantu regularly remove up to 45m of fencing, whether it is electrified or reinforced with barbed wire (Raghunandan, 2005; Naidoo, 2007).

The numerous spates of fires that have occurred in the past two years have been attributed to vagrants burning equipment to salvage copper and other metals which fetch higher monetary values at recycling centres and buy-back recyclers (Naidoo, 2007; Reddy, 2007). According to Section 4.3.2 of the permit, reclaiming waste that has been disposed of at the landfill site is not permissible. The site immediately bordering the entrance to the landfill site remains strewn with compacted litter, resembling a mini workface.

Waste tyres are also being dumped in open velds throughout the country as landfill sites charge high fees for accepting them – a deterrent due to the fact that tyres occupy large spaces because rubber does not degrade easily (RubberSA, 2008). Apart from the nuisance of aiding vector (flies and rats) production, informal salvagers tend to compound air pollution by burning tyres for scrap metal (Naidoo, 2007; RubberSA, 2008). This situation is still applicable to the NERLS, albeit on a much smaller scale currently.

The question that arises here is whether DWAF and DEAT who are responsible for monitoring the site and ensuring its compliance have actually made a concerted effort to resolve the issue. The role of regular internal audits, possibly on a monthly basis is advocated here to promote the compliance of the landfill site with permit regulations, and to ensure that issues of non-compliance are timeously dealt with. Are vagrants and street traders really above the law in South Africa? This is the obvious conclusion given the security issues that surface at the NERLS. It is evident that the South African legislation needs to be reviewed so that environmental justice is not jeopardized by other aspects of governance such as trade laws. Once more, the issue of co-operative governance comes to the fore in a situation such as this, where the indiscriminate issuing of street trading licences and the lack of provision and control over designated market and trade facilities are in direct conflict with the management of solid waste in urban areas.





**Figure: 5.3** Entrance of the New England Road Landfill Site strewn with litter from street vendors and vagrants. A similar situation was again observed in June of 2008 (photographed by Govender, 13 June 2006).

The landfill is surrounded by alien (instead of indigenous) trees as required by Section 4.3.8 of the permit. Although the trees increase the fire risk, they reduce the wind factor. The Wattle trees that are on the site grew from seeds that were actually in cover material used to construct berms on the site (Raghunandan, 2005). Fortunately, the trees that border the perimeter of the landfill site provide sufficient foliage to mask the operations at the landfill site and contain the dust and litter problems to a certain degree. Unfortunately, the removal of these trees at this stage would be problematic as they are well established and do provide positive functions. Replacement of these trees would be a costly and a lengthy process as indigenous trees would take several years to reach the maturity needed to provide the effective wind barrier and aesthetic functions needed at the site. However, provision should be made for reasonable compliance of the permit in this regard, so that it would have the added benefit for post closure of the site.

### **5.3.2 In-house Inspection**

There is currently no inspector at the weighbridge to ascertain the nature of the waste that enters the landfill site. The fact there is no staff member or officer at the weigh bridge to adequately

inspect and determine the nature of the solid waste entering the landfill is cause for great concern as the implications arising from hazardous waste unknowingly entering the site could have far-reaching and detrimental consequences from the contamination of soil and surrounding water bodies to the people who may come into contact with it.

Further, there is no strict or responsible method for administrative control (as explained in Chapter 4), where weigh bridge bills are collected in a cardboard box and filed by casual employees in lever arch files before being taken to the municipal offices. These invoices are not strictly in chronological or number order and are not available for checks at the landfill site in an electronic format. It is even more difficult to attain electronic copies of weigh bridge tonnage details from the administration offices at the municipal waste management division. An additional problem is that MSW is brought to the landfill site after business operation hours, therefore compromising accurate record-keeping as there is no staff to man the weigh bridge after 16H30 on weekdays and on weekends and public holidays.

In Chapter 4, almost 70% of the questionnaire respondents indicated that although they were satisfied with the refuse removal service, they would prefer the municipal waste division to collect their household waste more than once a week. Given the problems of inadequate staffing and insufficient operational budget, as well as poor administrative control, an increase in refuse removal frequency at this stage falls short of consideration and is unlikely to be implemented in the near future.

### **5.3.3 Monitoring**

There is currently inadequate management of stormwater runoff from the NERLS even though a previous Environmental Impact Assessment (EIA) report deemed it necessary (Raghunandan, 2005). The EIA that was conducted in 2007/2008 was to ensure that the site was compatible for the current methane gas to energy project which was outsourced to a private company so that carbon trading credits could be earned by South Africa, and monetary royalties could be earned by the Msunduzi Municipality. There are no cautionary measures taken as metre-wide water

pipes that run from neighbouring Sobantu across the Duzi River and onto the landfill site allows for easy trespassing, hence the high rate of informal salvaging at the landfill site. Steel collars should be erected around these water pipes to create a barrier so that people cannot use it as a bridge. Burglaries and muggings are rife in the area due to the easy access that criminals have to the landfill site and to Sobantu, where it is difficult for police to conduct searches. About 98% of pedestrian traffic would be reduced if these pipes were inaccessible.

An attempt to standardise the borehole water analyses from the site over the last five years at the NERLS has proved rather futile. The interviews conducted with key management personnel indicate that this has not been strictly complied with. This in itself is a direct violation of the NERLS permit and DWAF's Waste Management and the Minimum Requirements for Landfill (1998), where DEAT and DWAF stipulate that borehole water monitoring should be conducted quarterly. Internal and external audits are conducted to monitor the operations at the landfill site in accordance with the NERLS permit conditions. This facilitates the lack of capacity that may be experienced by internal audits to comprehensively cover all aspects of monitoring, as well as to show integrity and reduce public doubt and suspicion, where an external agent will be able to disclose all facts and figures as is. Envitech Solutions had previously indicated in external audit reports in 2004/5 that the borehole water was of an acceptable quality; and had found that landfill gas was migrating into the buildings, and this was almost immediately rectified (Envitech Solutions Environmental Reports 2004/067 for 23 November 2004 and 17 March 2005).

According to environmental consultants, DEC Consultants cc (DEC) and SRK Consulting Engineers and Scientists (SRK) who have produced various audit reports over the years for the landfill site, the high levels of salinity in boreholes of depths in the ranges of five, thirty and two hundred metres were due to natural leaching of the clay and shale formation beneath the landfill site (DEC, 2003; SRK, 2000b). Most boreholes on the site are hardly used and blocked by debris or dysfunctional (rusty and broken) caps. The monitoring roles of DEAT and DWAF can therefore be questioned with regard to this, even though it may be viewed as a maintenance issue. However, the importance of maintaining the condition of the boreholes at the landfill site serves to fulfill the permit prerequisite of conducting regular and accurate groundwater chemical analyses.

The composition of landfill leachate and its constituents were largely ignored until the methane gas that was being flared was outsourced to a private company, where it is now being fed into ESKOM's power grid and earning carbon trading credits. The extent and effects of methane gas migration was previously unknown, except when staff change-rooms at the landfill site had to be rebuilt a few years ago due to the gas moving laterally through cracks in the building. One wonders what happens at many other landfill sites in the country, which are not as intensely managed as the NERLS.

An additional but often neglected area of monitoring is that of air quality monitoring which has never been satisfactorily conducted by any specialists in the fields of climatology or geography (even though SRK undertook that task). In SRK's external audit Report number: 262923/1 in 2000, engineers and scientists maintained that up to that date there is no knowledge of any formal air quality studies having been undertaken at the landfill site. The main issue here is the fact that the municipality still lacks proper air quality monitoring equipment and where available, there is a shortage of skilled staff to efficiently conduct the analyses needed.

Odour control has improved in the vicinity of the landfill site, but the issue has never been properly dealt with, especially during extreme weather conditions and when animal waste is disposed of at the landfill site. Toxic landfill site fires presumably caused by vagrants have also caused respiratory problems for residents in the surrounding areas and remains to be thoroughly investigated. Smoking is prohibited at the landfill site due to the possibility of methane gas migration and its flammable properties. However, it is assumed that vagrants remain unaware of this or choose to ignore it as small and lengthy fires are both common at the landfill site.

The extent of sawdust problems though not MSW, which proved to be a major hazard previously has been contained since high tariffs served as a deterrent for landfill disposal of this substance (Naidoo, 2007). Industries such as PG Bison began to export its wood chips to Japan and elsewhere since 2005, while also reusing its sawdust as additional fuel supply (Chamberlain *et al.*, 2005).

The problem of dust still looms large, as heavy machinery on untarred access roads continue to raise dust plumes. These dust particles are a buildup of the initial inappropriate cover material of the fine silt that is used to cover the landfill workface. The cover material has also been agreed to be inappropriate for adequately covering the waste at the landfill site (SRK, 2000a; Rangunandan, 2005; Naidoo, 2006). Also, drier seasons do not promote the settling of dust on these earthen roads. Most of the exposed areas that are prone to erosion should be tarred or watered down daily (Durban Metro Online, 2005). The current landfill site manager has been trying to incorporate building rubble into the cover material to reduce litter problems and create a stable workface for equipment to operate on, especially in wet weather.

A closer degree of monitoring is required on the landfill site to ascertain the compliance of using cover material at the end of each working day to adequately cover the working face. It was personally observed by the researcher that cover material did not “cover” the compacted waste at the landfill site each day. Also, the fact that MSW is transported onto the site at such odd hours adds to the problem of waste not following permit protocol in terms of management which once again alludes to the fact that DWAF and DEAT are not strict in monitoring whether the permit regulations are being adhered to.

#### **5.3.4 Roads and mechanical equipment**

Some of the roads at the landfill site have been tarred, but several of them remain untarred and are often turned into marshes when there is heavy rainfall; which when combined with dense vegetation along the roads hinder proper circumference monitoring at the site. The untarred road surfaces which provide access to the workface of the landfill site have to be covered with building rubble or other suitable material that prevent the vehicles and equipment from being inoperable in wet weather conditions.

BOMAG compactors are used to compact the waste on the landfill’s workface each day (when the machinery is in working order), but was cited in SRK’s external report (262923/1) as being unsuitable. This was due to a combination of the fine silt cover and the mechanism of the

BOMAG that created an uneven surface, thus promoting plastic fly-away litter through inefficient compaction. The solution to this problem lies in choosing a suitably textured cover material. Litter pickers have also been employed to control fly-away litter at the site which usually finds itself stuck onto fences and trees (Naidoo, 2007).

The mechanical or technical breakdown of compactors and other equipment, results in a three to six week waiting period and sometimes lapses into months for repairs to be completed. There are no back-up vehicles of equivalent function and efficiency that can be utilised to complete the work, especially when it involves compaction of the waste on the landfill workface. Bulldozers are usually used in these instances, but have proved inefficient as compared to compactors (Naidoo, 2006; Reddy, 2007). Due to the 2007 problems, the NERLS has acquired a second BOMAG in 2008.

The importation of machinery can be a lengthy and expensive process that would cost the municipality millions of rand. The landfill site manager is not allowed to lease vehicles, but must replace parts or buy new vehicles (Raghunandan, 2005). An additional problem which understandably serves as a control factor is the administrative process of filling in requisition forms for vehicle maintenance and repair. This results in unnecessary time wastage as vehicles wait to be repaired, often resulting in days or weeks of inefficient operation at the landfill site especially when communication between municipal divisions is very poor (Naidoo, 2008).

The issue of privatization to deal with this problem warrants further consideration. Public-private partnerships have been previously suggested to ease financial and technical burdens that are currently being experienced, but this still remains a function of the municipal waste management division (Reddy, 2007). It is also frowned upon by labour intensive staff who are concerned that it may be the 'thin edge of a wedge' ultimately resulting in privatisation of sectors and associated job losses.

### 5.3.5 Operating hours

The municipal refuse removal vehicles continue to work throughout the night and into the early hours of the following morning, creating a noise disturbance through the change of gears, the sound generated by the movement of the vehicles itself on the roads and the roudiness of the engines. Municipal vehicles used to collect waste also have loud alarm beeps when the reverse gear is engaged. These vehicles also operate outside of the stipulated permit hours such as 2am, depending on the speed with which they have worked to remove the city's waste. The intention of collecting overtime pay has also been given as the reason for municipal workers or contractors stalling work into the night. This is a direct violation of Section 4.4 of the permit which states that the operating hours of the landfill site commences at 7am should cease at 5pm daily on weekdays with soil cover being completed by 6pm. The site will also be able to operate machinery on Saturdays between 7am and 2pm. There should not be any machinery or noisy equipment in operation on Sundays or times outside of the given operating times.

The remainder of the landfill site permit pertains to scientific water, soil and air analyses, with specific reference to the levels of minerals, chemicals and toxins. It is therefore beyond the scope of this research document to comprehensively and accurately investigate such levels or discrepancies that may exist, apart from using the available internal and external audit reports to highlight issues that have not been attended to at the NERLS.

The NERLS monitoring committee which was formed to address the solid waste needs or landfill-related issues of the public and private stakeholders, now meets on an ad hoc basis instead of the usual monthly basis to raise public concerns about the landfill site and discuss related solid waste management issues (Raghunandan, 2005; Pather, 2008). Meetings have now (2008) become a caucus for socio-political issues such as staffing and staff entitlements at the landfill site (Chamane, 2007; Naidoo, 2008). The municipality has decided to review the manner in which the monitoring committee is being managed with a proposed restructuring of its committee members so that public concerns can be adequately dealt with and timeously resolved (Pather, 2008). Some of these issues include the odd operating hours of municipal vehicles, air and water pollution, inadequate human resources, the prevention of veld fires, changes to the

permit conditions, and so forth (minutes from the NERLS monitoring committee for 2007/2008). These are important considerations that have been raised and seem to be continually falling short of being appropriately addressed. One needs to be mindful of the fact that most of the members who do attend these meetings are representatives of their suburbs and settlements, and as such need to provide positive feedback which includes educating community members about the landfill site and responsible MSW practices. It is therefore imperative that public stakeholder issues are adequately dealt with in what seems to be one of the key MSW forums to air grievances and seek clarification on waste and related environmental issues.

### **5.3.6 Further management considerations**

Local municipal authorities should look into the following considerations apart from the permit violations discussed above so that MSW can be better managed in terms of the waste stream itself, the administrative matters pertaining to it, as well as being adequately or safely disposed of within the long term vision of environmental sustainability. The following management considerations need to be taken into account as important issues that facilitate or hinder the efficient operation of the NERLS.

- (a) Staffing issues continue to undermine the efficient operation of the landfill site. Staff “freezing” means that the municipality cannot hire any more staff. They will have to make do with their current staff count. This has proved tedious, especially since several drivers employed at the landfill site itself have succumbed to diseases such as HIV AIDS (Naidoo, 2006). Appropriately qualified people are seriously lacking in the management ranks of the landfill site. The site should have been overseen by Pietermaritzburg’s Department of Waste Management since inception, but until early 2006, was managed by Mr Ramu Raghunandan who has multiple portfolios in the department of Risk Management. He has made sterling efforts, but unfortunately could not improve the operational or physical functioning of the landfill site due to insufficient funds. Cyril Naidoo, the current landfill site manager who has since made large strides in trying to appease all stakeholders involved, has cited a lack of human capacity and a shortfall in



operating budgets as hindrances to efficient management of the site. Staffing problems are exemplified during the festive season and school holidays as the Msunduzi Municipality's Waste Management Division operates with a skeleton staff.

- (b) There is no formal document containing a proposal about the nature of an intended rehabilitation process of the landfill site post closure, since it is envisaged by the local municipality that it is normally feasible to do so five years prior to closure (Naidoo, 2008). There has been speculation of closure of the NERLS in 2014, or if managed well, the lifespan of the site can continue for another decade or more (Pather, 2008). But, in February 2000, SRK Consulting Engineers and Scientists indicated in their external audit report (262923/1) what the landfill site may look like after closure from viewpoints in Sobantu, New England Road Extension and from Mr David Moon's property in Woodhouse Road (SRK, 2000b).
- (c) The permit states that the height of the berms or workface at the landfill site cannot exceed 654m. It is currently estimated at 630m and this probably explains why no formal document has been prepared for post-closure rehabilitation of the site. However, it is a suggestion that municipal authorities commence with such a document especially since the process of finding a site that can be suitably engineered for a landfill has begun (since 2006 with no suitable sites established as yet due to public opposition similar to "Not In My Backyard" organisations lobbying for environmental and human concerns).
- (d) In the Msunduzi Municipality, the landfill site and the Darville Sewage Works are in close proximity to each other. Therefore, incineration for the production of electrical energy while simultaneously extending the lifespan of the landfill site would prove to be highly beneficial as sewage sludge can be used to add bulk to the incinerator or to increase methane gas at the landfill site and subsequently using Darville to dispose of the residue. It has also been noted by Blignaut *et al.* (2004) that the decomposition rates and times for various MSW components to produce carbon dioxide and methane gas vary tremendously and the classification of biodegradable solid waste at landfill sites can be given as follows:

- Food residues which are easily degradable;
- Easily pliable plant waste which degrades moderately with a half life of five years;
- Wood and paper products that degrade slowly with an estimated half life of fifteen years.

One of the main public oppositions to incineration across the world is that this process would exacerbate the already deteriorating air quality, creating respiratory and skin disorders for people in the vicinity of an incineration plant. The initial costs for establishing an incineration plant and the subsequent maintenance and repair thereof also pose huge financial risks. Further, incineration of MSW still requires a landfill site for the disposal of the residue which is usually about 30% of the original volume of waste prior to incineration. The impact of an already deteriorating air quality in South African cities, especially in Pietermaritzburg, will create enormous opposition through public pressure on government, unless it can be proven that incineration is an absolute necessity and will not contribute to further declines in air quality. One of the observations by the principal researcher from this study is that most landfill sites in South Africa are located such that they are in close proximity to residential areas and regular air quality monitoring is practically non-existent.

As indicated in previous discussions, the numerous permit violations with regard to the operational and structural functioning of the NERLS indicate that the local municipality and national government need to resolve these issues so that permit compliance can be maintained. This would then augment the government's efforts to at least manage MSW on a national level, thereby establishing the uniform operational standards of landfill sites throughout South Africa. The public should not be held to task for environmental offences if the very authorities who advocate them do not practice them or incorporate them into municipal functions. It is strictly speaking a matter of continuous compliance and monitoring which is severely lacking at this landfill site after the permit was issued. The question that arises is whether the NERLS will actually face closure in the near future due to contraventions of the permit regulation.

It is most evident that legislation with regard to littering and dumping should be enforced in the public/ private arena with a view to facilitate smoother MSW management, among other factors

such as environmental protection and aesthetic appeal. Respondents did indicate in the survey (Section 4.4) that they would be happy with and welcome the introduction of fines for littering and illegal dumping in South Africa. This also alludes to the fact that if these environmental offences were not escalating to the point of being unmanageable, then 80% of the household respondents would not have advocated such measures. Further, only 45.5% of the population said that they do not litter, which means that the majority of the population litters in some form or another as indicated in Table 4.10 on page 101.

In the process of determining the efficacy of solid waste management at a local level, one can determine the efficacy of the applicable national (and provincial) legislation and the effectiveness of policy implementation and practices. When well documented laws and regulations are formulated into acceptable policy planning on provincial and district levels with subsequent inadequate procedures and irresponsible practices on local levels, one needs to question these aspects of governance – especially if it poses a risk to the natural environment and to humankind. At the same token the “custodians” of this earth, who is none other than every citizen, should behave in a responsible manner if advised correctly and adequately about solid waste management. Therefore, legislation pertaining to the management of MSW at the household level needs greater attention to facilitate mitigation measures such as recycling and solid waste reduction, while simultaneously aiding government measures to manage waste in the country.

#### **5.4 The management of municipal solid waste facilities**

The semi-formal structured interviews with key solid waste management personnel from the local Msunduzi Municipality’s Waste Management Division, and from the national authority of DWAF were conducted with the objective of gaining an “inside” understanding of how MSW is managed and the current challenges facing service delivery by government. This method of gaining primary data information was meant as an informative exercise only to gauge the views of experienced persons in the solid waste environment and to establish the areas of strengths and weaknesses in the Msunduzi Municipality’s attempt to responsibly manage MSW.

The first interview (schedule of questions for the semi-structured interviews attached as Appendix B<sub>1</sub>) was conducted in 2005 when Mr Ramu Raghunandan was the NERLS manager, where the site itself was managed by the Risk Management division of the Msunduzi Municipality due to a lack of skilled staff. This interview pertained mainly to information about the historic background and operational characteristics of the NERLS. Mr Raghunandan confirmed that areas outside of the local municipal jurisdiction such as Wartburg, Howick, Hilton and Greytown were serviced by the NERLS.

Mr Raghunandan argued that the steady increases in MSW per annum could be attributed to “newer suburbs and lavish lifestyles with increased shopping.” This is also evident from the household solid waste assessment carried out at the NERLS to gauge the nature of the waste stream for landfill disposal. Table 4.25 on page 138 clearly indicates this as the quantities of cardboard waste were mainly that of pizza boxes in the high income suburb of Chase Valley and perishable waste formed a sizeable quantity in all the suburbs of study; thus indicative of an increase in consumer disposable income levels.

It was also alleged that although the landfill site does not accept liquid and/ or hazardous waste, strict control was lacking. An attempt at this stage to verify this by attempting to acquire quarterly audit tests which would pronounce vegetables such as herbs bordering the landfill site safe for consumption, and quarterly leachate monitoring reports proved futile as the reports could not be found. The environmental reports found were sporadic and there was no evidence to show that vegetation in close vicinity to the landfill site was being tested for heavy metal contamination that is usually inherent to hazardous waste and as was suggested by Mr Raghunandan.

The next two interviews were conducted in 2007 to establish consistency with the outcomes of the questionnaire survey, regarding solid waste management from a government perspective. This also facilitated an understanding of the challenges that waste management-related personnel in government departments may face when tasked with responsibly managing MSW. Mr Pat Reddy who is the National Assistant Director of DWAF gave his views (schedule of questions for the semi-structured interviews attached as Appendix B<sub>2</sub>) on the management of MSW in

KwaZulu-Natal and in the country. Mr Rugen Poliah who manages the actual refuse removal from the city centre and suburbs was also interviewed (schedule of questions for the semi-structured interviews attached as Appendix B<sub>3</sub>), with the focus being on assessing the manner in which MSW is being managed in the Msunduzi Municipality. Mr Cyril Naidoo, the current NERLS manager did not respond to a formally structured interview, but did allow for discussions to be held with the principal researcher.

The outcomes of the interviews revealed that South Africa has a few exceptionally well managed landfill sites especially where these were contracted out to private companies; and that the majority of sites were of an unacceptable standard requiring urgent upgrading. One of the obstacles to responsibly managing MSW in strict accordance with prevailing legislation was the lack of adequate solid waste operating budgets issued to local municipalities. A further hindrance was the “apathetic attitude” of local municipalities toward managing MSW in their towns and cities. One of the aspects of concern was that of co-operative governance, where DWAF and DEAT needed to collaborate as a team on issues such as suitably engineered landfill sites to protect the country’s water resources.

It was also commented upon that the NERLS sometimes falls short of acceptable standards, where a lack of human capacity, finances and equipment proved to be obstacles for efficiently operating the site. The site is usually well managed when there are sufficient financial and human resources. It was established that the Bissasar Road Landfill Site in Durban was more suitably engineered while the NERLS was more aesthetically appealing. Privately managed landfill sites like Shongweni and Mariannhill were felt to be on par with First World standards while others definitely lacked MSW mitigation measures such as reduction, reuse and recycling. One of the most important observations made by the interviewees was the fact that local municipal strategies and policies were not in keeping with legislation and most lacked the engineering design to sustain long term initiatives such as recycling.

It was suggested that clearer chains of command with provincial and national accountability channels be established so that national government can monitor and take to task those municipal managers whose solid waste divisions are non-compliant with MSW legislation. In light of these

observations, it is arguable that national government is aware of the insufficient operating budgets granted to local landfill site managers but still expects them to function at optimal capacity. The implication is that given the views of the survey respondents in Chapter 4 on the poor solid waste management in Pietermaritzburg and the view of national officials, it is necessary for a serious restructuring of municipal budgets where adequate funds can be allocated to MSW management.

Initiatives to recover and recycle MSW through waste exchange for value where possible was suggested as a method to reduce the solid waste base. This would encompass extracting the most value out of solid waste by distributing it to where a market demand exists for its raw materials or finished products, similar to the exchange of aluminium waste that occurs between industries in Cato Ridge and in Richards Bay (example by Mr Pat Reddy). An important cause for concern raised during these interviews was the fact that although rural areas like Impendle (which falls under the jurisdiction of the uMgungundlovu District Municipality) had low levels of refuse removal services, the burying and burning of MSW was seen as a cheaper method of managing solid waste (even though it is not advocated) instead of increasing service delivery to these areas. With all due respect, government seems to operate on advocating double standards with reference to service delivery, thereby grossly infringing on the human rights of its citizens. The lack of MSW service delivery in rural areas actually becomes reminiscent of the practices in South Africa's Apartheid era.

Pietermaritzburg was seen to be lacking in the proactive implementation of solid waste minimization interventions, and that the NERLS "runs by default" to manage MSW on a daily basis. South Africa lags far behind First World countries in responsibly managing MSW due to a lack of expertise and initiatives. It was established during this interview that the Msunduzi Municipality has not progressed to the stage where it has formulated new techniques or approached households and businesses to sustainably manage their MSW through recommended practices such as reduction, reuse and recycling.

The suggestion that household waste separation be implemented in the near future was met with resistance, as it would place a financial constraint on the Waste Management division because

the provision and maintenance of recycling facilities in suburbs and increasing the refuse collection services would require special handling as well as more staff. It was envisaged that MSW separation at the landfill site itself would be more viable on a long term basis. It was also suggested that garden refuse sites should be converted into recycling transfer stations where MSW could be separated before reaching the landfill site. Mr Poliah made an important statement where he suggested that ward committees be responsible for specific suburbs to “ensure (that a) culture of cleanliness is instilled.”

The outcomes of these interviews clearly suggest that South Africa needs to improve the manner in which MSW is managed in its provinces so that it can emulate the standards of First World countries. There should be uniformity in governance matters such as service delivery so that all sectors of society can function equitably. This can be achieved by enforcing standard legislation and appropriately allocating operating budgets so that landfill sites can function optimally in the country. It is apparent that most of the landfill sites in South Africa are poorly managed and require attention. Therefore, the national government should seriously consider outsourcing the management of sanitary landfill sites to public-private partnerships as experience has shown that such landfill sites are better managed in South Africa.

It is further recommended that municipal staff receive regular skills and educational training to enhance the management of MSW as stipulated in NEMA (1998), apart from the fact that staffing is inadequate currently. In a 2006/7 municipal profile of the Msunduzi Municipality, “insufficient staff” was cited as a reason for not adequately servicing areas with refuse removal and was reported as a five year backlog in terms of MSW service provision (Municipal Demarcation Board, 2007). It became apparent during the interview process that members at all levels of governance are not adequately enabled to apply the principles of global environmental issues such as the Kyoto Protocol. This should hopefully allow for a change in attitudes where municipal personnel would be more equipped in applying and enforcing appropriate environmental legislation; as well as encouraging the public to practice responsible solid waste disposable methods to possibly decrease the solid waste base.

Mr Poliah's suggestion that MSW be managed through more strategic decentralization of functioning whereby ward committee members can be instrumental in reaching out to their households and encouraging sustainable MSW practices seems to be a plausible one. This would then call for greater hierarchical divisions of function within local municipalities for effectively managing solid waste in general.

The national levels of government need to review its legislative policies on recovery, reduction, reuse and recycling of MSW so that the channels of interaction can become transparent and promote responsible practices and procedures instead of fostering doubt and fear of prosecution for attempts to manage MSW. The poor management of MSW and landfill sites is not specific to the Msunduzi Municipality, as other local municipalities such as the Uthungulu District Municipality has cited an upgrading of landfill sites and an integration of solid waste disposal systems for efficient service delivery as environmental priorities (Uthungulu District Municipality Online, 2005).

## **5.5 Lessons to be learnt**

The aim of the case study of the New England Road Landfill Site was to assess the compliance of environmental legislation by a local municipality to manage its MSW in the greater interests of environmental sustainability; thereby contributing to global well-being as trans-frontier boundaries begin to dissolve in the combat against climate change.

There have been many permit violations, thus proving that compliance has not been strictly adhered to. The implication here is that there are insufficient control measures to enforce MSW legislation. The national government needs to ensure that adequate and enforceable policies and measures are put in place so that MSW is managed responsibly and effectively. The issues of control and monitoring are imperative to ensure the viability of implementing current legislation and timeously improving where and when necessary can be achieved so that environmental concerns do not just remain local, but become global. Environmental health and human health are interdependent and it therefore becomes necessary to reiterate that the reasoning behind



responsibly managing MSW is to prevent environmental degradation, subsequently enhancing the lives of people.

Aspects such as the lack of security should not be an “issue” as such due to policing being a vital component for any town or city, and Pietermaritzburg is a major legislative city that is being considered for the status of a metropole. Hence, justification for the lack of policing around a landfill site warrants serious (re)consideration.

The inspection and monitoring of the landfill site needs to occur on a regular basis by competent officials from DEAT and DWAF. This should hopefully solve the problem of suitable cover material being applied on a daily basis and ensure that operating hours are complied with. The monitoring of borehole water for contamination and water quality, as well as air quality monitoring needs to be a priority and should not occur on an ad hoc basis. Further, the results of these analyses should be transparent and available for public review and comment. Although the landfill monitoring committee meets more sporadically now than regularly, these statistics are also not available to its members (Pather, 2008).

A restructuring of the municipal budget and co-operative governance should allow for adequate funds for the repair and/ or replacement of machinery and equipment to ensure continual optimal operation. The fact that the municipality bills some 166 536 rate payers an average of R60.00 a month, should allow for at least 75% of this money received (with the balance as an allowance for defaulters and non-payments) to be allocated to the Waste Management Division as an operating budget for the landfill site.

There needs to be greater cooperation between municipal departments or divisions so that paperwork does not become an obstacle to smooth service delivery (Naidoo, 2008). This also poses a challenge as it was suggested that greater local hierarchical divisions should exist so that a culture of cleanliness can be nurtured (especially with regard ward committee members being able to influence the attitudes of households). However, if cooperative governance is a challenge now, then the task ahead to improve solid waste management will require a lot more effort than envisaged.

One of the most crucial aspects for any municipal division to operate effectively (apart from a financial perspective) is to concentrate on human resources that are suitably skilled and appropriate in number so that efficiency is maximized and environmental discrepancies are kept to a minimum or adequately resolved (Environmental Justice Networking Forum, 2005). The personnel of municipal waste divisions also need to be held accountable for the manner in which solid waste is managed, but need to be sufficiently empowered to ensure its management. All of the above mentioned issues are inextricably linked to compliance and monitoring of legislation – which in essence forms the focal point of this chapter.

As renowned environmental author, L. Graham Smith (1992) suggests, environmental challenges require a revision of previous approaches to account for the ‘resolution’ of solid waste management problems, especially at an operational level. He further states that provisions should be made for the mitigation and monitoring of waste facilities, once the problems and associated risks with the location and engineering of a site have been dealt with. These are important considerations for managing MSW as it is often associated with conflicts (from the public as stakeholders) and negativity. There are undoubtedly numerous factors such as the site suitability criteria which are used to identify a new landfill site that is usually sanctioned by an EIA process to ensure optimal operational functioning with minimum negative environmental effects. Geology and engineering are crucial aspects, notwithstanding the fact that stakeholder representation is now given a tremendous amount of importance. The problems that we are predominantly faced with in South Africa currently, is not just the location of new landfill sites – but the operational techniques and management practices of existing landfill sites.

Chapter 6 which follows will elaborate on the most important findings of the collective outcomes of the study. The implications of the research management process as outlined in the methodology and presented in Chapter 4, and the discussion on policy review will be collated in Chapter 6.

# CHAPTER 6

## Interpretation of the results

### 6.1 Consolidating the research results

The focus of this chapter is to draw together the results obtained from all of the analyses undertaken during this research with a view to answering the questions posed in response to the original aims and objectives of the study. The primary method of data collection was achieved through the administration of a questionnaire survey, and was further supported by an assessment of household MSW from three suburbs of varying socio-economic status, semi-structured interviews as well as a thorough review of the applicable policy and legislation.

The literature review in Chapters 1 and 2 set the scene for aspects that could influence MSW by providing an informative background and suggesting possible explanations for the expected outcomes of the data collection. Chapter 5 briefly examined legislation that influences MSW management in South Africa, and subsequently led to a more detailed discussion pertaining to the case study of the NERLS which examines policy implementation and compliance with the respective legislation on a local level. Interviews were also conducted with key solid waste management personnel at the local and national levels of governance to gain a better understanding of their roles and the inherent challenges that they experience or foresee in the management of MSW locally and nationally.

The main objective of the questionnaire survey was to determine whether socio-economic and socio-cultural aspects of society played a considerable role in determining MSW disposal practices, as well as their attitudes and behaviour towards MSW and environmental management in general. These practices included littering, illegal dumping and illegal burning. Reduction, reuse and recycling were important waste minimisation practices that were also investigated. The

willingness of households to formally practice such environmental management initiatives has been greatly ignored in the past, especially in KwaZulu Natal.

The mid-year 2006 population census conducted by Statistics South Africa revealed that South Africa's population estimate is in the region of between 47.4 and 47.9 million (Statistics South Africa, 2007). Pietermaritzburg is the legislative capital of KwaZulu-Natal and has a population of approximately half a million people of varied cultures and languages (Government Communication and Information System, 2008).

The questionnaire survey which was administered to 650 individuals from households in five suburbs of varying socio-economic status and the household MSW assessment was designed to address the objectives of this study by gauging the views of responsible members of households in the Msunduzi Municipality regarding refuse removal, their disposal methods; and their willingness to practice suggested MSW management strategies. The influence that socio-economic status (suburb) and culture (race group) have on the nature (quantity and composition) of solid waste, and the attitudes and behaviour of people with regard to solid waste disposal practices were also analysed. The results stemming from the investigation into these objectives will then be used to determine and suggest reforms that can be made to local, provincial and national service delivery strategies, aiding equity, affordability and accessibility with regard to MSW.

The MSW policy in review (Chapter 5) was meant to be reflective of whether local policy procedures and practices by municipal authorities were in fact compliant with stipulated national guidelines and legislation. The case study of the NERLS served to highlight this as a reflection of solid waste service delivery efficacy by national government, hence indicative of the degree of monitoring and control of national legislature on local policies and procedures.

The fact that South Africa has a politically determined historic past and a distinct population race grouping (Black, White, Indian, and Coloured, and as discussed in Chapter 1) alluded to the fact that correlations may exist between one or more of these factors, and the attitudes and behaviour of individuals (or households) that still continue today regarding MSW practices. Therefore,

when assessing the South African situation one should determine if the household refuse composition is indicative of differing economic levels, which then becomes a determinant of differing consumption levels of society (Cointreau *et al.*, 1985). This would then enable municipalities to focus on the different socio-income groups in their respective residential areas to effectively manage their MSW generation at the household and possibly commercial levels (where the same basic strategies can be applied). Such considerations would allow for specific community-orientated solid waste policy formulations that target problem areas.

According to du Plessis (2007), between 2005 and 2007 a quantity of 20 billion kilograms of MSW was managed through landfill disposal by local municipal solid waste management authorities; and that in several cities of which Cape Town is a good example, the rate of MSW production actually exceeded the economic growth rate. The quantity of waste generated; the method of disposal and the siting of disposal facilities have always been debatable topics (Smith, 1993). McLaren (1991) cited by Smith (1993 p28) on waste as a resource states that “waste also differs from other resources in two major ways: (1) its resource base has been steadily increasing, and (2) the goal of waste management is to reduce rather than to increase or sustain the resource base.” The resource base of waste is indicative of its potential to actually be used as a resource through processes such as recycling and reuse.

In December 2004, the Gauteng Department of Agriculture, Conservation and Environmental Affairs published a report that stated that the average South African generated at least 480 kilograms of waste per annum. The Msunduzi Municipality was said to generate approximately 400 tons of MSW per day (Templehoff, 2005). There is no doubt that these figures have definitely increased in the past two years.

## **6.2 Overview of the results**

The results of the data collection outcomes revealed that the nature of household MSW in the Msunduzi Municipality consists predominantly of paper and plastic followed by perishables. Perishables were greater in quantity among the White and Indian households, predominantly in

the suburbs of higher socio-economic status. It was further established that the types and (quantities thereof) of solid waste differed in the various suburbs. Therefore, MSW cannot be examined solely as a quantitative analysis. It requires a qualitative assessment where the composition of MSW can be assigned monetary values based on its inherent composition. For example, the fact that lower income suburbs had more spoilt cooked maize in their MSW which accounted for volume and mass instead of more meat and vegetable off-cuts as in higher socio-income suburbs and does not mean that the value of their solid waste is greater. Also, high income areas like Chase Valley had more cardboard waste due to the large quantities of pizza boxes which are indicative of higher consumer-purchasing power because of greater disposable incomes, hence suggesting that the nature of solid waste can allow for socio-economic inferences to be made.

The majority (69.5%) of households also indicated that they would prefer the municipality to remove refuse more than once a week only from suburbs. But, as discussed in Chapter 5, the fact that the solid waste divisions in the Msunduzi Municipality are operating on insufficient budget allocations means that such improvements or considerations would have to be viewed in the light of financial reviews first so that staffing and vehicle maintenance issues can receive priority. This would then facilitate adequate refuse removal and possibly be better able to consider looking into refuse removal frequencies.

It has been noted that homeowners in low-income housing settlements do not pay rates or refuse removal charges. This is especially true for those houses that government has provided for the informal dwellers at R30 000 and below. Unfortunately, the levels of refuse removal services are also irregular in these settlements as compared to those of middle and high income suburbs. Therefore, municipal regulatory frameworks and decision-making need to be more sensitive and responsive to the basic service delivery needs of those citizens living in the lower-income brackets in the country (Wall, 2000). In the low-cost housing settlement of Imbali in Pietermaritzburg, illegal dumping on vacant land in Mbhelebhele Road began after the municipality stopped picking up the MSW of nearby residents. An article in the local Maritzburg Sun newspaper highlighted the problem and within a few weeks the municipality had quietly cleaned up the illegally dumped refuse (*Maritzburg Sun*, 28/03/07).

It was found that socio-cultural attitudes do in fact influence MSW disposal practices. As discussed in Chapter 4, the results of the questionnaire survey revealed that the race groups (predominantly Black and Indian) who were politically disadvantaged in the past and who subsequently did not receive adequate service delivery such as refuse removal, still continued to practice illegal dumping and burning of MSW even though they did receive regular municipal refuse removal.

It must be borne in mind that illegal dumping is not exclusive to informal settlements, low-cost housing schemes and street traders. It still occurs in middle to high income suburbs and is also committed by educated people. The reasoning behind this could be a total disregard for environmental ethics or a cultural influence that sees nothing wrong with this destructive practice. It can be a phenomenon that has been passed down through generations in innocent ignorance as a societal norm.

In the middle to high income suburb of Lincoln Meade in Pietermaritzburg, residents discovered a dumping site that was responsible for bad odours and vectors such as flies and rats. It was also an eyesore and the Msunduzi Municipality claimed that it was not aware of this dumping site that contained scores of black refuse bags already torn and spilling MSW in its vicinity (Madlala, 2008).

The removal of illegal dumping contents always proves to be a financially costly task (Tshwane Online, 2007). Although the law allows for prosecution of illegal dumpers, there is no stringent monitoring and measures in place to ensure this. This further exacerbates the problem as there is no seriousness attached to the legal aspect of illegal dumping. In 2005 in South Africa's North-West Province, a child was killed when a bulldozer went over him while he slept at a dumping site (Environmental Justice Networking Forum, 2005).

Further, Zetter *et al.* (2002) maintain that accelerated urbanization and neoliberal rectitude have led to the planning and development of compact South African cities that do not cater for traditional space for religious and ethnic rituals. People then resort to acquiring privacy and space by carrying out these cultural practices on the outskirts of their communities, thereby

significantly contributing to negative disposal practices when their refuse is left behind, buried or burnt due to the absence of MSW disposal facilities.

Nevertheless, householders are not the only ones who practice dumping and burning in their backyards. The Howick police station (in the Midlands region under the jurisdiction of the uMngeni Municipality) had to be recently briefed and aided with the proper medical waste disposal practices and channels. Residents complained of hazardous medical waste such as coroners' gloves and garments being blown onto their gardens on windy days when the aforementioned police station illegally burns the waste on their premises (Mbanjwa, 2006). The question that arises is that if government officials and departments cannot follow and practice simple MSW and hazardous medical waste rules, how can the same be enforced onto the general public? It becomes more apparent after the interviews, that government officials and the public need to be simultaneously educated on MSW practices that enhance environmental and human welfare.

The Kruskal Wallis Test was applied to the original data set as configured for the SPSS analysis of the questionnaire survey to statistically verify the qualitative data outcomes (Chapter 4) of the survey. This non-parametric test is used to test three or more samples (varying socio-economic suburbs), where the null hypothesis states that there are no differences in the distribution of a population with regard to suburb location. The application of the Kruskal Wallis Test showed there are in fact differences between the areas (median) of residence and MSW management or disposal practices. This enforces the results from the questionnaire survey outcomes and the results from the household assessment at the NERLS, which indicated that MSW disposal practices and waste streams do in fact differ according to the varying socio-economic status of suburbs.

The Kruskal Wallis Test with the grouping variable of race was also applied to the data outcomes to determine if there actually were differences with regard to race grouping and MSW practices. There was sufficient statistical evidence to prove that race influences MSW practices in the Msunduzi Municipality. This is indicative of the fact that culture which is considered more or



less specific to race grouping actually does influence attitudes and behaviour toward MSW practices, and can be closely linked to South Africa's historic past.

The evidence for the finding that the type or composition of waste differs according to socio-economic status proved to be more conclusive than the variable of quantity, hence indicating that the value of waste also differs across suburbs of varying socio-economic status. This value of waste refers to the price that was paid for the original item before it became a waste product, as well as the price that the waste product can fetch if it is to be recovered or reused. The Kruskal Wallis Test with the grouping variable of income did indicate that MSW management practices differed among households of differing income levels.

The socio-economic status of households impacts on social patterns of behaviour that primarily arise from economic or consumer buying-power as determined by the income bracket that a particular household may fall into. Martins (2004) postulated that the level of income earned is influenced by the level of education received, where a directly proportional relationship exists between levels of education and income earned. The socio-economic status of people reflects on not only attitudes toward finance, but also on attitudes toward the environment and the nature of consumer products that can be purchased, thus influencing lifestyles and solid waste streams.

The Bureau for Market Research (BMR), in a national study conducted by Professor Helgard van Wyk while at the University of Cape Town, has shown that Black households in the high-middle and high income groups have increased by 368% to 440 000 between 1998 and 2004. White households in the same category and period increased by 16% to 642 000. The BMR forecasts also make mention of the fact that by 2007, a larger percentage of Black households would be in possession of personal disposable incomes of 46.5% as compared to Whites with 40.4% (van Wyk, 2005). This merely serves to show that a considerable percentage of previously disadvantaged Black households are now occupying suburbs of middle and high income status, thus indicative of a shift in lifestyles and possibly a shift in solid waste disposal practices – from informal to formal.

The responses to questions which were posed to determine the levels of environmental awareness of the survey respondents (Section 4.4.6) indicated that although most people are aware of the negative effects of littering and dumping, they remain largely unaware of global environmental issues such as the Kyoto Protocol, carbon trading credits, and greenhouse gas emissions. This implies that the dissemination of knowledge and environmental education is not reaching the public at large. Although these issues are widely publicized via the media, it may not reach the majority of households due to a lack of affordability or high levels of illiteracy (of the language of publication). Therefore, educational training with regard to solid waste management should be specifically tailored to suit a community or suburb where the population is fairly homogenous or all language groups should be taken into consideration. Mr Rugen Poliah's suggestion of ward committee members educating their wards or suburbs on such matters becomes highly relevant and applicable here. This would then take care of the issues relating to equity, affordability and accessibility to MSW information.

Most residents in the Msunduzi Municipality see MSW as being poorly managed in the city and in the country. As such, they indicated that they would welcome legislation that advocated the issuing of fines to litter and illegal dumping offenders. However, the greatest resistance to such environmental protection measures came from the Black and Indian populations, who were also more prone to these actions than the White and Coloured populations. Therefore, one can safely conclude that socio-cultural factors still influence attitudes and behaviour toward MSW practices. Once again the solution to this challenge is in educating the public according to concerted population group efforts, as well as possibly enforcing environmental legislation so that the penalties for MSW offenders will serve as a formidable deterrent. This in effect means that more skilled human resources would have to be tasked with this duty.

The fact that disposal methods such as littering and dumping are illegal according to NEMA, municipal solid waste bylaws and the new Waste Management Bill (2007); but still continue largely unabated, leads to the assumption that the proper monitoring, enforcement and control of legislation needs to be reviewed. Procedural and policy discrepancies need to be identified and constructive remediation must be determined. This entails a strategic, but workable framework that includes the general public as an important stakeholder and contributor to the solid waste

stream. It is often assumed that the general public is the least important role player in MSW management (eWASA strategic planning workshop, 2007). As highlighted previously, documenting and legislating solid waste procedures does not necessarily constitute its immediate practice and adaptation by local government authorities through enforcement or by the general public in an effort to promote environmental sustainability.

The Msunduzi Municipality's NERLS was initially a solid waste dump, whose lifespan goes back to approximately 55 years. The modern sanitary landfill sites have been colloquially termed as the "forerunners" of the open dumps of the past (eThekwini Online, 2005). The Bisasar Road and Mariannahill Landfill Sites have been operating since May 1980 and July 1997 respectively (eThekwini Online, 2005). Domestic waste was seen as a problem as early as 500BC in Athens, Greece; when rubbish accumulated on the streets and posed as a nuisance and a health hazard (Williams, 2005). One of the most surprising elements of the survey results was that most of the residents in the Msunduzi Municipality had very little knowledge of or are not even aware of the NERLS or its function in the city.

If methane gas from landfilling can be utilized at a wider national scale as an alternative to coal for energy distribution, then the general public would most probably have greater awareness of landfill sites, solid waste disposal and its responsible management. The environmental conservation principle then becomes two-fold; where a major greenhouse gas is being reduced and a decreased dependence upon and utilisation of fossil fuels will be realised. This proposition was a topic for discussion on the agenda of the G8 Summit in Heilingendamm, Germany on the 8<sup>th</sup> of June 2007 (The Federal Government of Germany, 2007). Some of the benefits of utilizing landfill methane gas as an alternate energy source are its reduced contribution to global warming and the fact that methane gas is a clean burning fuel, thereby not significantly contributing to smog or air pollution.

Among the key issues detailed in the National Waste Management Strategy and Action Plans (1999) which are common with the stipulations and guidelines of NEMA (1998) are capacity building, communication and creating public awareness; as well as accountability, affordability and equity (eThekwini Online, 2008a). Interesting but crucial points also include waste

avoidance and minimization, cooperative governance and environmental justice in the form of the “polluter pays principle” (eThekweni Online, 2008a). A lack of skilled labour has been cited by the DAEA as the delay in appointing environmental inspectors to enforce the “polluter pays principle,” where the focus is on industries that emit or release harmful pollutants into the environment (Costley, 2007). Guilty industries usually pay fines, reevaluate their environmental protection policies and/ or engage in green community initiatives. Nevertheless, it was established that due to a lack of human capacity and trained personnel, not all of South Africa’s industries can be guaranteed of being inspected, and those that are inspected may have a follow-up visit after two years or more (Costley, 2007). Further, it would be wise to simultaneously enforce the polluter pays principle with regard to illegal dumping and illegal burning as very rarely in this country does a householder get fined for dumping.

An important consideration for the near future would be to try and assign monetary values to solid waste outputs in the developing world, by looking into the costs that accumulate towards the collective natural resources and manufacturing procedures used to actually produce an item before it becomes waste. The contentious issue however, is attempting to actually assign reasonably accurate financial estimates for environmental procedures and its subsequent consequences. Science has already advanced to the stage of environmental auditing, where either monetary value is assigned to processes that concern the environment or the numerical evaluation of environmental systems and checks in place by institutions against prevailing environmental legislative policies (DEAT, 2004). However, without proper monitoring and control of landfill sites throughout the country, the feasibility of environmental auditing to accurately reflect the value of solid waste or its compliance with regard to environmental procedures and legislation becomes questionable. It is envisaged that only when mitigation and control measures for the reduction, reuse and recycling of MSW becomes established, will that aspect of environmental auditing play a substantial role in determining the value inherent to MSW.

Even the degradation of the natural environment through processes of littering, illegal dumping, and illegal burning; as well as the rehabilitation of landfill sites form integral constituents in the

environmental auditing process (Blignaut, *et al.*, 2004). These are some of the critical issues that one needs to consider in order to practice what has been legislated.

It can be argued that (within context) any population group may behave in a polarized manner when residing in a rural area and in a high class residential suburb. The same principle can be applied as the very same practices such as the ‘natural’ burning of solid waste in rural areas due to inadequate refuse removal services, which can be continued as a ‘norm’ in the residential suburbs of a metropolis where the service is adequately provided. In this instance, it is the mindset or ingrained attitudes of people that need to change and this can only be successfully accomplished through environmental education. One also needs to remember that if the capacity to responsibly manage solid waste is lacking and when further compounded with any number of factors such as a lack of funds or transport, an individual is unlikely to make an attempt to adequately dispose of his/ her MSW.

In Kennedy Road in Durban, the Abahlali baseMjondolo is an informal settlement where residents have been demanding land for housing and services such as potable water, electricity and refuse removal. They are purported to live amidst faecal matter and rubbish due to a lack of facilities and services (Kockott, 2005). This informal settlement actually borders the Bisasar Road Landfill Site in Durban. The informal dwellers are not entitled to any municipal services as explained in Chapter 1, but insist that attempts by environmentalists to clean up the area and supply electricity through landfill gas is unacceptable – as they demand proper land, housing and municipal services such as refuse removal like formal homeowners (Kockott, 2005). Such situations lead the argument that unless basic needs such as proper housing, safe sanitation, access to potable water and an adequate refuse removal service are met, all citizens cannot be expected to incorporate suggested methods of MSW management into their daily living; thus compromising environmental and human health in general.

On a more positive note though, the majority of the sampled households were willing to practice household waste separation and recycling. These initiatives were found to be more appealing and would gain more public support if incentives such as rebates in rates were to be offered. There was also a general indication that the majority of the households would be happy to buy and use

recycled material. However, the least receptive to such environmental initiatives were the Indian and Coloured populations. It is noticeable that culture and historic influences do in fact exert a role in solid waste practices as a medium for influencing attitudes and behaviour towards it.

Institutional capacity building and co-operative governance are crucial factors in achieving the drastic reduction of MSW landfilling by at least 2015. Capacity building and decision-making is not specific to government and/ or institutions, but is applicable to everybody – including communities. The primary goal is to empower and enable every abled person, industry or company to adopt a mindset that encourages responsible resource utilisation and solid waste disposal behaviour. Yacoob (1994) cited by the World Bank in the WRC 2000 Report emphasized the need for communities to become actively involved in the infrastructure and service delivery decision-making processes of the respective government bodies tasked with such issues. He further suggested that the differing “backgrounds” of various communities will need subsequent capacity-building such as education, training and skills so that public participation is not just seen as stakeholder recipients, but rather as resource managers. In economic terms, communities need to understand that they will not be tasked with the responsibilities of accounting for environment liabilities but as consumers who are contributing towards long-term sustainability for themselves (Wall, 2000).

Simply stated, in order to create societal awareness about responsible MSW management, education is the key means to achieving this. But, the challenge that lies ahead for the educated younger generations is the attitude and willingness to practice what has been taught in lieu of what is being practiced by the elder folk. This in essence incorporates responsible solid waste disposal methods such as recycling and reuse instead of littering, burning and dumping. Technology is continually changing and the consumer has a lot more purchasing power now than in the past. The consequences of urbanization are far reaching and manifold especially as the country’s population continues to increase despite its high mortality rates. Nevertheless, the experiences of Europe are dictated by the enforcement of environmental legislation, where the general public becomes aware of suggested environmental practices by virtually being fined or prosecuted for transgressing stipulated environmental policies – such as household waste separation or kerbside recycling (Williams, 2005).

The European Union also launched the WEEE (Waste Electrical and Electronic Equipment) directive in 2005 which basically compels manufacturers to take back and recycle their electrical and electronic products that are no longer needed by their customers (Hewlett Packard White Paper, 2007). It would be highly beneficial for the interests of environmental sustainability if such a scheme could be adopted in South Africa as electrical and electronic equipment continues to steadily grow in quantities and availability. The provision of incentives such as rebates on the purchases of new electrical and electronic equipment or a cash-back bonus for returning disused equipment would enhance this initiative (Anderson, 2007; SWICO, 2007).

Developing countries should take heed of the MSW management experiences of the developed world and capitalize on their positivity. Although MSW management has gained momentum and respect in terms of responsible recycling efforts across Europe, the same circumstances may not present themselves in and may not be applicable to South Africa. The positive aspect of this is that developing countries can choose from a number of tried and tested methods whilst modifying them to suit local climates and needs. This alone lessens the financial costs involved in devising and trying methods from inception that may not be feasible or practical at all.

South Africa may be forced to consider the possibility of establishing incinerators close to its major landfill sites as landfills reach capacity and suitable property for relocation becomes scarce. Energy recovery from the incineration of solid waste where sewage sludge has been utilized to enhance the process, has been used as a secondary resource recovery where heat is generated (exothermic process) to sustain combustion (Ausubel *et al.*, 1989). In the Msunduzi Municipality, the Darville Waste Works which manages sewage is in close proximity to the NERLS, thus facilitating such a process. The sewage sludge basically adds bulk and facilitates the rate of decomposition of organic matter due to the increased number of organic micro-organisms, hence producing more methane gas as compared to processing MSW only (Williams, 2005).

In terms of MSW, there are mixed waste incinerators now available in South Africa, where the need for waste to be sorted into the different composition types before incineration becomes unnecessary. Refuse is burnt at around a 1000 degrees centigrade and steam energy is created by

the hot gases, where it becomes possible to generate electricity (Citizens' Clearinghouse on Waste Management, 2003).

Given the current power cuts in South Africa and the fuel crisis, this form of incineration would alleviate the electricity and coal usage pressure in the respective municipalities who adopt this route for MSW disposal. Goodstein (2005) cites steeply rising MSW disposal costs and strict regulation as the principal reasons behind householders in 2002 in the United States recycling or composting almost 31% of their MSW. He further states that only 10 to 15% of MSW was incinerated and the balance was landfilled.

Chapter 7 which forms the concluding chapter will succinctly discuss the focal points of the research study and report on the implications of the results as a way forward for improving MSW management in the Msunduzi Municipality, and can be applicable to other municipalities in the country. The degree to which the aim and objectives of the study have been successfully accomplished will also be elaborated upon, with shortcomings and suggestions for future research analyses in the field of MSW.



# CHAPTER 7

## CONCLUSION AND RECOMMENDATIONS

### 7.1. Findings of the research

The study sought to analyse South Africa's approach to MSW, by investigating people's perceptions and attitudes to MSW and the discrepancies that exist between policy formulation at the national level and its practical implementation by local municipalities. Therefore, the approach to MSW in South Africa, by both the government and the public lead to a focus on investigating the shortcomings and discrepancies that exist between MSW legislative policies and actual management practices in South Africa. These investigations are also reflective of the attitudes and approaches of households to solid waste management, and their receptiveness to incorporate suggested solid waste practices with a view to environmental sustainability.

To gauge the attitudes and perceptions of individuals and/ or households to MSW and its management, the primary data collection methods included a sample survey of 650 questionnaires (aimed at household respondents), sifting through some twenty five tons of household refuse at the NERLS to categorise the MSW for specific suburbs, and interviewing the managers of the sanitary landfill site. The study was conducted in the Msunduzi Municipality under the jurisdiction of the Umgungundlovu District Municipality within the province of KwaZulu-Natal in South Africa, from August 2005 to August 2007.

The operation of the NERLS was also subjected to a critical analysis based on the landfill site permit. Supporting findings and statements were drawn from internal and external audit reports that were specific to the NERLS. The data obtained from all of the research undertakings (collectively) facilitated the following principal conclusions to be drawn:

- South Africa's MSW legislation and policies are inconsistent with the practices and procedures of local government, compromising service delivery and environmental sustainability.
- Socio-economic status and culture influence the attitudes and behaviour of people toward managing MSW, where disposal practices and the nature of the solid waste stream differs accordingly.
- A combined total of households already practicing and willing to practice recycling initiatives accounts for slightly more than half of the sample population, thus indicating future opportunities for recycling and carbon trading credits.
- The South African public remains largely ignorant of the MSW issues that impact directly on the environment and on human health, and therefore requires empowerment from the government and/ or private sectors.

The implications of the above findings support the focus of the study to review the municipal solid waste policies and strategies of local government authorities in South Africa, highlighting the shortcomings and discrepancies that exist between legislative policies and actual management practices. The attitudes and approaches to solid waste management by the residents of the Msunduzi Municipality (facilitated by the questionnaire survey) enabled further deductions to be made about the implementation and management of national government policies by local municipal authorities. The implication of the findings is suggestive of the mitigating and control measures that can be adopted in the near future to responsibly manage solid waste, not just locally, but nationally.

### **7.1.1 South Africa's legislative policies and actual management practices**

The study revealed that the MSW management practices of the NERLS were in contravention of the operating permit issued by national government authorities. This was indicated in the policy review in Chapter 5 where the landfill site permit violations were discussed. The focal points stemming from this critique indicate that the NERLS is non-compliant with legislation pertaining to securing the site against informal salvaging and restricting access to the public, the inspection

of solid waste entering the site; and the regular monitoring of leachate, soil, water and air quality. Further violations include insufficient maintenance of the site in terms of suitable cover material and accessible roads; and a lack of equipment (or replacement equipment) for optimal operation. The use of municipal vehicles to transport solid waste to the landfill site outside of the stipulated permit working hours was in direct contravention with legislation and poses the problem of inaccurate MSW record-keeping and jeopardizing the South African government's initiative in terms of the NWMS of providing a national waste information system. Hence, it is clear that solid waste legislation is not being adhered to and policy implementation is not being subjected to sufficient control measures to ensure compliance.

### **7.1.2 Socio-economic and cultural influences on the solid waste stream**

The responses to the questionnaire survey which was conducted in five suburbs of differing socio-economic status revealed that the attitudes and behaviour toward MSW, its nature and disposal practices are in fact influenced by household income and cultural beliefs. The MSW beliefs and practices of societies are widely dependent on race grouping in South Africa, and race was therefore used as a variable to determine the influences of culture. The Kruskal Wallis Test in Section 4.5 statistically validated this finding.

It was found that race groups who were previously politically disadvantaged were more inclined to illegally dump and burn their waste. This is in keeping with the practices of the Apartheid era where refuse removal and other basic services were minimal in the regions which fell under the Group Areas Act (1950 and 1966). It can therefore be construed that these solid waste practices are still viewed as a norm by the disadvantaged race groups in South Africa. However, this continues to occur due to the general population being uneducated about MSW in relation to environmental management.

The assessment of household MSW for disposal at the NERLS was based on the separation of some twenty five tons of refuse into the various types of waste categories, namely: polystyrene and plastic, glass and metal, cardboard and paper, and perishables. The refuse was received in

municipal sized black bags from three suburbs of differing socio-economic status. This assessment strongly supported the notion that the solid waste stream differs in composition in suburbs of different socio-economic status. However, it could not be substantially proven that the quantity of solid waste is directly proportional to socio-economic status. This was mainly due to the fact that there was (and still is) no administrative system in place to record the refuse tonnages collected per suburb for landfilling. Further, due to the collection of refuse after operating hours with no record keeping would have jeopardized accurate quantification, notwithstanding the fact that assessing large amounts of uncovered MSW would have posed a public hazard.

### **7.1.3 The receptiveness of households to practice solid waste strategies**

The responses to specific questions on the questionnaire led to the finding that just over one third of the population is willing to recycle. This figure increases to just over half of the population if those already practicing recycling measures such as composting are included. Another one third of the population indicated that they would consider recycling, and approximately 15% of the population is not willing to recycle at all. Therefore, it can be projected that the majority of the population in the Msunduzi Municipality would be able to practice MSW mitigation strategies, provided that they are adequately informed about the subject at hand or offered incentives such as a rebate in rates from the local municipality.

Should solid waste policies become enforced (as legislation) so that MSW management strategies have to be implemented at the household level, the general public would be forced to comply with such legislative measures. But, once again, the attitudes and receptiveness of the public to engage in such MSW practices will have to be investigated so that municipal workers and recyclers do not feel as if their roles and livelihoods are being sabotaged. More importantly, it is imperative to ensure that proper control and monitoring measures are in place to assure the success of such legislation. This will require sufficient skilled human resources and institutional capacity in the environmental and legal sectors to sustain the effectiveness of MSW management measures.

#### **7.1.4 The dissemination of environmental knowledge**

It was evident from the responses to the questionnaire survey and the interviews with municipal managers that the majority of the population remains ignorant of the MSW policies, strategies, and practices that are advocated by national government. The public seems to be aware of general environmental concepts such as the ill-effects of littering. However, even such basic awareness does not prevent them from littering. The public further remains largely unaware of national and global issues such as the Kyoto Protocol, the opportunities inherent in carbon credits and the contribution of landfill methane gas to climate change.

Most of the survey respondents indicated that they had no or very little knowledge of the NERLS, and debated its necessity to fulfill the function of safely disposing of solid waste. This in itself signals the need for environmental education at community-based levels. Once more, it is evident that environmental education needs to begin in earnest for all age groups, especially with regard to simple practices such as the need to eradicate littering, dumping and burning of solid waste.

### **7.2 Recommendations for municipal solid waste**

The study has indicated that the success of environmental sustainability projects is dependent on appropriate institutional, legislative and financial frameworks, and this concurs with the findings of Espinosa and Rivera (1994, 21) cited by Wall (2000). Other considerations pertain to the structure and functioning of institutions in their legislated capacities, the degree of co-operative governance between the respective municipal divisions and private/ public stakeholders, and the allocation of adequate operating finances. As discussed previously, the NERLS operates on an insufficient budget which compromises efficient service delivery and effective maintenance of the sanitary landfill site. An evaluation of institutions responsible for the infrastructure and service provision of MSW should ideally focus around issues of financial security, appropriately skilled human resources, and technological suitability where operation and maintenance standards are not compromised.

Urban institutions need to be proactive in anticipating (urban) growth and subsequently creating provisions for increased MSW demands, while being sensitive to the basic rights and needs of the urban poor and those who migrate into city centres and seek shelter in informal settlements. Rabinovitch *et al.* (1993) cited by Wall (2000) suggested that devolving responsibility to local institutions impact positively on service delivery if there is wide scale participation of communities and non-governmental organisations that utilise “local solutions” based on knowledge and experience. This is considered favourable for the service provision of MSW in South Africa, especially since local communities generally remain ignorant about solid waste and its associated environmental consequences due to prohibited management practices (at both the household and government levels). It has also been established that the rural areas countrywide do not receive adequate (if at all) refuse removal services, but rely on burying or burning their MSW. This has been condoned by national government because it is unable to meet the challenges of refuse removal and MSW management even though the NWMS recognizes the need for an urgent extension of waste systems and structures into previously unserved areas.

It is therefore recommended that the divisions of government tasked with managing MSW in South Africa maintain a co-operative relationship with other sectors that it impacts upon, but functions according to a clear hierarchial chain of command that supports community-based management. Rural and other areas not serviced with refuse removal and solid waste management strategies should at least be given a suitably engineered communal sanitary waste site until government addresses the issue further. Due to the sporadic locations of homesteads and properties in rural or outlying areas, workshops to educate people on MSW strategies would be advocated. In order to effectively accomplish this, municipal authorities would need human resources familiar with environmental legislation and the global challenges posed by MSW.

A shift in focus is needed to inform the general public about MSW management. There should be greater emphasis and efforts on community-based education instead of relying solely on the media for informing people about responsible solid waste management. This method is especially advocated for urban dwellers generally living within close proximity to one another, facilitating one-on-one workshops; and largely overcomes the problem where not all households are able to afford purchases of daily publications. Further, not all sectors of society in South

Africa are literate or can understand the English medium of communication. The pressure for maintaining suggested MSW practices will be far greater if the target community is personally approached. It is often a misconception that communities fail to understand the implications of MSW legislation and the recommended practices due to below average intelligence. Rather, it stems from the fact that South Africa is a multi-linguistic country whose population may not understand the language/s used for facilitating environmental education. If the South African public continues to remain uneducated on these matters, then the challenges envisaged for solid waste management will remain even greater through non-compliance.

It is not any one person, institution or authority that can be tasked with the responsibility of adequately managing MSW. Every person, household and institution generates solid waste during their lifetime. Lund (1993) very succinctly states this as given hereafter.

*“Every man, woman, and child generates garbage. Our businesses, factories, and institutional establishments generate garbage. The question is not whether we will or will not generate garbage, but how much, what kinds, and whether there is any secondary use for solid waste before we decide to bury or burn it”* (Lund, 1993 p3.1).

The barriers of socio-economic and cultural factors can be addressed at community-based levels so that the target population is more or less homogenous and this facilitates discussions on sound environmental practices. People need to understand the finer points of how and why their solid waste needs to be appropriately managed, with a view to safeguarding not only the environment, but themselves. It is strongly recommended at this stage that environmental education which incorporates issues such as responsible solid waste management practices is included in the primary and secondary school curriculums as a component of a life science subject.

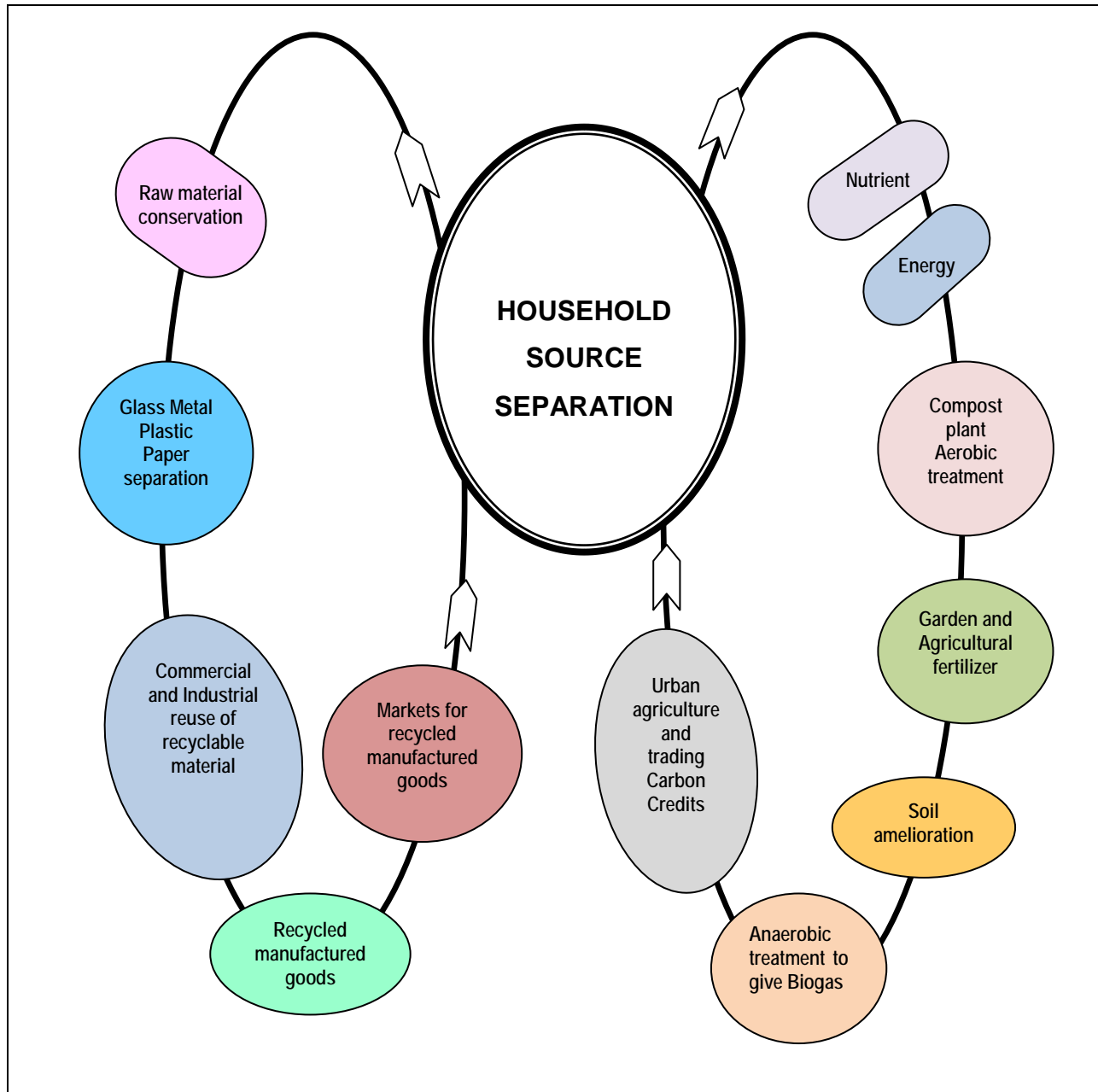
Industries can be environmentally proactive by working in conjunction with local governments to provide basic training in managing solid waste at the household and industrial levels; hopefully becoming a routine of daily living. Informal traders and street vendors also need to be specifically targeted into participating in informative environmental programmes that outline the need to manage MSW.

In order to effectively implement legislation pertaining to the management of MSW, the policies and practices of local municipalities need continual monitoring and evaluation to ensure that the goals of environmental sustainability are being fulfilled (Marshall, 2007). It becomes virtually worthless for South Africa to possess one of the best legislative environmental frameworks in the world, but have them incorrectly implemented or not at all enforced. Although solid waste legislation stipulates the need for monitoring, it is not being enforced and there are no real measures and checks in place to ensure that actual monitoring does occur throughout the country. Isolated incidences of penalising industries for violation of solid waste and environmental legislation does not constitute success in the implementation of control measures.

South Africa needs to look into seriously finalizing the new Waste Management Bill (2007), so that it can be promulgated and effectively implemented as soon as possible. However, the Bill needs to make adequate provision for monitoring the progress of its stipulated guidelines. A further consideration at a much later stage would entail reviewing the Bill to determine the success of its implementation. It would be advisable for national government to begin educating the public before enforcing environmental regulations such as household waste separation, fines for litter offenders and those who transgress legislation by illegally dumping and burning solid waste. The general public needs to be aware of the reasons for adhering to stipulated MSW policies and practices, and the consequences of non-compliance. This approach would enhance the sustainability of MSW initiatives and introduce a positive component of sharing MSW responsibility with government for the betterment of everybody.

Figure 7.1 shows the value that recycling can add to environmental sustainability if practiced according to the separation of solid waste at the household level into organic and inorganic components as practiced in most developed countries who insist upon it. This is partly due to the fact there is a scarcity of urban land and the luxury of huge waste streams cannot be afforded with the high population densities inherent to developed countries. An alternative to reducing the size of solid waste streams would be to introduce legislation governing the packaging material of products, where unnecessary packaging or its type is eliminated or amended. This becomes a debatable issue that will not be discussed within the ambit of this study as the implications thereof are wide reaching.





**Figure 7.1: Closing the Loop: Recycling objectives needed for the sustainable development of Municipal Solid Waste (adapted from Jenssen and Alsen, 2005).**

A national restructuring to eliminate or reduce refuse removal billing per household at a certain bin bag limit may prove to be a draw-card incentive to change the attitudes and perceptions of people regarding MSW and its management. A reasonable bin bag limit would be two municipal sized bin bags per household per week. If the principles of “closing the loop” in Figure 7.1 are

implemented, then the loss in monetary value for refuse billing should not outweigh the advantages afforded by engaging MSW as a resource base. Here, organic waste such as the perishables and garden waste from households can be composted or used to generate methane gas to feed electricity grids; and inorganic waste can be recycled into finished marketable products. The most noteworthy point of separating waste at the household level or at the source of generation is that it promotes cleaner technology, thus reducing recycling costs.

If the newly suggested waste hierarchy is going to be enforced as proposed in the new Waste Management Bill, then the Department of Water Affairs and Forestry (DWAF) and the Department of Environmental Affairs and Tourism (DEAT) should ensure that a diversified and skilled personnel base becomes available for the closing of administrative gaps in the management of MSW, and that easily accessible channels of communication can be provided between government and the public. Recommendations for the improvement of the study follow.

### **7.3 Recommendations for the improvement of the study**

After careful insight into the outcomes of the study, the possibilities for improvement of the study focuses mainly on extending future solid waste research initiatives into informal settlements and rural areas on a provincial and national level. Further avenues for investigating MSW service delivery can include analyses that are specific to the different socio-economic suburbs within a province in South Africa, enabling shortcomings in service delivery (by municipal authorities) and solid waste practices by residents to be rectified – hopefully suggestive of a positive way forward through co-operative governance and public-private partnerships.

Investigations pertaining to the compliance of landfill sites with legislative policies and recommended practices throughout the country would allow for comprehensive solid waste management within metropolitan regions, and could possibly extend itself into Sub-Saharan Africa where MSW management is well below acceptable levels. The metropolitan regions within South Africa would benefit by being interactive with each other, enabling the sharing of

research and techniques to improve MSW management nationally. Such interaction would be encouraged through the participation of key solid waste management personnel and interested private role players at informative waste management workshops. However, such workshops should extend to other government sectors which may invariably influence and be influenced by the waste management sector.

#### **7.4 Implications for policy direction and further research**

The discussion of the results and reforms presented in Chapter 6 and in this chapter for a review of MSW legislation to include checks and measures for the monitoring of solid waste policies and practices were made possible through integrated research methods, reviews and critical analyses. The thorough review of MSW legislation by all sectors of society is needed so that the most comprehensive and effective reforms can be instituted. The new Waste Management Bill (2007) needs to be implemented soon with proper monitoring facilities in place, as delays in environmental legislation continue to hinder the process of environmental sustainability which surpasses trans-frontier boundaries.

The Bill also introduces waste management practices such as waste reduction, reuse and recycling to be adopted by the public. However, this cannot be successfully achieved in the space of a shortened timeframe if the citizens of South Africa are not adequately prepared for these challenges. As such, it is proposed that environmental education be devolved to a community-based level, where the finer details of MSW management can be best explained. The use of the various radio stations as a broadcasting media would further ensure that the stipulations of responsible solid waste management reaches a broader spectrum of the population. National government needs to provide sufficient service provision budgets within which local municipalities can adequately manage MSW, while empowering themselves and the public about solid waste policies and procedures.

Refuse removal tariff structures should be reviewed and adjusted accordingly to the socio-economic status of suburbs, the quantity of solid waste being produced, and the community

initiatives to reduce the solid waste stream. This would require follow-up measures to ascertain the success of providing incentives for communities to manage their MSW. It is expected that financial losses from the provision of these incentives will balance with the reduced costs associated with landfilling and the economic gains from viable recycling opportunities. This would still be subjected to further investigations to determine long term viability.

The implementation of MSW legislation into local policies and practices should not be used as “pilot tests” in certain communities throughout the country as has been previously done. It has proven to be a lengthy exercise that does not trickle smoothly nationwide. Each municipality needs to be geared to adopt prevailing and new environmental legislation so that monitoring becomes a priority on the agenda of national government instead of an ad hoc procedure. Community research on the subject itself and employing community leaders to advocate MSW policies and strategies would aid government in their task and lead to a sustainable practice without compromising efficiency. To reiterate, it becomes necessary for government to initiate information dissemination, the mechanisms through which communities would be best able to acquire information about how to engage in the successful practices of MSW management. Additional considerations pertain to the issues of government being sensitive to the culture and economic status of communities, as well as their levels of education.

An attempt to improve the levels of MSW through the introduction of regional landfill sites as is currently the case with the uMgungundlovu District Municipality (uMDM) is being seen in a positive light (Umgungundlovu Municipality Online, 2008). Although the IWMP for uMDM is in the process of finalizing waste information databases, suitably enabling human resources with management skills, and improving cooperative governance, discrepancies in economies of scale between the several local municipalities that fall under regional municipal authorities may pose a major problem. Further, the creation regional landfill sites in the country would have to take many factors into consideration, such as local transfer stations, MSW transportation costs and levels of service delivery to the ratepayer, odour control, and adequate containment of MSW in vehicles to prevent litter on national roads from falling loads of municipal vehicles. These are just some of the issues that one needs to consider and weigh against the costs of new and

operating local landfill sites. However, this aspect of MSW warrants research in its entirety and cannot be adequately discussed here.

The future direction of solid waste management research needs to incorporate not just MSW from households and commercial outlets, but waste from industrial and hazardous waste sites as these waste types inevitably find their way onto sanitary landfill sites – either directly or as an end-product (ash) of incineration. As mentioned above, research and investigations into solid waste disposal in rural villages in South Africa should be intensified as these areas are not adequately serviced (if at all) with refuse removal facilities. The argument that is raised is that the South African government condones the burying, communal dumping and burning of solid waste in rural areas because they are unable to provide a refuse removal service. Without proper monitoring and control, the very same solid waste practices which is illegal by law, are encouraged as waste management measures. Is the government perpetuating groundwater pollution through leachate contamination? What measures and checks are in place in rural areas to monitor solid waste disposal?

From the above discussions and assuming the Msunduzi Municipality is representative of other metropolitan areas, it is clear that Municipal Solid Waste is not adequately or efficiently managed in South Africa, even though the laws governing solid waste and environmental management are worthy of global standards. Although attempts are being made to develop rural areas in the country, progress is slow and educating communities about Municipal Solid Waste should not be a foregone conclusion of general knowledge. The appropriate way forward to achieve responsible solid waste management in South Africa in the interests of environmental sustainability would be to provide adequate refuse removal services to all sectors of society (including rural and urban areas), while simultaneously educating the public about how to manage their solid waste. Legislation in this regard as previously stated should be enforced with strict monitoring and control measures to ensure it success. This would require appropriately qualified and skilled staff in sufficient numbers by the relevant government authorities (especially at the local municipality levels) to effectively implement, monitor and sustain the solid waste policies stipulated by legislation.

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## APPENDIX A: MSW QUESTIONNAIRE FOR HOUSEHOLD SURVEY

### PERSONAL DETAILS:

**N.B. Participation in this questionnaire survey is voluntary. The results of this research are for statistical purposes only and will not be used against you.**

|                                  |   |         |          |           |           |       |
|----------------------------------|---|---------|----------|-----------|-----------|-------|
| Area of residence                | : |         |          |           |           |       |
| Race group                       | : |         |          |           |           |       |
| Employed/ Unemployed             | : |         |          |           |           |       |
| Average household income (rands) | : | 100-500 | 500-1500 | 1500-3000 | 3000-5000 | 5000+ |
| Additional information           | : |         |          |           |           |       |

### RESEARCH STATISTICS

Kindly X boxes where applicable.

1. How do you get rid of your household refuse?

|         |                 |                       |                  |         |
|---------|-----------------|-----------------------|------------------|---------|
| burn it | leave on street | municipality picks up | take to landfill | dump it |
| other   | (specify)       |                       |                  |         |

2. Which general refuse do you have more of?

|                  |               |                  |                 |           |
|------------------|---------------|------------------|-----------------|-----------|
| leaves and grass | tree branches | tyres and rubber | building rubble | old items |
|------------------|---------------|------------------|-----------------|-----------|

3. About how many bin bags of refuse do you have a week?

|        |        |         |     |
|--------|--------|---------|-----|
| 1 to 3 | 4 to 6 | 7 to 10 | 10+ |
|--------|--------|---------|-----|

4. What do you do with your garden waste? \_\_\_\_\_

5. With regard to the New England Road Landfill Site:  
Please check the following boxes

(can x more than one box)

- know of its existence only
- visited or been to the site already
- go there often to dump/collect waste
- aware of what the site is all about
- causes unpleasant odours/smells
- responsible for flies and rats
- is necessary for treating our wastes
- should be located away from residential areas

6. Which of the following forms the bulk of your solid waste?

|                       |                    |             |           |
|-----------------------|--------------------|-------------|-----------|
| paper and<br>plastics | glass and<br>metal | perishables | cardboard |
|-----------------------|--------------------|-------------|-----------|

7. What is your level of satisfaction with the current refuse removal?

|                          |                |                          |              |
|--------------------------|----------------|--------------------------|--------------|
| <input type="checkbox"/> | dissatisfied   | <input type="checkbox"/> | satisfied    |
| <input type="checkbox"/> | very satisfied | <input type="checkbox"/> | not affected |

8. Is there a need for more frequent refuse removal?

|                          |     |                          |    |
|--------------------------|-----|--------------------------|----|
| <input type="checkbox"/> | yes | <input type="checkbox"/> | no |
|--------------------------|-----|--------------------------|----|

9. What do you think about the current solid waste management practices in Pietermaritzburg?

|           |      |            |      |           |
|-----------|------|------------|------|-----------|
| very poor | poor | acceptable | good | very good |
|-----------|------|------------|------|-----------|

10. What do you think about the solid waste management practices in South Africa?

|           |      |            |      |           |
|-----------|------|------------|------|-----------|
| very poor | poor | acceptable | good | very good |
|-----------|------|------------|------|-----------|

11. What do you think about littering and illegal dumping in the country?

|                |                        |                |                          |
|----------------|------------------------|----------------|--------------------------|
| should<br>stop | makes no<br>difference | fine<br>people | it's up to<br>the person |
|----------------|------------------------|----------------|--------------------------|

12. If the South African government imposed fines for public littering, would you be:

|           |             |       |          |            |
|-----------|-------------|-------|----------|------------|
| irritated | indifferent | happy | relieved | welcome it |
|-----------|-------------|-------|----------|------------|

13. Would you be interested in using vegetable (organic) waste that you throw away as compost for your garden or crops?

|     |    |       |          |         |
|-----|----|-------|----------|---------|
| yes | no | maybe | doing so | already |
|-----|----|-------|----------|---------|

14. How do you feel about separating your glass and metal, paper and plastic, and perishables into separate bags?

|            |         |               |          |         |
|------------|---------|---------------|----------|---------|
| against it | willing | will consider | happy to | recycle |
|------------|---------|---------------|----------|---------|

15. If there was a reduction in rates, money back or certificate in recognition of recycling, would you:

|             |             |           |
|-------------|-------------|-----------|
| consider it | practice it | ignore it |
|-------------|-------------|-----------|

16. Waste such as glass, metals, plastic and paper can be sold for cash. Would you like to make money in this way?

|                          |     |                          |    |
|--------------------------|-----|--------------------------|----|
| <input type="checkbox"/> | yes | <input type="checkbox"/> | no |
|--------------------------|-----|--------------------------|----|

17. I am :  aware  unaware

don't know too much about the fact that littering can cause soil and water pollution. It can also choke birds and fish, while aiding the spread of disease by pests such as rats, flies, worms and other insects that breed in it, especially take-away litter?

18. Are you aware that the refuse removal rates can increase by R40 to R50 should the landfill site relocate to the city outskirts?

yes  no

19. How do you feel about air, water and ground pollution in South Africa?

very poor  poor  acceptable  bad  very bad

20. Have you heard about The Kyoto Protocol?

yes  no

21. Do you litter :

no  seldom  often  when travelling  at the beach

22. Did you learn about caring for nature and the environment at school?

yes  no

23. Did you read the newspaper and learn about protecting the natural environment?

yes  no

24. Do you believe that our children are the future, and we must protect nature for them as well?

yes  no

25. Would you use books and paper made from recycled material?

yes  no  maybe

*If there is any aspect that you would like more information on please inform the researcher who will be more than willing to help you.*

Kindly note that the contents of this questionnaire is for research purposes only and will not be divulged to any authority or to any one to prejudice you in a personal capacity.

Thank you for your participation. It is sincerely appreciated.

**APPENDIX B<sub>1</sub>: QUESTIONS POSED DURING THE INTERVIEW  
WITH RAMU RAGHUNANDAN (NEW ENGLAND ROAD  
LANDFILL SITE MANAGER 2005)**

1. What was the historic reason for the location of the New England Road Landfill site, especially so close to the Msunduzi (Duzi) River?
2. What is the expected lifespan of the landfill currently?
3. How many metres of buffer zone are there around the landfill?
4. Did the council map out any potential landfill sites, and why were these areas considered?
5. This is a municipal landfill. What happens to Pietermaritzburg's hazardous wastes?
6. How are these wastes transported?
7. What is the approximate monthly or per annum running allocation of the budget for the operation costs of the landfill?
8. What quantity of soil cover material is needed per month?
9. In your opinion, what is the extent of public and/ or NGO resistance to the current location and operation of the landfill?
10. Have you ever considered having a scientific environmental research department as compared to frequently contracting out to consulting companies for environmental projects and monitoring?
11. Is there any sludge that was previously or is currently being accepted from Darville onto the landfill site?
12. With the knowledge that you are equipped with, do you think that Darville is a well managed site?
13. Would you be keen to accept sludge from Darville to enhance the methane gas to energy potential – should carbon trading credits become a reality in the near future?
14. Do private companies play a role in the municipal waste management infrastructure, as in collection and transportation of wastes?
15. Are the vehicles of these private contractors inspected to ensure safe and proper standards of service delivery?

16. Is there a check in place to periodically inspect those municipal vehicles that transport wastes?
17. Is there a separation process in place, where glass, plastics, metals and cardboard are sorted into different piles?
18. Are waste oils, paints, solvents, insecticides and batteries accepted at the landfill for disposal? If so, are there any precautionary measures taken?
19. Are there any areas outside of Pietermaritzburg that the landfill site services?
20. Please explain the classification of landfill sites, example: G:L:B+.
21. Are recycling and reuse currently being practiced at the landfill site? What are your views on these subjects?
22. How would you rate the control measures for the type of waste that is allowed to enter the landfill premises?
23. Is there soil cover over compacted waste at the end of each day, without any exceptions?
24. Is there a stipulation on the thickness of the soil cover?
25. Describe the extent to which scavengers plague the site.
26. Is the vegetation (normally edible) that surrounds the site perimeter fit for human consumption? Have there been any scientific studies to determine flora toxicity levels (if any)?
27. Precipitation, existing liquids in waste and liquids through microbial action (anaerobic degradation) are the main sources of leachate. Is it safe to assume that precipitation is a major leachate hazard?
28. What is the lifespan of the geotextile liner, and the frequency of leachate testing?
29. Are there changes in practices or behavioural aspects of the landfill with a change in season?
30. Are there any special precautions taken during the rainy seasons or on rainy days?
31. If leachate levels were to be exceptionally high, would that be a strong indication of a leaking liner? Are there any other factors to indicate a leaking liner?
32. How would the above be remedied if it did occur?

33. Has there been a steady increase in the amount of municipal or household wastes noted (including garden refuse), from existing and newly established suburbs?
34. Whose responsibility is it, if anyone's, to control or clear the wastes often associated with informal settlements?
35. What are your views on methane gas, the Kyoto Protocol and carbon trading credits?

## **APPENDIX B<sub>2</sub>: LOCAL MSW MANAGEMENT INTERVIEW**

1. How would you rate or assess MSW management in Pietermaritzburg and in the province respectively?

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2. Would South Africa be considered 'on par' internationally with regard to MSW management?

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3. What roles do the Umgungundlovu District Municipality and the Msunduzi Municipality play in the operation and management of MSW and the New England Road Landfill Site?

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4. What is the scope of DWAF's influence in the environmental monitoring aspect of the NEW England Road Landfill site?

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5. Kindly comment on the impact of the Kyoto Protocol and Carbon Trading Credits with regard to the Msunduzi Municipality?

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6. Are there any expectations for a new landfill site in the near future for the Msunduzi Municipality; and if so where will the most likely location be?

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7. How will a new landfill site impact on the ratepayer, especially in low income areas?

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8. What would you list as the most important causes for concern or stresses that characterize the current MSW management in Pietermaritzburg?

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9. Kindly identify the areas of MSW management that require high costs.

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Does the Msunduzi municipality actively encourage recycling on a householder and /or commercial level/s? If there are any such initiatives, please explain.

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10. Would you consider it more advantageous to practice recycling on a household separation level first or at the landfill site itself?

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11. What are your views regarding landfilling and incineration in this municipality?

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12. Are there any waste categories currently subjected to incineration in Pietermaritzburg?

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13. Were there any discontinuations of waste incineration in Pietermaritzburg; and if so, why?

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14. Are there adequate provincial and national support structures in place for the Msunduzi municipality in terms of MSW management?

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15. Are there any other garden refuse or formal refuse dump sites in the Msunduzi municipality besides the New England Road Landfill Site?

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16. Are there any recommendations that you would like to mention regarding the improvement of MSW management in South Africa?

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**APPENDIX B3: NATIONAL MUNICIPAL SOLID WASTE  
MANAGEMENT INTERVIEW**

1. What is the general impression that is held by officials in the local municipal solid waste (MSW) government departments with regard to the standard of MSW management in KwaZulu Natal and in the country?

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2. Are there any areas for concern and /or any new developments in the pipeline on a national level with regard to MSW management?

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3. What is your impression of the New England Road Landfill Site and the Msunduzi Municipality's management thereof?

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4. Will you kindly comment on the financial and environmental impact that the Kyoto Protocol has or will have on South Africa?

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5. Are there any landfill sites in the province or in the country that currently convert landfill methane gas into electrical energy?

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6. Do you consider South Africa 'on par' with First World countries from an environmental perspective, especially with regard to MSW?

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7. What is the scope of DWAF in the monitoring of South Africa's landfill sites?

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8. Furthermore, are there adequate measures in place to ensure that local municipal strategies and practices are in keeping with MSW legislation and policies?

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9. How would you rate the level of MSW recycling provincially and nationally?

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10. Do you think that there are adequate municipal budget allocations and national support structures in place for responsible environmental and MSW management in the province/s?

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11. Are there any recommendations or suggestions that you would like to discuss, regarding the improvement of MSW management in South Africa – especially from a householder perspective?

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