

An Investigation into Solid Waste Management in
Townships: The Case Study of Clermont, Kwa-Zulu Natal

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ABSTRACT

An environmental challenge that is currently plaguing the South African townships in the Metropolitan Area is the volume of solid waste being illegally disposed in open spaces along road verges as well as in streams. The research aims to identify the root cause of illegal dumping in the township of Clermont, Kwa-Zulu Natal. The researcher used quantitative, qualitative and observation methodologies to collect data from member's of the community of Clermont. The severity of the problem will be measured by looking at different age groups; level of income per household as well as gender. In general waste management and environmental management has received little attention compared to other socio-economic problems like un-employment.

As the bulk of the world's population move from rural areas to urban areas, poverty is becoming an increasingly urban phenomenon. Environmental problems range from impairment of human health, economic and other welfare and extinction of the ecosystem. The urban poor bear the greatest burden of urban environmental risks. The most significant environmental challenge in South Africa is effectively management of waste. Currently the focus in South Africa has been on waste disposal rather than on waste prevention. Consequently there are no incentives for reducing waste and industries are not required to submit plans for waste management when commencing a new business. Waste management legislation is fragmented; as a result there is a lack of control in waste management.

This research will investigate whether community members are aware of what is expected from them by the municipality and private waste collection companies. It will further analyse at the norm of waste disposal within the developing countries compared to developed countries. The study will attempt to provide practical solutions for the township of Clermont. The study has five chapters. The first chapter introduce the problem, objectives and hypothesis. The second chapter deals with the theoretical review to help the reader understand different cases and how waste management handled in different parts of the world. This has been done by looking at the international, national and local level, comparing waste management trends. The third chapter describe the study area in detail and different scientific methodologies researcher used to prove or disprove the hypothesis and objectives that were set in the first chapter. Chapter four analyses all the data that was collected from the community of Clermont and unpack other underlying factors that lead to poor waste management in this township. For example the researcher will conclude using the data collected if the frequency of waste collection is sufficient for the community and what can be done to minimize illegal dumping. Chapter five, which is the last chapter of this dissertation will suggest recommendations that can be used to correct all problems that associated with illegal dumping in Clermont Township.

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Most of all I thank God for all the blessings he had given me and giving me strength to go on when the world said it's impossible. I have learnt that through prayer everything is possible and if life gives you lemon make lemon juice.

Declaration-Plagiarism

I Precious S'thabile Ngeleka declare that

- 1) The research report in this thesis, except where otherwise indicated is my original research.
- 2) This thesis has not been submitted for any degree or examination at any other university.
- 3) This thesis does not contain other person's data, graphs or other information, unless specifically acknowledgement as being sourced from other persons.
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Precious S'thabile Ngeleka

ABBREVIATIONS

CO₂ - Carbon dioxide

CH₄ - Methane

CT - Cleaner Technology

DMA- Durban Metropolitan Area

D'MOSS - Durban Metropolitan Open Space System

DEC - Department of Environmental Conservation

DEAT - Department of Environmental Affairs and Tourism

IDP - Integrated Development Plans

KAB - Keep America Beautiful

LA21 - Local Agenda 21

LAC - Latin American Countries

LCA - Life Cycle Assessment

LD - Lethal Dose

MSW - Municipality Solid Waste

NFPA - National Fire Protection

NGO - Non- Government Organisation

NWMS - National Waste Management Strategy

SWMP -Solid Waste Management Policy

WTE - Waste-to-Energy

Chapter One

Introduction and Contextualization of the Problem

1.1 Pre-amble

The study of degradation, since the Earth Summit of 1992 has become a global phenomenon. The subject has gained phenomenal interest among the international community. Conservationists, environmentalist, planners, researchers, academics and those that are concerned with environmental issues began documenting the alarming rate of environmental degradation and subsequent impacts. Reference in this regard can be made to air pollution for example ninety 90% of South Africa's electricity is generated by burning coal, which contains 1.2% of sulphur and 45% ash. Burning of coal contributes to air pollution.

Department of Water Affairs and Forestry (DWAF) admits that 160 of the country's 294 dams did not comply with modern safety standards. The destruction of indigenous forests in South Africa is estimated to be about 2.2 million square kilometers of indigenous forest that have been degraded including soil erosion. It is estimated that approximately 25% of South African topsoil is lost due to water erosion, about 2.5 tons of hectares of soil is lost annually. Human dependence on these resources, most of which are non-renewable, compounded by growth in population numbers will inevitably impact on the quality of life of the global community (Moyo, 1995).

Simmons (1989) cited in Moyo 1995) notes that energy consumption has played its role in environmental degradation in that the use of coal, oil and natural gas has reduced direct dependence of industries on biological energy fixation through plants. Consequently this

has changed the way human beings relate to the environments. In developed countries eighty percent (80%) of the population use electricity instead of fuel wood, however the electricity generation also cause air pollution due to coal burning. This is a result of the scarcity of fuel wood and also to avoid air pollution.

Concerns about the environment gave rise to certain global meetings in order to come up with some solutions. These included UN Conference on Human Environment in Stockholm in 1972; Brundtland Commission Report of 1987; and Earth Summit at Rio de Janeiro, Brazil in 1992. In all these conferences, the nations of the world met to discuss environmental problems related to human impacts. Rio conference was important in that it initiated two legally binding conventions for protecting the global environment; these are Local Agenda 21 (LA21) which was to be implemented at a local level and Environmental Management Policies that could result in the sustainable use of environmental resources (Remmen, 1999).

Insufficient and ineffective waste collection, storage and disposal are, *inter alia*, one of the environmental problems in Namibia. Consequently such conditions threaten public health and the aesthetic nature of the environment. According to Re'Source (2000), insufficient bins at residential and commercial properties results in waste collectors having to collect loose waste which is time consuming and of course there is the problem of wind blown litter. To exacerbate the existing problem the vehicles utilized for waste collection are conventional open trucks without covering nets.

According to Seaberg (1988), the problem in Namibia can, to a large extent can be attributed to the lack of awareness with reference to waste and the low priority given to solid waste management as a municipal service. Educational programs related to waste management were implemented to create awareness. Waste collection vehicles were

improved and waste bins were installed in residential areas as well as in commercial properties. Research concerning solid waste management was done, which helped to identify the needs of different areas in Namibia and also to implement strategies to overcome the problem of waste disposal.

Barbara (1998) estimates that in the United States agricultural and industrial waste disposed per capita per year is in excess of one ton. In New York 4,4 kg of solid waste is generated by each person per day, which amounts to 24 000 tons being disposed off daily. The cost of waste disposed in California amounts to 1 billion dollars per year.

Latin American countries are characterized by high population growth, increase in urbanization and economic growth, and are confronted with increased disposal of solid waste especially non-biodegradable products. The packaged goods market is the primary cause of solid waste in these countries (Prates & Eli, 1995).

Foreign knowledge of managing solid waste is being implemented in various countries of Latin America. The Latin American Countries have to purchase waste management technology and this had been proven to be very expensive, with Mexico and Venezuela spending vast amount of money. One must bear in mind that these countries are still developing countries with limited finances. Research suggests that for a country to be successful in managing its environment indigenous knowledge must be considered (Nozick, 1992). This will enable the country to effect savings that can be used for other basic needs that includes education, health, housing and food. There is also a plastic ban in Latin American countries. This will mean considering a biodegradable material that can substitute plastic. However other countries have different strategy of dealing with the problem, for example using lubricant oils for special recycling regimes. The 1992 Rio

Summit led to the introduction of tougher new environmental laws in LAC (Latin American Countries) region. Landfills are filling rapidly, while local opposition to new sites and incineration are growing. Consequently, solid waste management is climbing up the political agenda in the region (Nozick, 1992).

Currently the ownership in the waste management companies is monopolized, in that there is no evidence of new companies coming in the business. The landfill tax is said to play an important role in boosting leading operators in the United Kingdom, the main benefit of the landfill tax is that it has influenced business's waste management decisions in that most companies in the United Kingdom have began practicing recycling, re-use and waste minimization. The main objective of the landfill tax was to minimize the amount of solid waste that comes from households and companies (Nozick, 1992).

1.2 Waste disposal

Waste disposal is when humans throw away-unwanted materials on land. Such materials are regarded as useless, however through research it has been proven that waste materials can be reusable through recycling.

The past forms of governance in South Africa have, to a large extent exacerbated the environmental challenges confronting the country. The denial of access to land ownership, education and certain essential services created a sense of unworthiness among the affected communities. This contributes significantly to the levels of natural resource degradation such as water and land, in areas occupied by affected communities. The severity of the deterioration of these natural resources however is not restricted only to those areas where services are lacking (informal communities) but also to formal established areas, especially African townships (South Africa Year Book, 2001/2002).

Solid waste disposal in South Africa has been a major problem for many years. This is characterized by illegal dumping and improper management of waste that result from poor agricultural practices, wood processing industries, repair shops and scrap yards as well as service stations and mining related activities. According to the South African White Paper on Environmental Management (May 2000), the environmental and socially unacceptable practices such as illegal dumping and littering can impact negatively on human health. Waste disposal facilities themselves are sited and designed in such a manner that is detrimental to communities. Reference in this regard can be made to the Bissesar Road landfill site as well as the one in Umlazi which has been decommissioned. Both of these sites are situated in close proximity to densely populated residential areas.

According to Environmental Management Policy for Durban Metropolitan Area December 1998, the latest statistics indicate that 350 million tones is generated annually. Currently, the control over land pollution is exercised through thirty-seven Acts of Parliament, sixteen Provincial ordinances and Local authority by-laws. Apart from the Environmental Conservation of Act 73 of 1989 the focus of the by-laws dealing with solid waste is on the protection of public health and prevention of nuisances related to solid waste.

According to Environmental Management Policy for the Durban Metropolitan Area December 1998, an integrated pollution and waste management policy is currently being developed for the Durban Metro Area (DMA). The policy will be developed and implemented in collaboration with all stakeholders concerned. All relevant authorities will collaborate in an attempt to control pollution and manage waste disposal. The local government of the area with the co-operation of CBOs, NGOs, business and labour will

be jointly involved in problem solving and determining common goals and standards for pollution and waste management. Such positive attempts will contribute to a sustainable economy and a clean and healthy Metropolitan Area. (Durban Metropolitan Open Space System Framework Plan ,1999)

1.3 Contextualization of the problem

Several goals have been mentioned in the report of Environmental Management Policy for the Durban Metropolitan Area December, 1998, but the goal that is of interest in this research is to have a clean and healthy metropolitan environment through establishing an integrated system of pollution and waste management and effective solid waste management. In order to achieve such objective the local government is obliged to work towards avoiding, minimization, recycling, collecting and disposing responsibly of commercial, domestic and industrial solid waste produced in the Durban Metropolitan Area. This will mean that there responsibility will shift from waste collectors to waste producers.

As the bulk of the world's population move from rural areas to urban areas, poverty is becoming an increasingly urban phenomenon. The World Bank estimated that in 1988 approximately one quarter of the developing world's absolute poor was living in urban areas and projects that by the year 2008 this proportion will increase to one-half (URT, 1997). It is said that within the next 20 years more poor people will live in the cities than in rural areas (URT,1997). Increasingly, the lives of urban slum dwellers, street children and those forced to drift between the city and its fringes will characterize the face of global poverty. Environmental problems range from impairment of human health,

economic and other welfare losses to extinction of the ecosystem. The urban poor bear the greatest burden of urban environmental risks.

Currently the focus in South Africa has been on waste disposal rather than on waste prevention. Consequently there are no incentives for reducing waste and industries are not required to submit plans for waste management when commencing a new business. Waste management legislation is fragmented; as a result there is a lack of control in waste management.

According to the report of Environmental Management Policy for the Durban Metropolitan Area, December 1998, an environmental challenge that is currently plaguing the African townships in the Metropolitan Area is the volume of solid waste being illegally disposed in open spaces along road verges as well as in streams. The situation has become a major concern to authorities, especially in view of the fact that, unlike the apartheid era, services relating to collection and management of solid waste are being rendered in these areas. One such township where solid waste management is a problem is Clermont. The township, despite being a formal residential area is similar to informal communities with respect to waste disposal. Mountains of solid waste disposed in vacant spaces characterize the area of Clermont. Such sites serve as a breeding ground for rats, insects, worms and rodents. These together with the noxious odours emanating from the illegal dumps pose a major health hazard to the communities. Waste disposal services are being rendered in the townships, but yet illegal dumping is as rampant as ever in the area. This study is being undertaken to determine the reasons for such a situation

1.4 Aims, Objectives and Hypothesis

1.4.1 Aim

The aim of this study is to assess solid waste management in the Township of Clermont.

1.4.2 Objectives

- To identify waste streams that is generated in Clermont Townships in order to verify whether they can be recyclable.
- To record if the waste collection frequency is adequate and can minimize illegal dumping
- To examine the impact of illegal dumping on the communities
- To review the waste management mechanisms
- To assess the main root cause of illegal dumping.
- To recommend appropriate waste management strategies to local authorities

1.4.3 Hypothesis

Illegal dumping of solid waste result from poor waste management practices.

1.5 Chapter sequence

The first chapter, is primarily concerned with contextualising the problem under investigation, which is followed by a comprehensive review of literature pertaining to solid waste management. The study area and methodology approach that was chosen to execute the study will be discussed in the third chapter. The fourth chapter will focus on the results of the investigation presented in tables and graphs. Discussion of the results

and recommendations together with the overall conclusion will encompass the fifth chapter.

1.6 Conclusion

For communities to achieve better quality of life, waste minimization plans must be put in place and be implemented properly. Formal waste management techniques must be implemented as we experience increased population in both developed and developing countries.. Likewise it is important for the townships to have a strategy on how to better handle their waste materials that are generated. This will reduce the amounts of waste being disposed in landfill sites South Africa. This study sets to investigate how the community of Clermont township deals with waste management.

Chapter two

Solid Waste Management: A Theoretical Review

2.1 Introduction

Solid waste is commonly called a third pollution after air and water pollution. Solid waste results from human activities and usually refers to discarded, useless and unwanted material. It is composed of highly heterogeneous mass of unwanted materials which, *inter alia*, includes homogenous accumulation of agricultural, industrial and mining waste (Darmstadter, 1992).

According to Technobannoglous (1983) solid waste may be categorized on the basis of content and partly on moisture and heating values. The typical classification is given as:

- Garbage – which refers to perishable solid waste constituents produced during the preparation or storage of meat, fruit or vegetables. These solid waste have a moisture content of about 70% and heating value of 6×10^6 (J/kg);
- Rubbish – refers to non-perishable solid waste constituents either combustible or non-combustible. Combustible material will include paper and non-combustible will include metal and glass;
- Pathological waste – these are dead animals and human waste. The moisture content is 85% and there are 5% non-combustible solids. The heating value is around 2.5×10^6 J/kg;
- Industrial waste- refers to chemical paints, sand, metal ore processing and sewage treatment sludge; and

- Agricultural waste –these are animal manure and crop residues. The principal sources of solid waste in this category are domestic commercial, industrial and agricultural activities (Rao, 1995)

2.2 Hazardous wastes

According to the EPA (Environmental Protection Agency) hazardous waste is a combination of wastes that pose a potential hazard to human health or living organisms (Environmental Protection Agency, 1996). This is due to the fact that such wastes are non-degradable; biologically magnified and lethal. Hazardous waste tends to cause detrimental cumulative effect. However all waste can be harmful to our environment when it is not properly managed. For example when waste is not controlled and dumped in open spaces, it can cause significant problems to the environment, especially if such waste is hazardous (Keep America Beautiful, 1996). In most cases environmental problems are exacerbated by the general inadequacies of the collection and disposal systems (Rao, 1995). There is no doubt that the issue of hazard waste disposal needs urgent attention in South Africa, but the acceptability of a landfill continues to be questioned due to shortage of land. Incorporating environmental issues into the initial site selection studies can optimize the location of a hazardous waste landfill (Technobanoglous, 1983).

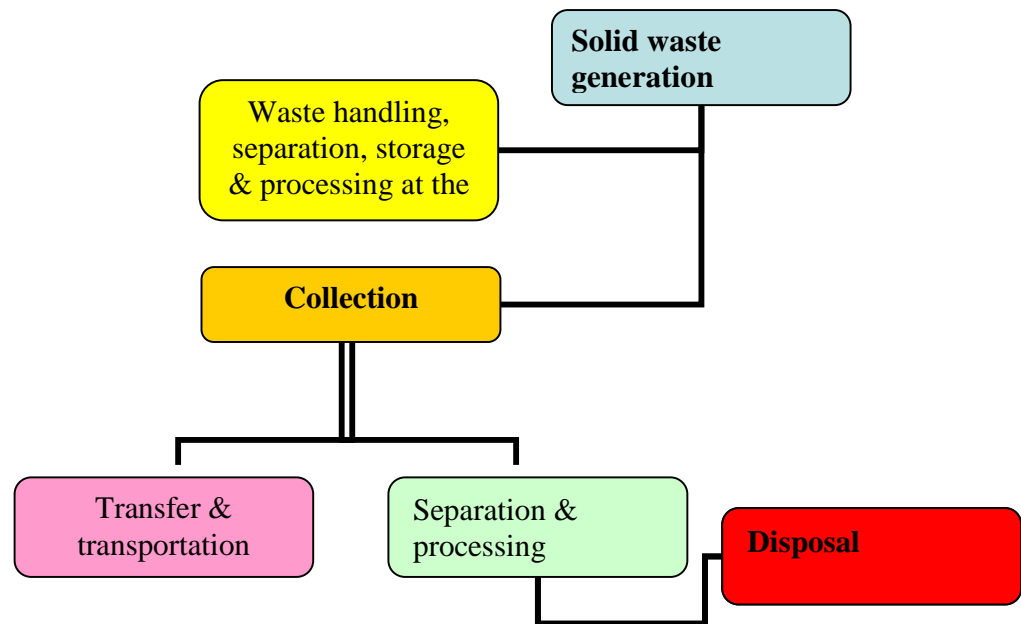
The main sources of harmful biological wastes are hospitals and biological research facilities. The ability of such waste to infect and produces toxins for the living organisms are the most significant characteristics of harmful biological waste. Such wastes include a group of solid waste like malignant tissues taken during surgical procedures and

contaminated materials such as hypodermic needles, bandages and expired drugs. Biological waste is also generated as a by-product of industrial biological conversion process (Rao, 1995).

2.3 Waste Management

Solid waste management maybe defined as a discipline that is associated with the control storage, collection, generation, transfer and transportation, processing and disposal of solid waste in a manner that is in accord with the best principles of public health and other environmental considerations. Solid waste management will include administration, financial, legal and engineering functions in finding solutions to all solid waste management problems. The solutions to such problems may involve the integration of disciplines such as political science, city and regional planning, geography, economics, public health, sociology conservation and other material sciences (Tchnobanglous, 1993).

Fig 2. 1. Functional elements in Solid Waste



(Tchobanoglous et al.,1983)

There are six functional elements in waste management. These are solid waste generation collection , waste handling separation, storage and processing at the source, transfer and transportation , separation and processing. There are several elements that are involved in solid waste management, however the most important ones are the handling and separation of solid waste and the collection of waste. These elements will be discussed below:

Element 1-solid waste management

The quantities of solid waste generated vary in different societies. This variation can be used to select appropriate equipment and achieve the best solid waste management practice. For example residential waste generation rates usually peak during holiday

seasons and housecleaning days. In some communities, during such periods extra waste collection services are provided. There are factors that affect waste generation These include:

Source Reduction: solid waste reduction can be achieved through the design, packaging and manufacturing of the product with minimum volume of material. Solid waste reduction can be achieved in households through selective buying patterns and reuse of products and materials. Residents can also achieve source reduction in following ways:

- By decreasing unnecessary packaging. In general by using minimum material when wrapping a product;
- Develop and reuse the products with greater durability and reparability for example more durable tires and appliances;
- Use fewer resources for example two sided photo copying or printing (to minimize the use of paper);
- Increase the recycled materials content of products. For example in South Africa the law forces manufacturers to produce recyclable plastic bags as from May 2003. This was done to eliminate plastic bag waste on the environment ; and
- To develop structures that encourage generators to produce minimum waste (Holmes,1983).

Public attitude: For the reduction of waste to occur people must be willing to change their attitude towards waste management. It is also imperative for them to alter their lifestyles and habits in order to conserve natural resources. This will also help in reducing economic burdens associated with the management of solid waste. (Tchobanoglous, 1983).

Seasons of the year: the amount of waste generated is also affected by seasons of the year. For example the large quantities of food waste that is usually generated during the growing season of fruit and vegetables (Tchobanoglous et al., 1983).

Element 2-Collection

If there is unlimited collection service of waste in a community, more waste will be collected. The uniqueness of the collection service in an area can influence the quantity of solid waste generated for instance the quantities of garden waste that is generated in wealthy communities is considerably greater compared to other low or medium income communities.

Generally collection of waste is provided under various management arrangement that range from municipal services to private contractors. Collection of services for industries vary according to the type of industry. In some industries solid waste is handled in the same way as residential wastes. Other industries have their own disposal site on their properties. The latter is used for mineral and agricultural wastes. Consequently each require s individual solutions to its solid waste problems (Tchobanoglous, 1983).

Element 3 Solid waste handling and separation, storage and processing at the source

Waste handling and separation is regarded as an important element of all six functional elements of solid waste management. Handling of waste refers to the activities associated with managing solid waste until they are placed in a container for storage before collection. Separation of solid waste is when different wastes are stored separately. Such

solid waste will include components like aluminum cans, papers, glass and card board. The best place to separate waste materials for reuse and recycling is at the source of generation. Residents are now more aware of the importance of separating of newspapers, aluminum cans, cardboards and bottles. The separation and handling of solid waste at the source before they are collected is a critical step in residential solid waste. Separating waste at the source is also an important element of solid waste management strategy. Once the waste has been separated the major question is how the homeowner will store it till is collected. In some homes they have different containers where they store separated waste until it is transferred to recycle centers. The separated waste is placed in special containers or in bags (Environmental Protection Agency, 1996; Tchobanoglous, 1983).

Storage and processing at the source

The factors that need to be considered on onsite storage of solid waste include the type of container that is to be used and the contamination of waste components. The type of containers that is to be used to store waste depends on its characteristics and types of wastes to be collected. Plastic and metal containers are commonly used to collect solid waste. However there are limitations that are associated with such containers, for example they can be damaged over time. Containers add extra weight that must be lifted during collection. Containers are not aftern large enough for bulky solid waste. The majority of household utilize disposable plastic bags for storing solid waste. Such bags are used alone or sometimes as a liner inside the waste container. Problems that are posed by this type of storage is the high cost that is associated with storage bags. Plastic bags can also tear easily. Commercial and industrial areas often uses large container. The main problem about these containers is the high initial costs. In cold areas snow accumulates inside the container lowering the carrying capacity (Techobanoglous, 1983).

Contamination is the main problem that is experienced in solid waste storage. Major wastes can be contaminated by small amount of containers such as motor oil. This contamination can reduce recycle value of recyclable solid waste (Samuel, 1983).

Element 4- Separation and processing

Solid waste processing is practiced to reduce the volume, recover usable material and to alter the physical form of solid waste. The most common type of solid waste processing is the food waste grinding, component separating and composting. In previous years food grinders were commonly used in many households and they have gained popularity in new homes. Food grinders are primary for waste from food preparation, cooking and serving of food. However such grinders could not be used for bulky items and large bones. Where food waste grinders are used there is a remarkable reduction in the amount of waste collected (Techonobaglous,1983).

Separation of waste components is an effective way of achieving the recovery and reuse of material. The 1970's have been marked by the increased popularity of recycling organic material by composting. This method has been effective in reducing volume and altering physical composting of solid waste. In some countries law requires the composting of leaves. Composting of leaves or garden waste can solve problems that are posed by the disposal of garden waste. This is what we call backyard composting whereby residents develop methods of composting garden waste. The method involves the placement of waste materials to be composted in a pile. To speed up the process one may water the pile on occasional basis and turn it to provide moisture and oxygen to the organisms. The pile of waste will undergo bacterial and fungal decomposition until only humus material (compost) is left. Another type of composting involves leaving grass clippings where they were cut. They will eventually fall through the humus layer. This

method will reduce the amount of waste generated at the source and also allows nutrients to be recycled (Tchobanoglous, 1983).

Element 5- Transfer and transportation

Transfer and transportation of waste refers to the facilities used to transfer waste material from one location to another. The functional element of transfer and transportation involves two steps *viz.*, the transfer of waste from smaller collection vehicles to larger transport equipment and second one is subsequent transportation of waste to disposal site. Such transfer usually happens at the transfer station. Motor vehicles are normally used to transport waste, but rail cars are also used to transport solid waste. For example in the city of San Francisco the collection vehicle haul their loads to a transfer station at the southern boundary of the city. At the transfer station the waste is unloaded from the collection vehicles and reloaded into large tractor-trailer trucks. There various reasons that tend to make the use of transfer operation attractive. The first factor is the reoccurrence of illegal dumping due to long haul distances. For example high fuel costs and the absence of nearby solid waste disposal sites has made the use of transfer stations become common again. The second factor is the location of disposal sites that are relatively far from collection route, as a result the occurrence of illegal dumping increases. Generally small quantities of waste from small collection vehicles are transferred to larger vehicles that are utilized to transport waste over long distances. Transfer and transport operations are also used to transport recovered materials to markets or waste –to-energy facility and the remaining materials are transferred to landfills (Theisen, 1983).

Element 6- Disposal

The last element of the six elements is the disposal of waste. The waste is normally disposed by land filling or land spreading. The modern landfill is not merely a dumping site, but an engineering facility that is used for disposing solid waste on land without creating hazard to public health. Waste disposal is an integrated component in regional planning. As a result land use planning becomes a primary factor in the selection, design and operation of the landfill. Environmental impact statement is required for new landfill sites to ensure compliance with aesthetic and future land use (Tchbanoglous,, 1983).

The early waste minimization practices have been linked directly to domestic waste as Danish people define it as “*Kitchen maddens*”, (Jolley and Wang, 1993). It was possible to manage solid waste in the past because there was plenty of land for disposal. At present land is very limited and we have a lot of industries globally, which produce a lot of solid waste. As the global community becomes more and more sophisticated the need for solid waste collection services is imminent. There are mainly two methods that can be utilized to manage solid waste. The prevention or controlling of solid waste at all sources is very cheap than purifying the contaminated environment Waste minimization is also important at early stages of production.

Biotechnology can play an important role in the reclamation and recycling of wastes particularly the municipal, agro-industrial mining and chemical sectors. Biotechnology includes the usage of bacteria in the processing of waste. The technology is currently used in the US. This technique is considered to be less expensive and can serve as a means of environmental monitoring. Community waste such as sewage sludge and urban

refuse can be utilized as fertilizer. Low-grade ore left at dumps in mining areas can be economically used through bio-Beneficiation and in situ bacteria leaching.

It is clear that the major producers of solid waste are industries; therefore it is essential for them to practice waste minimization. Senior management of these industries must be committed towards such programs. However there are obstacles that can hinder the implementation of solid waste minimization in industries, for example there might be a change in the manufacturing firms, whereby the product might be very expensive to the public than before. The technology may incur high capital investments. However the company might try to seek technology that requires low capital investments (Seaberg, 1988).

When considering industries in the generation of solid waste one can note that the most environmentally problematic are those that utilize no-renewable resources in their production. These include paper and power generating industries. Therefore the change from non-renewable resource to renewable resource is necessary for the prevention of environmental degradation. Historically the issue of waste management in the world of industries was not a serious issue; it was taken to be a minor subject. As the decades went by, there were visible negative impacts on the environment that resulted from free disposal of industrial waste on land, air and water (Sivaramakrishnan, 1995).

Currently the norm is that, industries that produce less waste will have competitive advantage from the local, national to global markets. Over the past 15-20 years waste management has become more of a regulatory compliance issue, this is evident in the number of laws that had been passed in order to protect the environment. Such law includes Polluter Pays Principle (PPP), ISO 14000, and ISO 14001 and recently there is

Solid Waste Management Policy. . Because of the demands of the buyer in the global market the big corporations have considered environmental Laws as part of the business. According to Seaberg (1988) in United States alone federal regulations relating to the environment increased by 25% per year over the past 10-15 years. The future expectation can be one or more environmental regulation at all levels. This can be attributed, largely to the increase in the number of Environmental groups and exposure by the media. The community as a whole is giving forth their concerns about public health. The records in the markets have shown the popularity of products that are environmentally friendly. For example Germany and Canada have programs that are able to identify environmentally friendly products (Moyo, 1995).

Some countries such as Japan, Korea and New Zealand have high degree of waste reduction, separation at the source and recycling. This is achieved through environmental education and new practices such as curbside collection and volume based collection fees. Korea is implementing a volume based fee system, which was extended to all towns in 1995. Waste generators must put out their wastes in bags bought from the municipality and must separate recyclables. Local governments are responsible for collecting the source separated materials. These initiatives have resulted in a 20% -30% decreases in waste that require disposal (Moyo,1995).

Promoting the American concept of the “garage sale” as a means of waste reduction, some Japanese cities are now actively encouraging exchanges and gift of unwanted clothes or daily necessities within neighbourhood, encourages exchanges, particularly of furniture and electrical goods. This reduces white elephant waste.

The Hong Kong Productivity Council is promoting waste education in several ways. There are sophisticated waste trading businesses, some dealing international (for instance, used clothes export companies in Yokohama, Japan). These cities have specialized companies to collect recyclables for processing, sale and export for use and recycling. For example, 38% of the total Municipality Solid Waste (MSW) generated in Singapore is recycled by commercial companies. Although in this city-state waste materials recycled are largely from industries and commerce, commercially viable wastes such as papers, cardboard, textiles, plastics and glass are collected from households. In Singapore, the Ministry of the environment encourages private enterprises to set up recycling plants on land set aside at a closed dumping ground. There is little or no direct financial support from the government (Moyo, 1995).

In the Republic of China and Vietnam, waste recovery and recycling has been organized at the city level and supported by national ministries. In China, especially, the major cities have large recovery companies, which collect recyclables from offices, institutions, and factories. There are also neighbourhood redemption centers where people can sell bottles, papers and clothes. State policies govern the trading of materials and prices and these companies are often inefficient. Since the new economic policy, they have preferred to deal mainly with profitable materials, such as metals, and not in most household recyclables. Other materials are now collected and traded by private entrepreneurs who may either sell to the government companies or directly to factories. The neighbourhood redemption centers have declined and as a result, more recyclables are put out as waste by residents. There are new attempts to deal with household recyclables, such as the source separation being organized in residential complexes (DSNI. 1999).

In Hanoi and Ho Chi Minh City, a greater part of waste recovery and recycling is in the hands of family businesses. In Hanoi, there are close connections to particular rural villages from which most of the waste traders come. A notable feature of this sector in Ho Chi Minh City is that 50% of the operators are women; women are also prominent in Hanoi. This may be the result of the traditional trading culture and the opportunities that women gained in both government services in solid waste management and informal waste trading during the war period, when most men were in military service.

The quantity of plastic material has surpassed the recovery capacity of even the high – recycling cities. Now the larger cities of China are beginning to experience the proliferation of plastic waste that is so problematic in Hong Kong, Indonesia, The Philippines, South Korea, and Thailand. Even in Yangon, where non-organic wastes are minimal, increasing numbers of small plastic bags are found in open drains. The ban of plastic bag material has been proposed in these cities (DSNI. 1999).

Different strategies are used to overcome poor solid waste management like tree planting from urban forestry. There are several important reasons why they chose tree plantation as part of waste management plan, in that trees mitigate pollution by reducing energy use carbon dioxide emission and ground-level ozone. Urban forests purify air and control soil erosion. Wetlands provide crucial service in that they filter pollutants, recycling of nutrients on the urban ecosystem and reducing destruction of floods. Tree plantation in urban areas promotes soil conservation in fragile ecosystems where landslides can easily occur with steep terrain, a little vegetation and protecting people's lives and their homes. Tree planting especially agro-forestry systems can be labour intensive; consequently this provides job opportunities for the urban people who are unemployed. This strategy may be essential to developing countries, which are facing poverty. Tree planting provides

work and the opportunity for informal learning, for example the youth in Baltimore, Maryland and United States participate in an educational tree -planting project in a city park (Environmental Protection Agency, 1996)

Unutilized and degraded land and terminated landfill sites are increasingly being reclaimed through forestation and converted to Parks. Where land is contaminated, particularly with heavy metals, some trees are capable of absorbing the pollutants. Through felling and removal of timber, the level of contamination can gradually be reduced. By incorporating green areas in the network will improve biological conservation and biodiversity and can serve as biological corridors, social benefits such as entertainment parks (DSNI, 1999). Community building and property value had improved because of this tree-planting project that was meant to curb the waste management problem. Studies have shown that an increase in house prices where property is associated with urban tree planting project was 5% in Hong Kong.

Solid waste collection and disposal is one of the major challenges in Lusaka. The lack of proper equipment and resources to provide collection services has resulted in rampant illegal dumping and subsequent deterioration in public health with people suffering from such diseases as TB, asthma and cholera. The Resource Cities programme was introduced to overcome the problem. The programme managed to establish a better management strategy for waste collection services in the area. As a result the city became more effective in developing a process under which they would routinely collect and dispose solid waste. Such a program in Zambia has sharpened citizen's awareness about health and environmental importance of proper waste disposal. The programme also initiated public education campaigns by using brochures, radio announcements and public

meetings to help develop environmental awareness. Local officials worked very hard to draw the attention of citizens and non-government organizations into the process of reshaping the system of refuse collection and disposal. The result of such campaign was the partnership of different people working together to improve environmental quality (The U.S. Department file Program, 2002).

The reality of not having proper facilities for certain types of waste like clinical and batteries ensures that the environment is left at the mercy of our own bad habits. For example in Greater Banjul Area located in Gambia, Africa there are only two landfill sites apart from the MRC incinerator, the municipal landfill at Mile Two and the one in Bakoteh are the only disposal facilities available for the whole area. Consequently a wide range of wastes is being disposed in them without considering its capacity and the capabilities. Un-favorable environmental conditions are visible in these disposal sites, the workers are exposed to health hazards and other dangers that is characterized by poor handling facilities. The waste that is deposited in these landfill sites includes industrial and clinical waste that can pose a danger to the environment and people. The significant problem that is mostly encountered in African cities is transportation of waste. In general the overloading of vehicles in windy conditions cause waste to be blown in the streets. It is not unusual to see to see plastic bags and other solid waste littering the streets after the waste-carrying vehicle has passed. As a result we are left with the same dirt that we were trying to get rid of, meaning we are trapped in the same cycle of doing same thing numerous times without any progress. The city environment is largely affected by such vicious cycles (DSNI, 1999).

2.4. Landfill Management

Land filling as a means of waste disposal has been recognized as the most economical and environmentally acceptable strategy for the disposal of solid waste in most parts of the world. Although there are new techniques in solid waste management, landfills still plays an important role in integrated solid waste management strategy. Landfill management includes the planning, design, operation, closure and post-closure control of landfills (Selke, 2001).

Landfills manage about sixty one percent (61%) of Municipality Solid Waste in general. Modern landfills are managed on a grid system where only a small part of the landfill, called a "cell," is exposed for receiving Municipality Solid Waste on any day. The era of "open dumps" is over: modern landfills manage waste in such a way that the top ground can be used for parks and recreation without any gas or water contamination. Safeguards such as protective liners are used to prevent leachate, or the liquids or gases that can seep from a landfill. A network of drains is installed at the bottom of the landfill to collect any leachate and protect groundwater sources. Monitoring wells are installed around the perimeter to test for contamination. Fans vent and draft gas from the landfill and collect it in a pressurized tank. The gas is then recycled for Waste-to-Energy burn-off. For up to 30 years after final capping and sealing of the landfill, landfill operators are required to monitor the site for leaching. Landfill sites can settle and therefore are not used for housing or building construction (Smink, 2001).

Landfill gas is the mixture of gases found within a landfill. Globally, including South Africa the bulk of landfill gas consists of methane (CH₄) and carbon dioxide (CO₂). Landfill liners are materials that are used to line the bottom area and below-graded sides of a landfill. It usually consists of layers of compacted clay or geo-membrane material

designed to prevent migration of landfill leachate. Landfill closure is a term used to characterize the steps that must be taken to close and secure a landfill site once the filling operation has been completed. Post closure care refers to the activities associated with the long-term monitoring and maintenance of a completed landfill, more likely 30 to 50 years (Smink, 2001).

The impact of the land filling of solid wastes will include the uncontrolled release of landfill gases that might migrate off-site and cause odour and potentially unhealthy conditions. The uncontrolled gases also contribute to the green house effect in the atmosphere. The release of leachate that might migrate down to underlying groundwater or surface water can produce contaminated water. The breeding and harboring of disease vectors in improperly managed landfills and the health and environmental impacts associated with the release of trace gases result from the hazardous material disposed in the landfills. The main goal of developing modern landfills is to minimize such concerns (Technobanoglous, 1983).

According to Zambia Solid Waste Strategy (1997) there are other impacts caused by landfilling with water pollution being a principal one. This happens when water entering landfill as rain run-off becomes contaminated primarily by the process of decomposition of organic waste and by absorbing contaminants from the items in the wastes such as batteries. When landfill sites are allocated in areas where the underlying rock material is porous or permeable, contaminated water will reach the aquifer below.

Leachate material is very hard to get rid off than gas that can be utilized for energy. Gas' environmental effects are very limited. Leachate is defined as a medium by which soluble

materials inside the landfill may subsequently be transported in the environment. It is necessary for the leachate to be transported continuously in order to avoid leachate hydraulic head over the barrier system. In order to avoid negative environmental effects landfills are lined, the leachate is collected and treated (Tchnobanoglous,1983).

According to Selke (2001) there are several barrier systems that have to be considered when constructing a landfill system. The bottom barrier has to prevent leachate and biogas from escaping into the environment. It has to provide mechanical support for the waste mass and avoid accumulation of leachate by means of filtration, drainage and collection system located above the bottom barrier. The side barrier in the landfills found below surface level should provide impermeability to leachate and external water fluxes, mechanical resistance to water pressure, drainage leachate and prevent lateral migration of biogas. The top cover in the landfill system should prevent biogas from escaping into the environment; reduce rainwater infiltration through a combination of sealing and drainage function. Lastly it must provide support from aftercare options such as vegetation and erosion control. The barrier system components are clay soil and gravel.

In the quest to save natural resources, synthetic materials have been utilized as barrier systems. Such materials are able to perform same functions as barrier systems mentioned earlier. These materials are referred to as Geosynthetics. Various components of lining in a landfill have different characteristics and advantages. A single liner of natural material of low permeability soil is considered acceptable only under specific and fully safe hydrological situations. The single liner of synthetic material geo-membrane may be utilized only under conditions similar to natural material lining, single composite liner clayey soil + geo-membrane is widely recommended for municipal solid waste (MSW) land filling and is included in the guidelines of many industrialized countries. Currently

for municipal solid Waste landfill lining a minimum clay liner thickness of 1.0m is deemed necessary with a maximum permeability of 10^{-9} m/s (ms-1) (Selke, 2001).

For the landfill to function properly, it has to have a drainage system that will drain leachate that is produced by the landfill. It is vital for the drainage to be designed in such a way that it resists the potential damage by operating machines Hoeks, (1987 cited in Christensen; Stegmann, (1994).

2.5.1 Classification of landfills

The most widely accepted classification is the one adopted by the State of California in 1984. There are mainly three categories under this classification. According to Technonglous, 1983 these are:

Designated wastes

Designated waste is defined as non-hazardous wastes that may release constituents in contraction that exceed applicable water quality objective.

There are mainly three types of landfills, the first one being the conventional landfills for commingled Municipal Solid Waste (MSW). The second one is the landfill for milled solid wastes and lastly the non-fills for designated or specialized wastes.

Landfills for commingled (MSW)

Generally the landfills of United States are designed for commingled MSW. This class of landfills also accepts industrial solid waste, sludge from water waste water treatment

plants. However in many States the sludge from treatment plant are accepted only if it has 51% water.

The native soil is used as a intermediate and final cover material, but in countries like Florida and New Jersey where the amount of indigenous soil available for such purpose is limited, the alternative materials such as compost produced from yard wastes has been utilized.

Landfills for Shredded Solid Wastes

One strategy that is adopted as an alternative from traditional disposal methods in several United State locations concerns shredding of solid wastes prior to placement of it in the landfill. The toned waste can accommodate up to 35% greater density than the un-shredded waste and it can do without daily cover. Flies, rats, blown litter and odours are not a major problem to such waste. The disadvantage of this strategy include the need for shredding facility and the need to operate the conventional landfill section for waste that can not be easily shredded. This form of waste disposal has tremendous potential in view of the conventional landfilling being very expensive. The process of compaction enabling greater capacity makes this method comparatively more attractive. However shredded waste can be used to produce compost that can be utilized as an intermediate cover material.

In South Africa landfill sites can be categorized as follows:

1. General landfill sites that accommodate non-hazardous material for example food waste generated in households. These are normally operated by the local municipalities.

2. H-h landfill sites accommodate low hazardous waste material. This type of waste can be generated by small businesses and households. For example paint containers and oil contaminated materials.
3. H-H landfill sites accommodate highly hazardous material that is generated by industries. The example includes nuclear waste.

2.5 Privatization of Solid Waste services

Privatization can be defined as a process of disconnecting state owned enterprises or state provided services from the government control to the market forces. In most African countries privatization differs from the above in that it is characterized by expanding the sphere of the market through a host of regulations that can create an enabling environment for free enterprise to operate as a strategy for sustainable economic development. Privatization of municipal services generally refers to the reduction of local government activity within the given service like solid waste management. Furthermore there is a reduction in local government ownership (Santa Monica Sustainable City Programme report, 1997).

In Nairobi privatization can be perceived as both reduction of the city and municipal council activity through the involvement of private sector as well as the reduction of government ownership. Through the commercialization of government agencies where the municipal council has re-organized itself into an accountable and financially autonomous semi-private enterprise for the delivery of a specific service, the definition of privatization also includes the management of contracts, concessions, franchise, leases, commercialization and pure private entrepreneurship. Privatization can be viewed as a form of decentralization of management functions from government to private enterprise. It can also be seen as a shift of responsibility for direct services and infrastructure (DSNI, 1999).

In Dar-es-Salaam there are several modes of privatization established countrywide. These include open competition, whereby licenses are prograded for the provision of private firms. In open competition individual households establishments make private arrangements with individual firms for services delivery. In this mode no firm holds a zonal monopoly that means any number of firms may compete within the same zone. The second mode is the management contracts that can be awarded to private firm. In this mode of management contract there is a placement of municipal services under private management for the specific period of time. The private sector has extensive autonomy as stated in the contract. Services operated under this mode include solid waste management, public toilets and parking lots (DSNI, 1999).

The concession mode described as a contractual arrangement, is where certain private companies are awarded a license to provide specified services over a certain period of time. The ownership of principal assets remains with the private firm. In normal circumstance concessions are awarded after a competitive tendering process. In this mode there is an obligation on the part of the service provider in that they must provide services that are economically and socially important and need significant improvement and is large and usually enjoys a monopoly position within an area (DSNI, 1999).

Compulsory competitive tendering is where, through force of legislation, the city council has defined types of work to external competition and the contracts are awarded on merit. Compulsory competitive tendering has occurred in the privatization of solid waste collection and disposal in the city of Dar es Salaam where a number of private firms bid for the award of contracts to provide the services. The last mode is the Shifting of responsibilities where the services, which were once nationalized, are re-allocated to the

community-based organization (CBO). Shifting of responsibilities has also occurred in the local areas where CBOs have been established and assigned service duties. Shifting of responsibilities have also occurred at local level where CBOs have been established and assigned service responsibilities.

2. 7 Case studies on Solid Waste Management

Americans are usually generating an estimated 223 million tons of municipal solid waste (MSW) for year. While tonnage continues to increase, the amount deposited in landfills continues to decrease due to recycling and composting programmes (Keep America Beautiful, 1996). Effective waste management involves an integrated approach utilizing the programs of source reduction, recycling, composting, waste-to-energy, and sanitary landfill.

The concept of conducting a detailed examination of the life cycle of a product or a process is referred to as "Life Cycle Assessment" (LCA). LCA, involves taking detailed measurements of a product and assess its life expectancy from "cradle to grave". Some products, like steel and aluminum, can be recycled indefinitely (with some melt losses) without ever reaching a "grave" stage, while others, like paper, can be recycled only four or five times (Keep America Beautiful, 1996).

Urban growth in Kenya has been associated with unemployment, low levels of life expectancy related to health problem. In most cases the health problems are associated with illegal dumping of solid waste in open spaces. People turn to dump solid waste in these open space because Local Urban Management can not cope with a high urban influx rate. 70% of households in urban areas in Kenya are low-income household as a result they have no adequate access to services such as clean running water, road

infrastructure and garbage collection. They are therefore exposed to various kinds of diseases that include TB, Asthma and other skin diseases.

2.8 Landfill Management in developing countries

Successful management processing of wastes will largely depend on the types, quantities and composition waste material. The bulk density of residential wastes in the developing countries varies from about 180 to 390 kg/m³ (Smith,1992). Currently the majority of solid wastes generated in the developing countries like South Africa are disposed in open dumps. Most of the open dumps lack the proper equipment and trained personnel necessary for conducting the operation in the manner such that the public health and the environment are protected. There are very few modern landfills in the developing countries and the majority of them are designed as sanitary landfills.

In South Africa there are new environmental standards for the design of landfill sites. Currently the landfill management scheme owns and controls seven hi-tech disposal sites that are well developed and manages eighteen general landfill sites for local authorities through out South Africa (Smith,1992). The landfills have scientific expertise that controls operating procedures, site auditing and surface and storm run-off. They also monitor methane extraction and rehabilitation processes, for closed landfills. Such management standards reduce long-term environmental liability that might have negative impacts on the environment.

In the National Gazette there are provisions for waste disposal and the environment as a whole. Environmental Conservation Act 73 of 1989 provides principles that should be followed by the Minister when issuing a permit to operate any disposal site. The Minister

of Water Affairs and Forestry has a right to alter or cancel any permit or condition in the permit and the minister may refuse to issue a permit (subsection 1). It is also stated in this Act that no person is allowed to dispose waste in any other manner except at the disposal site for which the permit has been issued. The authorization shall only be issued after consideration of reports concerning the impacts of the proposed activities and alternative proposed activities on the environment.

2.9 Transportation and collection of solid waste

A wide range of methods and equipment is utilized in the collection of wastes. The methods vary from labour-intensive to fully mechanized. Types of equipment and vehicles vary from simple hand-drawn carts and wagons to modern compaction vehicles. Generally, a collection crew consists of three or four workers, although crews of as few as two or as many as eight have been observed. In some locations, unauthorized individuals who take part in the collection activity in order to recover materials from the wastes may increase the number of people working in a particular vehicle. Excessive handling and the use of inefficient methods characterize the collection activity. This results in high collection costs (Smith, 1992).

The use of compactor trucks in developing countries is becoming popular practice in waste removal. Some features include may not be considered at the time that the vehicle is purchase. These features include the importance of matching the compaction chamber to the truck chassis; the possibility that the loaded weight of the truck exceeds the bearing capacity of streets and roads; inaccessibility of the vehicle to remote areas and narrow streets; the need to have proper machinery and equipment, as well as trained personnel to

conduct repairs and preventive maintenance; and the need for a supply of spare parts to maintain the regularity of the collection service (Smith, 1992).

Despite the fact that it has been amply demonstrated that the implementation of sound preventive maintenance is absolutely necessary to maintain a collection fleet in proper operating condition, neglect of preventive maintenance is a common situation in developing countries. Generally, maintenance is carried out only after a catastrophic failure of the equipment. A maintenance programme is extremely important since collection and transport account for a substantial proportion of the total cost of the waste management system. Due to the absence of maintenance programmes, those responsible for dispatching the vehicles to their respective routes generally are not aware of the exact number of vehicles available on any given day (Furley, 1994).

The frequency of collection varies from daily to monthly. In some locations, particularly low income areas and human settlements; waste collection is provided only on special occasions, such as during cleaning campaigns. In most situations, collection routes are not firmly established. It is a common practice to leave the decision for the route to the discretion of the driver. Consequently, it is common for a particular vehicle to arrive at the disposal site only partially loaded due to inefficient routing. In some instances, an indirect route is taken to the disposal site in order to discharge part or even the entire load for use as animal feed or for salvaging some of the materials that may have some monetary value (CNN, Environmental World Report, June 22, 2002).

2.10 Resource Recovery

The term "resource recovery" is used to mean the recovery of materials discarded as wastes, and to the institutional arrangements leading to resource recovery (for example, scavenging and governmentally or industrially operated enterprises). Scavenging is the process through which materials are recovered by entities not sanctioned by the government (Re' Source, 2000).

The following three factors generally contribute to the practice of resource recovery in developing countries: 1) Economics – a relatively undeveloped economy of the country; 2) Material and Energy Conservation shortage of inexpensive raw materials which are essential to local industries, lack of affordability or production capacity for items that can be remedied by recovery of useable materials from wastes, and shortage or cost of energy; and 3) Soil Conservation -- soils that are of low quality or that are being rapidly depleted of organic matter (Re' Source, 2000).

Resource recovery is an advisable policy for developing countries because it usually catalyzes the development of organized systematic waste management and leads to a reduction of the amount of wastes that require disposal. Furthermore, resource recovery provides a source of income for a relatively large number of people in the lower economic sector. Finally, if the system is properly planned, implemented, and administered, some of the revenue obtained from the sale of the materials can be used to defray part of the cost of waste management.

Economics

The status of the economy of a particular region or country plays a critical role in all aspects of resource recovery. Since the economic situation is most Developing Countries

leaves them with little or no access to capital to import raw materials, one alternative available is to conserve raw materials by recovering and recycling materials. This approach is worth consideration and implementation despite some reports that recycling a material would be more costly than importing it. Careful analysis of such reports shows that in most DCs, the findings and conclusions are based on questionable assumptions and on a short-term outlook rather than on a long-term horizon (Smith, 1992).

Materials that typically are recovered from solid waste can be recycled into primary manufacturing products especially aluminum, steel cans and plastics. Energy can be recovered from solid wastes by using one of two methods. One is to recover and recycle materials that can be substituted for those that require a substantial amount of energy to process and manufacture into consumer products. The second method is to convert the chemical energy of waste into a usable form e.g., through bio-gasification or thermal conversion (Smith, 1992).

Implementation of Resource Recovery

Resource recovery from solid waste can be implemented at two levels: 1) manual recovery (scavenging) by individuals before collection, treatment, or disposal of the solid waste; and 2) a combination of manual and mechanical processing carried out on a relatively large scale and according to a governmentally sanctioned plan. The term "scavenging" usually is applied to the first of the two levels of recovery. The second level is typically termed, "conventional resource recovery" (Sivaramakrishnan, 1995).

Scavenging is a process that is well established in developing countries. In fact, scavenging is such a strong part of the waste management system that attempts made to

abolish the practice in some cities in South Africa have been met with strong resistance. Some scavengers roam the streets looking for items that can be reused, and are known as "itinerant." Other scavengers conduct their activities at the disposal sites and limit their activities to the collection of one or two materials (e.g., paper, metal objects). Generally, scavengers have an agreement with a "middle-man." The middle-man is an individual who has the contacts with the end users of the waste, can process, prepare, and sell the quantities of materials desired by users; and provides the scavengers with compensation and, in some cases, a collection vehicle (e.g., a cart or tricycle). In some locations, the solid waste collection crew conducts its collection activities as well as some scavenging of materials (Folz, 1991).

Generally, the families and social backgrounds of scavengers are such that scavenging is the only option available to them to earn a living. The work of a scavenger is difficult and has little reward and the social status of these people is considered to be low. Scavengers can work up to 12 hours each day in order to earn money sufficient only to survive and sometimes they get nothing after long hard work. In addition, scavengers often live at or in the vicinity of the final disposal site, under unhealthy conditions. The conditions in such places are a threat to the quality of their own families especially children and pregnant women. For example in India, most of the families that are stricken by poverty survive on scavenging and they are just 50 meters from dump sites. Infant mortality rate is very high in these sites and life expectancy is very low. The cases of ill health are reported daily with such diseases as lung cancer, respiratory diseases, and tuberculosis that can result in death if not treated (Arkava,1983).

Another example where the effect of illegal dumping of solid waste has resulted in poor health is near Hartbeespoort Dam in South Africa. Piles of solid waste sprawl across the

path at the entrance to the compound where workers reside. Unpleasant smell emanating from blocked toilets intensifies the unhygienic status of the compound. The open pipes that run chicken waste from the slaughterhouse passes the employee's rooms down to the river polluting water resources. The compound houses about hundred workers; there is only one shower with no electricity and hot water for workers. It is said that at least one child per week spends the next eighteen months in hospital after contracting tuberculosis while living in the compound. Most of workers have developed asthma (Smith, 1992)

2.11 Importance of Open Spaces

Previously decision-makers and communities have undervalued open spaces, this is because benefits and services that are provided by open spaces were not understood. The recognition that open spaces provide services such as waste treatment, erosion control, nutrient cycling and cultural and demand from both urban and rural communities of these services gives open spaces new economic value. As result decision-makers make more informed decisions about conservation and management of resources provided by open spaces. It was also acknowledged that through proper management of open spaces and its resources such demands can be met.

As part of Local Agenda 21, environmental development of open spaces was also included. There are several reason why open spaces are important to human development, both economically and social wellbeing. Due to the importance of open spaces, the protection plan called D'MOSS was initiated in Durban in 1994. The aim of the programme was conserving and preventing degradation of such crucial natural areas. To achieve the main goal, in 1996 the government structures and councils devise a plan

based on the principles of sustainable development and community participation (Durban Metropolitan Open Space System (DMOSS) Framework Plan, 1999).

Types of open spaces and their benefits

Natural spaces can be defined according to their different shapes and forms. Due to this fact they turn to vary with characteristics and qualities. There are mainly two types of open spaces viz.; urban and natural open spaces (Durban Metropolitan Open Space System (DMOSS) Framework Plan, 1999).

- i. Urban spaces are man-made or designated spaces within any metropolitan area. Such spaces are developed for community use and they include areas like parks, agricultural fields, streets and sport-fields.
- ii. Natural open spaces are undisturbed natural and undeveloped areas within the city,, they include core areas like terrestrial, fresh water marine ecosystems estuarine. The land cover of such areas can also include grasslands, forests, and wetlands.

Both natural and urban spaces link various ecosystems, for example dams that are man-made can be part of fresh water ecosystem like wetland. Each type of open space has assets that are very important to human survival and development. Such spaces contain resources like water, fuel-wood, grass and medicinal plants.

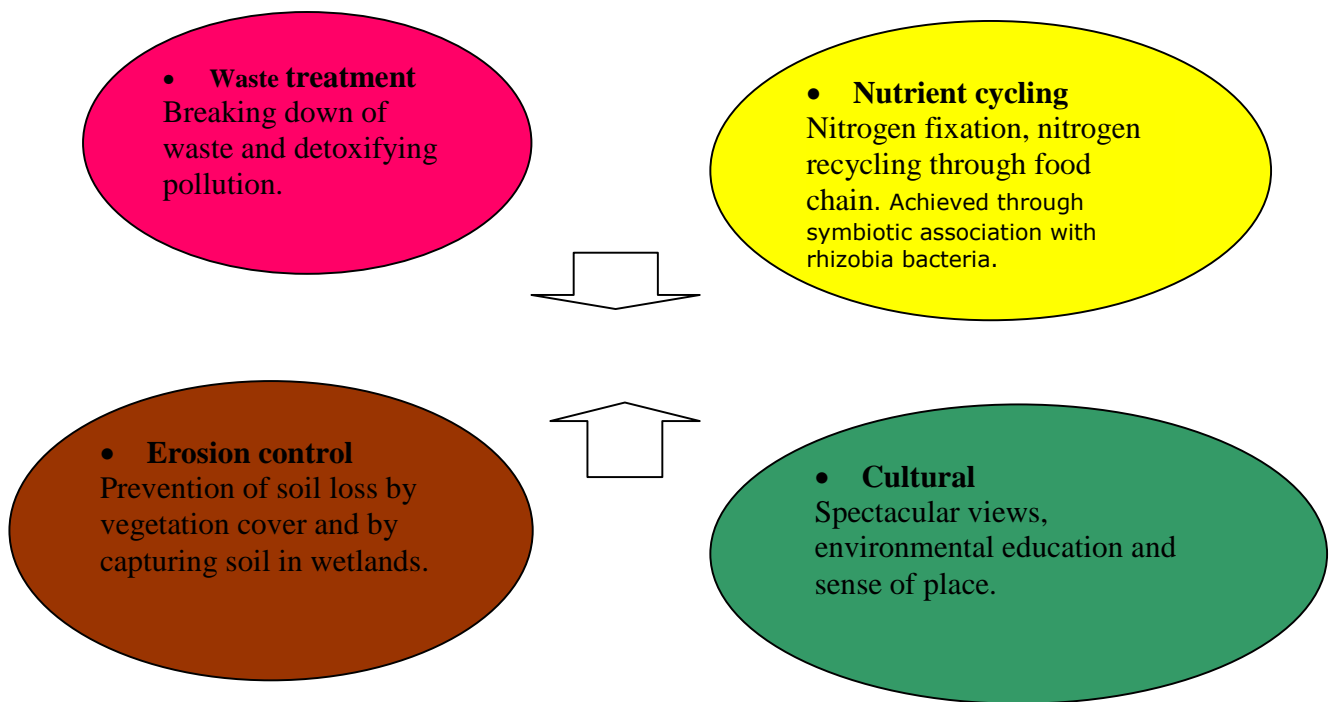
Open spaces serve the follow:

- Wood for fuel and building ;
- Soil for growing food for ever-increasing population;
- Provide space to absorb the impact of floods and treatment of waste;
- Grass for thatch and grazing.

However the importance of open space is not entirely dependent on its ability to supply different services rather on the demand by communities for the services can supply. Open spaces that provide resources and enhance development are natural factories that provide goods and services. Open spaces services have a number of benefits in different sectors of the community. There are direct benefits, which is the use of resources such as domestic use of water, wood for fuel and as building material. Indirect benefits are also referred to as non-consumptive of resources. They provide cost savings to the community, for example floodplains reduce flood damage and trees keep air clean for all life forms. Option benefits are when resources are protected for future consumption, for example a coastline can be used to promote tourism growth in future. Existence benefits can viewed as existing resources, they may give people a sense of identity and an urge to improve their overall quality of life (D'MOSS Framework Plan, 1999).

There is a great demand of open spaces, however such demand is determined by the kind of service that is provided by that particular space, for example when people in an urban area need water resources, the type of open space that they will need is the catchment type of open space, since it will provide water resource. The services that are provided by open spaces vary, depending on the communities that are using such services. They are also important for the wellbeing of the environment. *Figure 2.2* illustrate the ecosystem services that are provided by open spaces in order to prevent environmental degradation (D'MOSS Framework Plan, 1999): Currently the plan has been implemented only on the grass-root level; there is a need for comprehensive implementation.

Figure 2.2: Ecosystem Services provided by open spaces



2.11 Waste Minimization in South Africa

By examining the depth of waste problems in South Africa, Action Plan was needed to eliminate large amount of solid waste that is problematic in our country. Action Plan is within the National Waste Management Strategy (NWMS) (South Africa Year Book, 2001/2002), which has both short and long-term objectives. The Action Plan was

developed as a result of logical Framework analysis methodology that analyses the nature of the problem, reviews stakeholder and identifies the key risks that are critical to implementation of the Action Plan. It contains a set of initiatives that are essential for the government to adopt in order to create sufficient motivation and capacity among waste generators to implement recycling practices. Such initiatives are categorized into three key outputs:

- The introduction and enforcement of appropriate regulatory instruments with a priority to eliminate pollution and to promote the adoption of waste minimization and recycling practices.
- Appropriate economic and financial incentives, this is based on the study done by the Departments of Finance and Trade and Industry.
- The implementation of programmes for waste minimization and recycling. Such initiatives will be integrated in a broader Action Plan for Cleaner Production. The plan is depended on certain factors in order for the project to be successful. In South Africa waste minimization plan still needs to be implemented.

2.13 Solid Waste Management and World Summit on Sustainable Development (WSSD)

One point that was repeatedly highlighted in the WSSD was that the rapid increase in solid waste has become a major problem for the municipalities in both developed and developing countries. The brief example is from Rio de Janeiro where solid waste generation reached a maximum of 8, 042 tons per day in 1997 compared to previous figure of 6,200 tons per day in 1994. In Norway solid waste generation increased by three percent in the 1990's, in the United State there was a sharp increase of 4.5% in waste generation. (DSNI,1999).

Unsustainable human settlements, or slums, are mostly informal and unplanned, often in dangerous locations and generally lacking basic municipal services such as safe drinking water, sanitation, public transport, schools and clinics. These may be the result of inadequate urban planning, lack of investment in infrastructure, speculative investment patterns, and indifference to the needs of the poor. Realization of the Millennium Declaration target would require action at many levels. Access to improved housing, safe drinking water; sanitation facilities, health and education are urgent priorities for improving the lives of slum dwellers. Long-term improvements that would require better city planning and attention to land right urban infrastructures (UN Report, 2001).

Sustainable development cannot be achieved without addressing the causes of ill health and its impact on development. Many health problems are exacerbated by air and water pollution, noise, crowding, inadequate water supplies, poor sanitation, unsafe waste disposal, chemical contamination, poisoning and physical hazards associated with the growth of densely populated cities. WHO estimates that poor environmental quality contributes to 25 per cent of all preventable illnesses in the world today? Air pollution, both ambient and indoors, including the work environment, continues to be a major contributor to respiratory and other illnesses, particularly in children (asthma and acute respiratory infections), women and the elderly (chronic respiratory illness). Some 2.1 million people, of whom 1.8 million live in rural areas of developing countries, die annually from indoor air pollution from traditional biomass fuels, with 80 per cent of those deaths among women and children. Due to the fact that there are no proper services that are present there are numerous diseases such as TB and Cholera that are associated with improper disposal of waste. Recent years have also seen a growing concern over the disposal of hazardous wastes, which are often dumped together with other wastes. This has posed severe health hazards for poor people who survive by scavenging wastes. Some

vector-borne diseases, such as Dengue fever, are linked to poor solid waste disposal. Some cities have experienced epidemics due to poor waste management, resulting in significant human and economic losses (Keep America Beautiful, 1996).

2.14 Conclusion

Although policies in some countries are promoting waste reduction, recycling and safe disposal, most developing countries are lagging behind in terms of implementation of such policies. There is a great potential for labour-intensive waste collection with resource recovery and recycling. Some progress has been made in recognizing the contributions and potential of citizens' groups, grass roots organizations and civic leaders. Some community initiatives have created opportunities for low-income families to participate in community improvements, budget setting, citywide planning, disaster preparedness and other sustainable urban development activities. There is one initiative that comes from the youth of the countries of the world, they call themselves “*Espineers*”, the youth all over the world volunteered to clean tons of solid waste that was illegally dumped in open spaces. They manage to collect tons of solid waste in South Africa clearing up most of illegal dumping sites.

Waste minimization is the major term in the preparation of WSSD; people are urged not to pollute their surrounding by recycling the solid waste that will be produced during the summit on sustainable development. This sends a clear message to the entire community of South Africa that solid waste can be minimized through recycling programme regardless of the area and the situation that one is in. furthermore it has created hope that there is a room for improvement and that we can still pick up the pieces of our broken

planet and mend it while we still can, as the SWWD is about saving the planet and life on it. During the summit people from around the world have shown how they reduce waste by recycling and making other useful product.

Chapter three

Study Area and Methodology

3.1 Introduction

The focus in this section will be the description of the study area and the methodological approach that was adopted by the researcher to collect data.

The description of the study area complimented by a map will enable the reader as well as other interested parties to identify the area with ease. Research to some individuals in the community is useless and a waste of time. The researcher however can convince such individuals of the relevance of the exercise. It is of vital importance to explain to the respondent the purpose of the study, so that they understand why they are engaged in the process of collecting data and the impact that research can have on their lifestyles. There are several methods that can be utilized to collect data. It is imperative for the researcher to implement the method most suitable for the particular investigation (Bailey, 1994). Details of the various methods and techniques will also assist future students, academic, researchers and authorities who will not need to explore for methods conducive for this type of investigation in this particular area.

For the purposes of collecting data for this investigation, the researcher used the following methodologies:

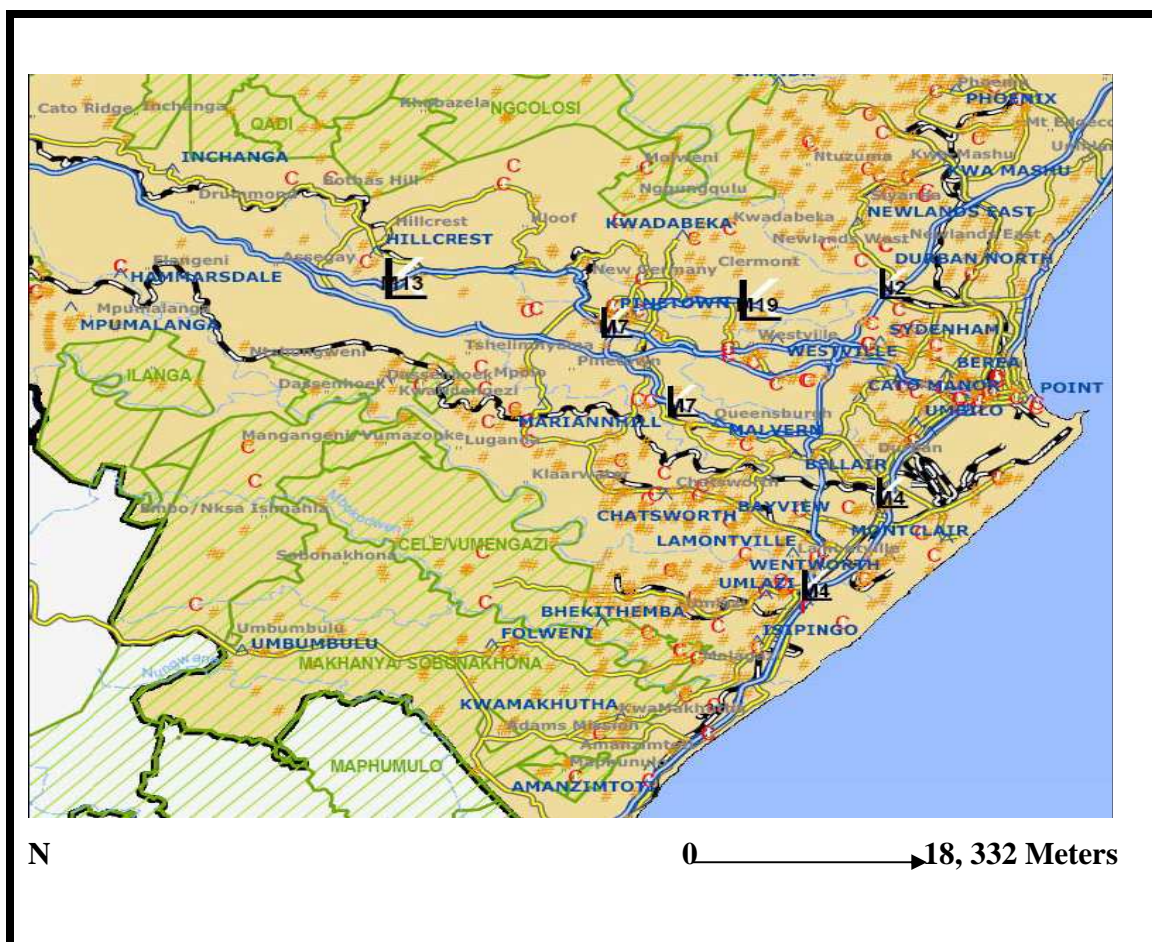
- Sampling method ;
- Observation method,
- Participatory method

- Photographic data was collected as evidence to support the presence of the problem.

The researcher conducted interviews with members of the household residing in Clermont. The interviews were conducted to understand how they view the problem of illegal dumping and establish how they rate environmental problems in relation to other social problems in the community.

3.2 Study Area

Figure 3.2.1: Locality Map



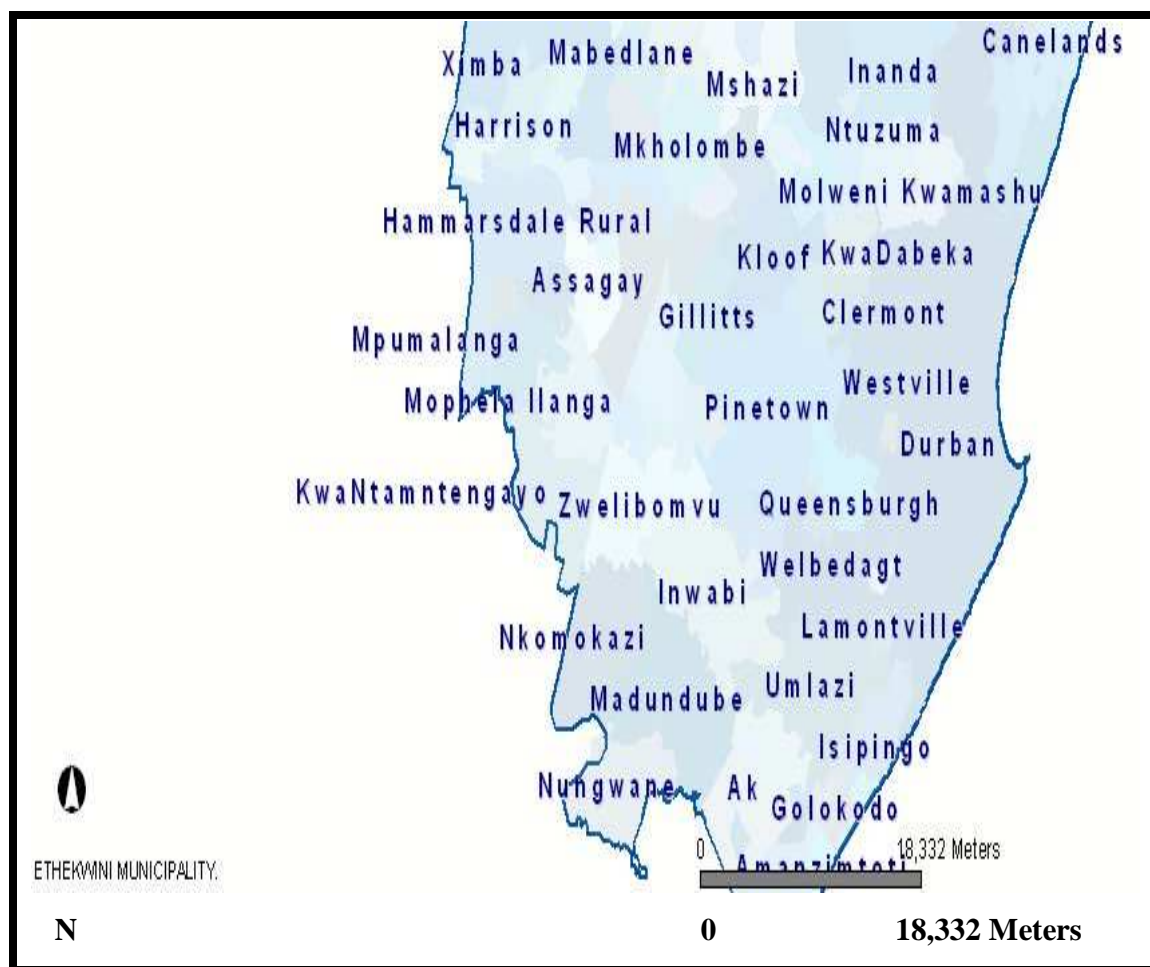
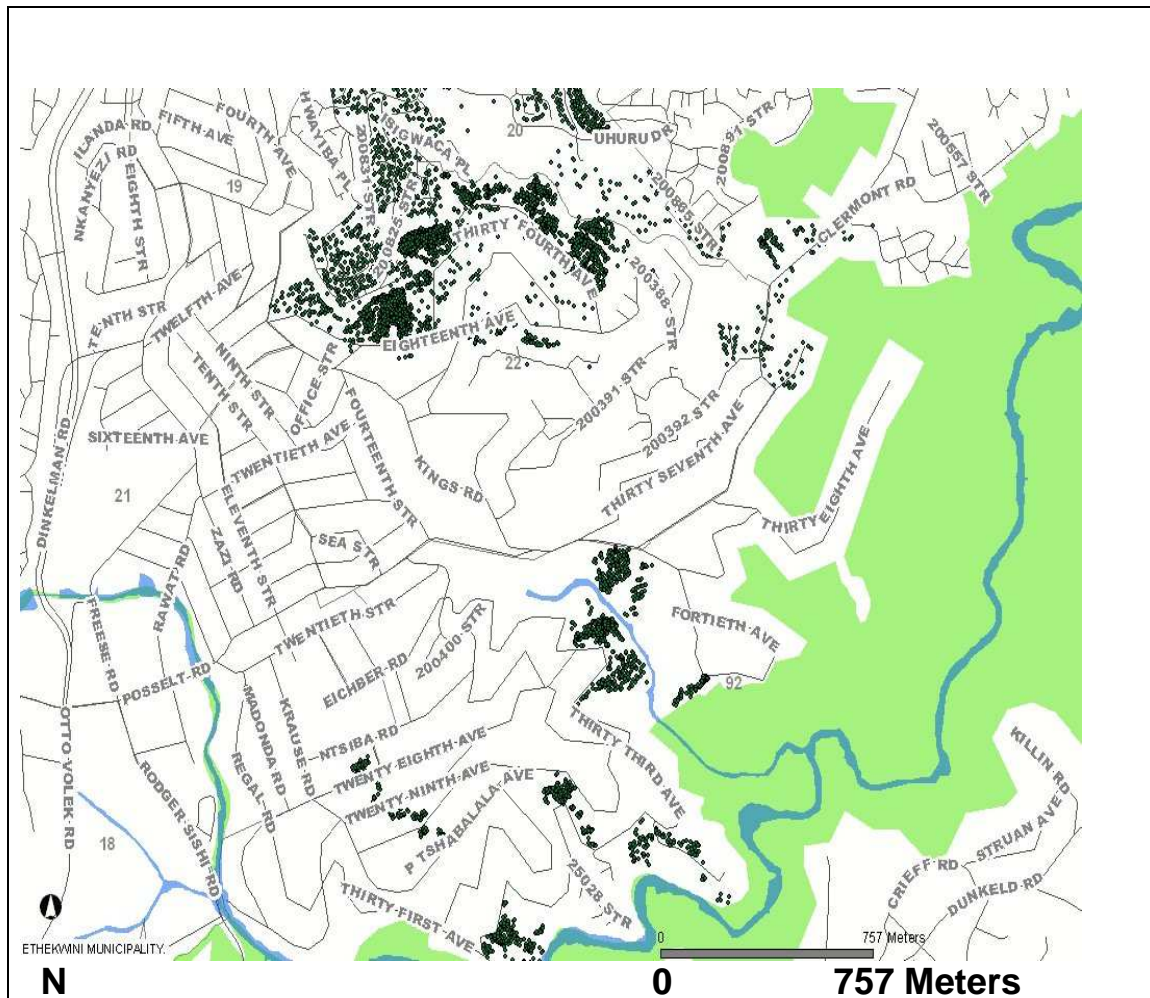


Figure 3.2.2: Map showing different wards of Clermont the black dots shows informal settlement



The African township called Clermont which is characterized by formal and informal dwellings is situated 20 kilometers west of Durban centre and 5 kilometers north east of Pinetown. Clermont township is located in the inner west region of the eThekweni municipality area, and 2-3 kilometers from New Germany. The township is situated at 30.9 longitude; latitude – 29. 78.333. This area founded in 1931, and encompasses 1600

acres of land. Kwa-Dabeka, a component of the study area was subjected to land invasion in the early 1990's. Initially a thousand people invaded and settled in the area due to it being in close proximity to the employment opportunities. The population was estimated to be in excess of ten thousand. Currently the population is in excess of fifty thousand.

Prior to the invasion of the area there were plans of building major tarred free way road across this area. Due to this reason people were told not to interfere with proposed development. People residing in this affected area did not have their shacks upgraded due to the proposed road development.

Since the upgrading process more people moved to the area with the two manufacturing industrial areas viz, Pinetown and New Germany being the pull factors. Some families, however, arrived here because of the violence in their areas. Such politically unstable areas include Richmond and Hammarsdale.

The majority of the population in Clermont work in New Germany and in Pinetown. In New Germany there is well-established cotton industry that is able to accommodate most of the workforce. This company has well developed branches that can serve as source of employment in the future for the skilled population of Clermont. The subdivisions of cotton industry are Frametax and Pinetax. There are, however many unskilled and unemployed people. Unemployed residents are unable to afford basic services that include water, electricity, sanitation and solid waste removal. Most of the formal houses that are built, end up not being occupied by the residents due to high levels of unemployment.

The inability of residents to pay for basic services has a negative impact on the natural environment as well as on the health of the community. Communities resort to building of shallow pit latrines and disposal of solid waste illegally. Heaps of garbage is very often seen on pavements, grass verges and sometimes in streams. Raw sewage from overloaded latrines can also be seen following down the roads the latter is a common phenomenon after rainfall events.



Plate 3.1 Illegal dumps in Clermont Township



Plate 3.2 Rich bio-diversity of Clermont threatened by the illegal solid waste disposal

3.3 Methodology

3.3.1 Survey method

Survey is a widely used data gathering technique. Surveys, based on professional social research like other scientific tools can be used appropriately (Strydom, 1998). Surveys usually produce information that is statistical in nature. It is regarded as the stem of quantitative research. Researchers usually ask numerous questions concerning people's beliefs, characters, past, present and future behaviour.

Observation

One of the methods that chosen for this study is observation. Observation is defined as a “purposeful systematic and selective way of watching and listening to an interaction or phenomenon as it take place”(Bailey, 1994). It is a method that is ideal for situations where accurate information cannot be elicited by questioning, due to unwillingness of the respondent to co-operate and when the researcher is interested on the behavior rather than the perception of the respondent. This method will be ideal in this particular research due to the fact that the residents or industries may not admit their illegal dumping of solid waste in open space. Observation can overcome this problem.

Observation method does however have some constraints. When individuals are aware that they are observed, they may change their behavior compared to what would be a normal situation. There is always the possibility of observer bias and therefore it is not easy to verify the inferences drawn from them. In most cases the interpretation that is drawn from observation differs from observer to observer. In the process the information becomes unreliable. When a researcher engages in observation there is a possibility of incomplete observation. For example when the observer is taking some notes, she/he may miss an interaction. Recordings of conversation can compliment the observation method Bailey, 1994).

The other method that will be used to conduct this study is the survey method. The survey method is the scientific way of collecting the data from the targeted population. The survey method is aimed at efficiency, precision and logic. The survey method comprise of questionnaires and interviews. In this study both interviews and questionnaires were administered to the sample of 100 households. Questionnaires are defined as instruments that contain both close and open questions to which a respondent must react. According

to Bailey, 1994 questionnaires are a set of questions on the form of which is completed by the respondent in respect of a research project. Questionnaires can be categorized as, mailed questionnaires, telephonic questionnaires, and quantitative data collection questionnaire (De Vos & Fouche', 1998). It is vital for the research to use the ideal type to undertake a particular research. Questionnaire is a written list of questions where the researcher records the answers from the respondents. In a questionnaire the researcher reads the question, interprets what is expected and then records the responses.

The researcher will be able to select the right type of questionnaire type by reviewing the advantages and disadvantages. Mailed questionnaire is defined as a questionnaire that is sent off by mail in the hope that the respondent will complete and return it (Grinnell & William (1990). However this method does not always work at its best. Statistics indicate that a 50% response rate is considered adequate, 60% as good and 70% as excellent.. The major disadvantage of the mailed questionnaire is that the researcher is totally separated from the respondent; the questionnaire is the only communication medium between the researcher and the respondent. However the most prominent advantage is that the costs are considerably low and a larger geographical area is covered by the researcher. The possible influence from the fieldworker is eliminated. Although there are advantages the non-response data might be significantly high.

The self administered questionnaire is where the respondents have to complete the questionnaires themselves. The researcher has to explain the whole questionnaire to the respondents. Group administered questionnaires require the respondents to assemble together to answer questions. If the literacy level of the group is low assistance from the researcher is required. In this study the questionnaires had to be administered to the people by the researcher since a certain percentage of the population don't understand

English. The researcher had to interpret the questionnaire in their home language so that respondents can understand what is required.

Interviews will be conducted in the quest of collecting enough information. In many walks of life we collect information through different forms of interaction with others. Any person-to-person interaction between two or more individuals with a specific purpose in mind is called an interview. Interviewing can be very flexible, this means that an interviewer has the freedom to formulate questions as they come to mind around the issue being investigated. Interviews are classified according to the degree of flexibility as unstructured (formulation of questions during an interview) and structured (pre-determined set of questions, using the same wording and order of the questions as specified in an interview schedules) interviews. An interview schedule is research tool where as interviewing is a method of data collection. Structured interviews provides uniform information that assures the comparability of data (Ranjit, 1999)

3.4 Sampling

Sampling is a process of selecting a few from a bigger group to become a basis for estimating or predicting a fact regarding the bigger group. Arkava and Lane (1983) define a sample as the element of the population considered for the actual inclusion in the study. In other words a sample can be viewed as a subset of measurements drawn from the population in question (Strydom and Vos, 1998). The main purpose of studying a sample rather than the entire population is to gain an in-depth understanding of some facets of the population. The advantage of the sample is that, it saves time, finance and human resources. The disadvantage lies when the researcher does not find out the facts about the population character. Lane and Arkava (1985) agree that if one can study the entire population, the procedure will be tedious and time consuming.

Sample size from the population

There are general rules for the sample number that can be drawn from the entire population. The rule of thumb that is normally stated in the literature is that the larger the population, the smaller the percentage of that population sample needs to be. On the other hand the smaller the population is the sample size should comprise a larger percentage of the population. However larger sample enables the researchers to draw more accurate conclusions and possible predictions (Arkava, 1985).

Random sampling

The sampling method that will be employed in the research is random sampling that is categorized under “*Mixed sampling Design*”. Kerlinger (1986) defines random sampling as the method of drawing a portion from the population so that each member of the population in question has equal chance of being selected. Random sampling can also be defined as a method of drawing a sample from the population so that all possible sample of n has same probability of being selected for the study (Strydom and Vos, 1998). For this particular research the random sampling was used to select desired sample, hundred households from a population of 49 580 households. A comprehensive map of Clermont indicating households enables the researcher to choose the sample. A table of random numbers was employed to determine the households to be part of the sample.

Participatory Method

The community members and researchers, very often, perceive participation differently. In spite of differences there are however, common aspects that can be recognized viz; sharing of knowledge and skills between the researcher and community members, (Indigenous knowledge and skills) and the distribution of power in that the respondents

have a say on the solutions of the problems at hand. Pretty (1995) and Mayoux (1995) cited in Strydom & Vos, 1998 agree that the definition and aims of participation are entirely different across different individuals and that the term has become a stylish word with numerous interpretations, others impedes sustainability and empowerment aspects. According to Strydom (1998) participation is viewed as a means to efficiency. Whereby people are involved in a problem-solving task in which they are more likely to agree with and give support to the chosen development. The second view is mainly based on participation as a fundamental right to initiate mobilization for collective action to facilitate community capacity building and enhance local empowerment.

According to Strydom (1998) participation in the context of this investigation involves a group of people from the community working together with the researcher in identifying a problem. The community will collectively seek solutions to their problems with the assurance of the leaders. This however was only possible after the researcher gained the trust and confidence of the communities.

In traditional research, the conservative models of attitudes, beliefs, values and indigenous knowledge of township people remain undervalued and simplified by so called “experts”. The commonality in those top-down approaches is that they homogenize the population; consequently there is a failure to recognize the differences that exist through gender, time, geographical space, age and ethnic groups (Bailey, 1994).

According to Bailey (1994) participation is a cross-disciplinary and cross- sectoral approach that is able to connect communities in the development process through interaction and participatory process. It is a method when experts are able to understand

and learn from the community's experiences. The process of sharing knowledge comes in three forms *viz*:

- The local people share knowledge among themselves through analysis in groups and visual representation;
- Local people share knowledge with outsiders (expects);and
- The outsiders share knowledge with community and among themselves of what they have learned when interacting with local people.

Participatory method ropes the new emerging paradigm of development hence NEPAD (New Partnership African Development) where all South African are expected to participate in the development of Africa. In this respect there is a visible recognition of significance of context and multiple realities. It is important to note that learning takes place through sharing and there is no such thing as “expert” knowledge (Strydom, 1998). There are numerous advantages of using participatory method to gather information. The approach is flexible and innovative with a more semi-structured manner. It also put emphasis on understanding processes through involving people, gathering insights and their suggested solutions rather than providing final answers to the observed problems without consulting the people who are experiencing such problems. The major shift from traditional teaching and learning styles to development and research is the major component of participatory method. Participatory method helps to use research to acquire a greater understanding of realities and needs of communities.

The researcher in the field becomes an activist that is able to create a research environment in which participants are able to take over the process of investigation and aid their use of innovation of research techniques. The same techniques allow them to identify their own problems and solutions to their physical existence (Grinnell, 1990).

Although many authors praise participatory method there are some concerns that are put forth by few writers. By looking at the above-mentioned methodology it is a promising alternative to the traditional way of conducting research. It is imperative for the research to be aware of such limitations when using this method. Participatory research is often considered to be the subject to copious inherent tensions. Mostly participatory research is based on focus groups and is therefore premised on the possibility of consensus. It is also based on the assumption that the benefits of the research are self evident if the role of the outsider is to implement the will of the people “the nation has spoken and it must not be disputed” (Ranjit,1999). There are many aspects that influence participation for an example gender, kingship and ethnicity. There are also several reasons that can influence people not to participate in a particular study; these can include political alliances, social factors, time and geographical distance as well as the social status.

Other limitations that are presented by the participatory method is that some communities are not familiar with the visual representations. Consequently this can create further problems with regards to interpretation and representation. In most cases it is not easy to conduct activities that are associated with participatory method (Ranjit, 1999). The tools that are utilized by the participatory method can create a sense of puzzlement than traditional research methods. Another obstacle can be that, the methods can fall short to give best results where members are not sufficiently trained. According to Strydom (1998) participatory method had failed to incorporate gender dynamics in relation to the development of its techniques

Collection of Primary data

In this particular study, the researcher with the assistance of trained field workers did data collection. Both qualitative and quantitative methods had been utilized to collect

primary data for the proposed study. In the case of qualitative method semi-structured interviews were conducted with different stakeholders and relevant authorities. Contemporary, the socio-economic questionnaire (survey) was used, to gather data that can be quantified. The main purpose of the questionnaire was to collect primary data from the hundred households that were selected to participate in the study. In some instances where the researcher saw the need, semi structured interviews were conducted in some households in order to determine day-to-day problems concerning solid waste management. Strydom (1998) state that to create a less hierarchical relationship between the members of the community and the researching team, it is necessary to conduct such interviews.

Prior to the initiation of the study, the researcher saw the necessity of meeting with different stakeholders that included Councilors of the township and sub-committees of Women's Organization of Clermont. Meetings were also held with the company contracted to collect and transport waste, the Durban Metro Solid Waste Department and the Department of Environment and Tourism. The purpose of the meeting was to introduce the research, the aims, and objectives of the study and arrange interviews with different stakeholders.

During the fieldwork most of the respondents did not understand the purpose of the study and they were reluctant to participate. They feared that they would be identified as being responsible for illegal disposal of solid waste. The researcher had to explain the intentions of conducting the study and that they will remain unanimous.

3.5 Conclusion

It is imperative that the results of the research are reliable, valid and effective. The researcher had to implement different methods for this particular study. The information given by the respondents was treated with great confidentiality. The willing participants had the opportunity to understand the importance of the study and how it affects their daily lives. The process of collecting data is about sharing knowledge rather than imposing of ideas on the community.

As a researcher the aim is not to undermine, but to add to the existing knowledge. During the fieldwork, the researcher was aware of the limitation and biases that may arise due to resource limitation. The researcher will respect and recognize cultural issues of the community of Clermont.

In the field the researcher maintained flexibility with the participants. The researcher was aware of the fact that no research can be neutral or value free. Although the researcher was more interested on the scientific part of the study, political and gender issues were also focused upon. It was important for the researcher to have lived with the community for the several weeks. This enabled her to earn their trust and confidence. The researcher was also able to observe their lifestyle during this time.

The researcher used the participatory methodology to collect data. Using the councilor the researcher called community members to participate on this investigation, during the community meetings residents were asked to rank the problems using their understanding of environmental status quo. A sample of 100 households was randomly selected to collect data. Interviews were held with each members of the household. Interviews with

the local councilors were held to understand how they would to solve environmental problems in the township of Clermont.

Chapter Four

Results and Data Analysis

4.1. Introduction

This section of the study will concentrate on a presentation of the results of the investigation. These results, obtained from the implementation of the methods described in the previous chapter, will be depicted graphically and in tabulation form. Both tables and graphs will be followed by an analysis of the results.

4.2 Results and analysis

The graphs, tables and subsequent analysis of the results will *inter-alia*, include such issues as nature of the problem of solid waste, types of solid waste, cost of facilities to dispose solid waste and impacts of illegal dumping on the total environment.

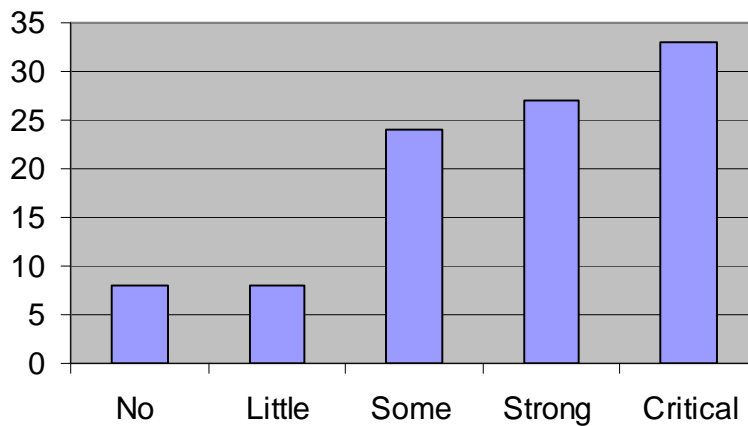
4.2.1 Nature of the solid waste problem

The nature of the problem refers to the level at which the community perceives solid waste management in their area. The levels refer from the problem being now exist into critical.

There was a clear difference in gender participation in the community meetings. According to female respondents women are not given opportunity to make major decisions that will affect the entire community,” they are expected to take care of the families”. It was also revealed that women could play a major role in eliminating illegal solid waste disposal. This is because they are the ones that are mostly affected by the problem and also contribute to the problem at the same time. However when any disease even waste related illness affects a member of the family, it is a responsibility of women to take care of the family and make sure that they receive medical attention. One can understand why women are very passionate about eliminating solid waste problem.

It was also highlighted that if women were given a chance to voice their needs the problems that are now faced by the community should have been avoided by taking precautionary majors.

Fig. 4.1 Illegal dumping being a problem.



Thirty-three of the respondents regard solid waste as a critical problem in Clermont and it needs urgent attention of the authorities. Respondents, in general indicated that among the community members there is a “culture of littering” that needs to be eradicated. 27% of the respondents indicated that impact of solid waste was strong, these who showed strong concern about the problem are those people allocated 100 meters away from dumping site and they pass through them when ever they are going to town or to work. They also complain about odours when passing such areas. However 24% showed some concern and 8% little concern, the respondents did not see solid waste as a critical problem. Although there are dumping sites around them they are not exposed to them like the other respondents.

Table 4.1 Types of solid waste disposed

Garden waste	35%
Domestic waste	63%
Building material	2%

One of the objectives was to determine types of waste disposed by the community of Clermont. The wastes disposed in the Township Clermont are mainly domestic (63 %) and garden waste (35%). Through observation it was noted that most of the domestic waste disposed are papers, tins, and bottles. All such waste can be recycled and could generate income since there is high unemployment in Clermont. The most problematic waste to dispose is garden waste due to the following factors:

It is very expensive to dispose garden waste, as residents are required to buy separate plastic bags in order to dispose garden waste. If residents use the same black refuse bag to store garden waste, the waste collectors will not collect it and it will be left on road verges or on any open space. Although garden waste is broken down the refuse bags took a long period of time to be biodegradable.

If a resident decide to cut down some trees or shrubs in his/her yard, one has to hire a garden waste skip from the waste collecting company. Cost of such facilities is very high, considering the fact that most of the residents are unemployed or underemployed. The cost of eight cubic meters waste skip to collect waste is two hundred and fifty one rand (R251) and eighteen cubic meters cost three hundred and eighty nine rand (R389). This

proves that root cause of illegal dumping of garden waste is the fact that the community members can not afford the hiring of waste skips. When community members try to dispose garden waste using normal black refuse bags, waste collecting companies do not collect the waste. Level of income therefore has major bearing sound waste management practices in Clermont.



Plate 4.1 facilities used to collect garden waste in Claremont.

The vehicle shown in the above plate is utilised to carry skips that collect garden waste such as big trees and shrubs.

For people of Clermont to spend such amount of money to dispose garden waste is a luxury, they are only concerned about their livelihood and how can they put bread and butter on the table. With unemployment taking its toll in the area, environmental concerns enjoy a low priority.

Table 4.2 Methods of garden waste disposal

Not Applicable	3%
Dump it on open space	22%
Burn	48%
Bury in the trench	23%
Refuse Bag	2%
Contractor removal	2%

The above table illustrates alternative methods used by the residents of Clermont to dispose their garden waste. 3% indicated that they do not dispose garden waste there fore this is not applicable to them and 22% of the respondents admitted to contribute to illegal dumping by disposing garden waste such as trees and grass. A large percentage (48%) of respondents proudly reported that they do not dispose garden waste at any open space they resort to burning. They were not aware that they are also contributing to air pollution that can pose danger to human health. The 23% said they bury garden waste in a trench, only 5% said that they utilise garden waste as an organic fertiliser in their small gardens. Only 2% of the respondents indicated that they put their garden waste in the refuse bag,

which however waste collector never takes it because they use wrong bags (Black refuse bags). The last 2% revealed that they get contractor to remove their garden waste,



Plate 4.2 the use of black refuse bags to store garden waste.

Residences utilise incorrect refuse bag to store garden waste, the result of such actions are illustrated in the above plate (4.2). Waste collectors always leave behind all the garden waste that is stored in such a manner. This course problem in that when there is rain waste block drainage pipes and cause flooding during rainy season.

Table 4.3 The number of persons in a household and refuse generated

Number of refuse bags	Percentage	Members	Percentage
One Bag	33%	5-10	49%
Two bags	47%	11+	5%
Three bags +	20%	1-4	46%

The majority of respondents indicated that they generate two bags of waste per week. The household had members ranging from five to ten members; most of the households that fall from this category are breadwinners who are pensioners or underemployed labourers. It was mentioned that during holidays the amount of waste generated per week per household increases from two to five or seven bags per household. The theory “bigger the family more waste is generated” did not apply in Clermont. The theory is proven wrong by the theory of consumerism where by people are required to have capital in order to acquire products. In various families that, there was a pattern that was large families did not have breadwinners that earned more than a thousand rand. Such families only buy goods that will help them to survive only basic needs; there is little no money that is left to by other products that can increase their levels of waste generation.

Other families regardless of the size (33%) reported to generate one bag of waste per week and 20% said they produce at least three refuse bags per week. Income of money earned determines the amount of waste that can be generated by household. Size of the family rarely plays a role in this regard. However when a family is big and there is

enough income for goods then we will find more waste being generation. Respondents who earned more than thousand rand generated more waste than those who earned less than or who are unemployed.

Table 4.4 Occurrence of illegal dumping in the area

Yes	there is illegal dumping	55%
No	there is no illegal dumping	45%

Fifty-five percent (55%) of the respondents reported that illegal dumping occurs in their area. However most of the respondents interviewed denied that they contributed to this problem. The blame was shifted to the neighbours and people who are passing by. Others admitted that they were contributing to the problem of illegal dumping of waste and one of the reasons for illegal dumping was that the frequency at which the waste is collected is not adequate. Since the waste is collected once a week in Clermont and if they miss the collection date they have nowhere to put their waste but to dispose it in any open space available. Ownership was brought into play; residents residing near dumping sites reported that their neighbours do not have the sense of pride with their surroundings due to the fact that they are renting the houses. According to the people rented households that were visited during the investigation, it is responsibility of the landlord or landlady to keep their surroundings clean.

Table 4.5 the impacts of illegal dumping

Environ. Impact	Percentage	Health Impact	Percentage
Not applicable	46%	Not applicable	45%
Unclean	18%	Cholera	52%
Unattractive	21%	Not sure	3%
Environ. Degrading	15%		

The researcher was able to explore whether illegal disposal of solid waste in the area has negative impact on public health, the above table indicate results that were found. 55% residents that are living in close proximity to the dumping sites reported that they are suffering from Cholera, respiratory problems and common cold. During the interviews 45% reported no health impacts that were associated with solid waste mismanagement in their area. The group of respondent that reported no health impacts lived far from illegal dumping sites. Three percent of respondents are not sure about those effects, but some of them had skin rashes that they were not sure how to name.

The study conducted reveals that most of the respondents (46%) consider illegal dumping to have no environmental impacts. These respondents live some distance away from dumping sites. Consequently they get minimum effects of the problem. Eighteen and twenty –one percent reported that the area looks unclean and unattractive respectively. Fifteen percent (15%) of respondents reported that illegal disposal of solid waste is

causing environmental degradation. The main reasons attributed for illegal dumping of solid waste were, viz:

- The refuse plastic bags are not enough furthermore it was indicated that refuse bags were of poor quality.
- No other place to dispose solid waste if one misses the day of collection.
- Most of the people were not concern about the importance of living in aesthetically clean environment.

The researcher also observed that in other households they did not have bins to store their waste; as a result they only used refuse plastic bags. The use of plastic bags only has its problems in that the domestic animals like chicken and dog easily scatter waste around and no one takes the responsibility of picking the waste and put it into relevant plastics again. It is therefore important for household to have refuse bin, because such incidents exacerbate the problem of illegal dumping.



Plate 4.3: illegal dump. This plate shows ash and biological waste that is illegally disposed by the local butchery store in Clermont. The main reason for this act is to avoid costs associated with the removal of such waste.

4.3 Collection frequency and subsequent problems

The Company responsible for waste collection in Clermont Township is called eThembeni community service Solid Waste Management. Waste is collected using trucks that are suitable for collecting waste. Waste is collected once a week in each and every section of Clermont. The same company also provides street cleaning services. Seventy-five (75%) of the respondents indicated that they do have street cleaning but it is not adequate. Twenty-five percent (25%) do not receive this service because there is no proper road infrastructure.

Waste collectors' work five times a week in order to cover all the sections of the area. Clermont is the "Nation of Shop keepers" where even households are running tuck shops in order to earn a living. According to the waste collecting company the shopkeeper has

to hire trolley bins to store waste that was generated. The majority of shopkeepers are unable to pay for trolley bins; wait for the collection day for their waste to be collected.

Problems that are encountered by waste collectors can, at times, be unbearable (Senzo Mkhize, May 02, 2002 waste collector). Some members of the community take out waste before or after the agreed time and date. In most cases after all the waste has been sorted the animals (birds, chickens and dogs) disperse it and it is very difficult for waste collectors to return to clean up the mess. As a result it seems as if the waste collectors are not efficient in what they are employed to do, because the area looks unclean and unattractive. According to Senzo Mkhize who is a waste collector in Clermont township, there was an agreement between the community and waste collecting company that the waste will be taken outside at six am (06H: 00) in order for collectors to sort out the waste in an appropriate manner. When the day of collection has passed, the waste is illegally disposed to any open space. Residents also dispose whole and broken bottles with other types of waste despite them being advised to separate bottles from other waste.

To eliminate the problem of bottles the waste collector recommended that recycling should be introduced in the area, because he believed that it would reduce waste such as bottles, papers and cans. However people will only recycle when they know that they will generate some form of remuneration for their effort. Waste collectors very often are subjected to verbal abuses from the community. The community is convinced that they are paying rates and that they have a right to do as they please. According to the councillor majority of the residents do not pay rates due to little or no income. There is a deep concern, in that people in general don't want to pay rates as required. However there are people who like to pay rates but they are unemployed and they are without income. The researcher was told that there is a payment plan for those who cannot afford the

required amount. Those who has houses with a property market value of R0, 00-30 000 do not pay rates and those with house with property market value of R30, 000-60 000 only pay R20, 00 per month. There are different systems that the residents can use to pay for the rates, one can pay on monthly bases or on an annual basis.

Most of the respondents (87%) indicated that they want recycling projects to be expanded in the area. Recycling projects can help reduce the amount of waste being disposed. The researcher noted that most of the waste disposed on open spaces included cans, paper and bottles, which are recyclable. Garden waste can be recycled, by turning it into compost.

Table 4.6 Preferred type of recycling program

A drop off to recycling station program	22%
A door to door collection	78%

Two types of recycling programmes were proposed to the community. These were the dropping off of material at the recycling stations and the door-to-door collection of recyclable material. Seventy eight percent (78%) of the respondents preferred the door-to- door collection of the recyclable material. These people indicated that they did not have time to walk to the station where material can be disposed. The balance of the respondents (22%) was happy to walk the short distance to hand in their recyclable material.

Table 4.7 Reasons for introducing recycling Projects in the area

Reasons for recycling project	Percentage	No recycling project –reasons	Percentage
Not Applicable	14%	Not Applicable	86%
Reduce waste	34%	Few will benefit	5%
To gain income	44%	Money not enough	9%
Create employment	8%		

There are numerous reasons why people need to have recycling program expanded in their area. From the above table 44% wanted recycling projects because of income gain, and 8% thought that the projects would create employment in the area. In these areas environmental issues enjoys a low priority compared to unemployment problems. The respondents even mentioned that before they can take full responsibility, they need employment first and one cannot expect them to take care of the environment on hungry stomach. Thirty four percent (34%) of residents showed concern about the environment, stating that recycling projects will help reduce waste being illegally disposed and the waste that is disposed on the landfills sites considering the fact that it is very expensive to construct landfill sites. It is therefore important to limit the amount of waste that is taken to our tip sites. Fourteen percent of the (14%) of people did not know what were the benefits of expanding recycling projects in the area.

According to the councillor there are Environmental committees that deal with Solid Waste Management issues. Due to the visible problems posed by solid waste in the

community there was a need for initiative to curb the problem; consequently Green Clean Health Committee was formed with the main objective being to keep the environment clean. The committee did the following in order to achieve the main objectives

- Identified the illegal dumping spots in the area;
- Determine the reasons for people to dump wastes in these open spaces; and
- Find funding for the cleaning up projects.

Table 4.8 The perception of Solid Waste Management in Clermont

Poor	9%
Adequate but poorly managed	32%
Good	51%
Very good	1%

Fifty one percent (51%) noted that the services were good in the area and thirty two percent (32%) indicated that the services were adequate, but poorly managed. Nine percent (9%) of the respondents indicated that solid waste management services in the township were poor. The researcher noted that the majority of such respondents reside in areas where there is no proper road infrastructure. Only one percent (1%) stated that services were very good and the remaining seven percent (7%) was sure about the status of the waste management in the township. However most of the respondents indicate that the frequency of the services should be increased.

Table 4.9 Suggestions from the community about waste management related problems

Collect twice a week	53%
More attention during holidays	7%
Strong plastic bags & more plastic bags	18%
More attention on street cleaning	9%
Environmental Education	9%
Not sure	4%

The main finding of this investigation was that fifty three percent (53%) indicated that when waste is collected twice a week there will be a decrease in illegal dumping in the area. Seven percent (7%) of respondents pointed out that illegal dumping occur at a high rate during the holidays because more waste is generated during holiday period. More attention must therefore be given to holidays on basis of frequency. Eighteen percent (18%) wanted more refuse plastic bags that should be more durable. Nine percent (9%) were adamant that environmental education programmes be introduced in Clermont.

In order to ensure that the results that are obtained from this particular project are accurate and reliable the research used a more qualitative way of collecting data. This was done by randomly selecting respondents from the original sample to participate on participatory method whereby respondents were required to rank the problems in their community according to their level of being problematic. The method is explained in detail in the previous chapter. The following table will illustrate the results of the participatory method. In this manner members of the community were given a chance to make a difference in their lives and make decisions that were going to affect them and

their families in the near future. It was satisfying for the researcher to acknowledge that people are making decisions that they can live with them, unlike in a traditional manner whereby an outsider is able make decisions for the community.

Table 4.12 The table below indicates the level of income per month of the residents of Clermont Township

Income/month	Percentage
300-499	5%
500-699	22%
700-899	11%
900-1099	21%
1100-1299	13%
1300-1499	5%
1500-1699	5%
1700-1899	1%
Other	8%
Not Applicable	9%

From the obtained data it is clear that the residents fall under low-income group. Majority of the residents earn between, 300-899 per month, this figure is generally

considered as low income. Most of the households visited by the researcher depend solely on social grants for their livelihood. Those who are underemployed (22%) manage to get a salary between 500-699, from casual employments. According to literature areas like Clermont will not accumulate much waste due to the fact that unemployment is rife and people don't have much to spend on goods that will generate more solid waste. Forty seven percent (47%) of the households generate two bags of waste per week, the rate depends on the activities they are engaged in. In some instances the households can generate more than five or six bags of solid waste. Nine percent (9%) of the respondents were unemployed with most of them selling fruits and vegetables on the central market of Clermont. Consequently there is more waste created by informal trading that sometimes takes place in the homes of the respondents. In most cases informal traders have to buy extra refuse bags in order to accommodate the solid waste they accumulate. The majority of the residents confirmed that they were not willing to stay with this waste till the next collection day; therefore they have to dispose of it somewhere.

Table 4.10 The below table indicates the comparing of problematic waste in Clermont





































Legend	Str.cl	D.wast	Electr.	Inf.tr.w	Scr.met	Gar.wst	SS/wst	Ind.wst
Street cleaning		Domestic .waste /Street cleaning	Str.eet cleaning	Str.eet cleaning	Str.eet cleaning	Garden .waste	Sewage Sanitary waste .	Street .cleaning
Domesticwaste			Domestic .waste	Inf.ormal trading .waste	Domestic .waste	Garden .waste	Domestic .waste	Domestic .waste
Electricity.				Informal.tr.adin g waste	Electr.icity	Garden. waste	SewageSanitar y /waste	Electr.icity
Informal .trading.waste					Inf.ormal trading .waste	Gar.den waste	Informal.tradin g.waste	Informal .trading .waste
Scrap.metal						Garden waste	Sewage Sanitary/waste	Industrial .waste
Garden.waste							Garden waste	Garden. waste
SewageSanitar y/waste								Sewage Sanitary/waste
Industrial.wast e.								

Table 4.10.1 Ranking of waste problems

Problem	Scoring	Ranking
Street cleaning	5	2
Domestic waste	5	2
Electricity	2	4
Informal trading waste	4	3
Scrap metal waste	0	6
Garden waste	7	1
Sewage Sanitary waste	4	3
Industrial waste	1	5

Note: Ranking of the above table is as follows, 1-3= Less problematic, 4-5=problematic, 6-10= most problematic

The above tables have illustrated that the most problematic waste is garden waste, which ranked seven points on the ranking table. Since municipal waste collectors do not take garden waste due to the fact that those residents use the wrong plastic bags to store garden waste, such waste ends up in open spaces. The initiation of vegetable gardens where garden waste can be used as organic manure was also a suggested means of solving the garden waste problem. The shortage of land exacerbated by the high cost of land discourages people from initiating garden projects. Vegetable garden projects can alleviate poverty and hunger. People can plant and be able to feed their families and sell the surplus.

Street cleaning service and domestic waste rank second on the ranking scale. The problems that are encountered in the street-cleaning category have been associated with the garden waste problems. There was an agreement between residents and councillors that at least the street cleaning should be carried out four times a month. The reason why they mention domestic waste as a problem is because residents are not satisfied with the frequency at which the domestic waste is collected. Community suggested that an increase in waste collection frequency could reduce illegal disposal of waste.

In the case of sanitary waste there are major improvements that need to be made. The groups of respondents indicated that sewage waste is the problem in some parts of Clermont especially those parts that are still using bucket system. In such area there are many diseases because sewage waste is not taken for disposal anymore. Although the

issue of sewage waste is alarming some efforts however are being made by the councillors to alleviate the problem. The researcher observed that in some parts of Clermont water borne toilets are being built for the residents. However respondents said that the process of building water borne toilet is very slow and caters for households with income. In the case where residents are building their own pit latrine, they are always shallow and filled rapidly. The toilets are usually unhygienic and cause spillage during rainy seasons.

Table 4.13 The table indicate levels of education and age groups in Clermont

Age group	Percentage	Education level	Percentage
15-24	7%	Primary	20%
25-34	20%	Secondary	48%
35-44	26%	Tertiary	25%
45-54	16%	Nursery school	2%
55-75	31%	No formal educ.	5%

Forty-eight percent (48%) of the respondents have secondary education. The researcher also found that although these people can read and write, they can not understand English. Therefore it is important that all the material that is written on solid waste and general environmental awareness be interpreted in a language that people can understand. Twenty-five (25%) of the respondents received tertiary education and they can read and write both languages, however this is a minority

group. Twenty percent (20%) of the residents had received primary education and 2% only received pre-school education.

Most of the pensioners (55-75 age group) have little or no education, it is therefore necessary for the environmental educators to use visuals like pictures to help them understand impacts of illegal waste disposal. Five percent (5%) of those interviewed did not receive formal education. A similar number of respondents did not go to nursery school because in that period there were no nursery schools in Clermont.

4.4 Conclusion

During the investigation we have revealed many underlying facts that have largely contributed to the improper management of solid waste in Clermont. Although in Clermont there is a low-income group, people are passionate about taking care of their surrounding environment. They have indicated that they are caught in the cycle of poverty and it is impossible for them to take care of the environment. They suggested that opportunities need to be created, that can help them to eradicate poverty at the same time bring in a positive change in the environment. Levels of education if enhanced can make a difference in terms of how people perceive the environment. Results indicate that the respondents that received formal education are aware of environmental problems.

This study was able to confirm the types of waste streams that are generated in Clermont Township. The researcher was able to prove that frequency of waste collection in Clermont was inadequate. Investigation was able to understand waste mechanism that were used in Clermont and identify where the residents are facing a problems and what was the root cause of poor waste management in Clermont township.

Chapter Five

Discussion, recommendations and conclusion

5.1 Introduction

The final chapter of the report will focus on discussion of the results presented in the previous chapter. This will be followed by recommendations on how to eliminate illegal dumping in Clermont. The recommendations will, to a large extent, be those put forward by the community as well as from the viewpoint of the researcher. An overall conclusion will be presented at the end of the study

5.2 General Discussion

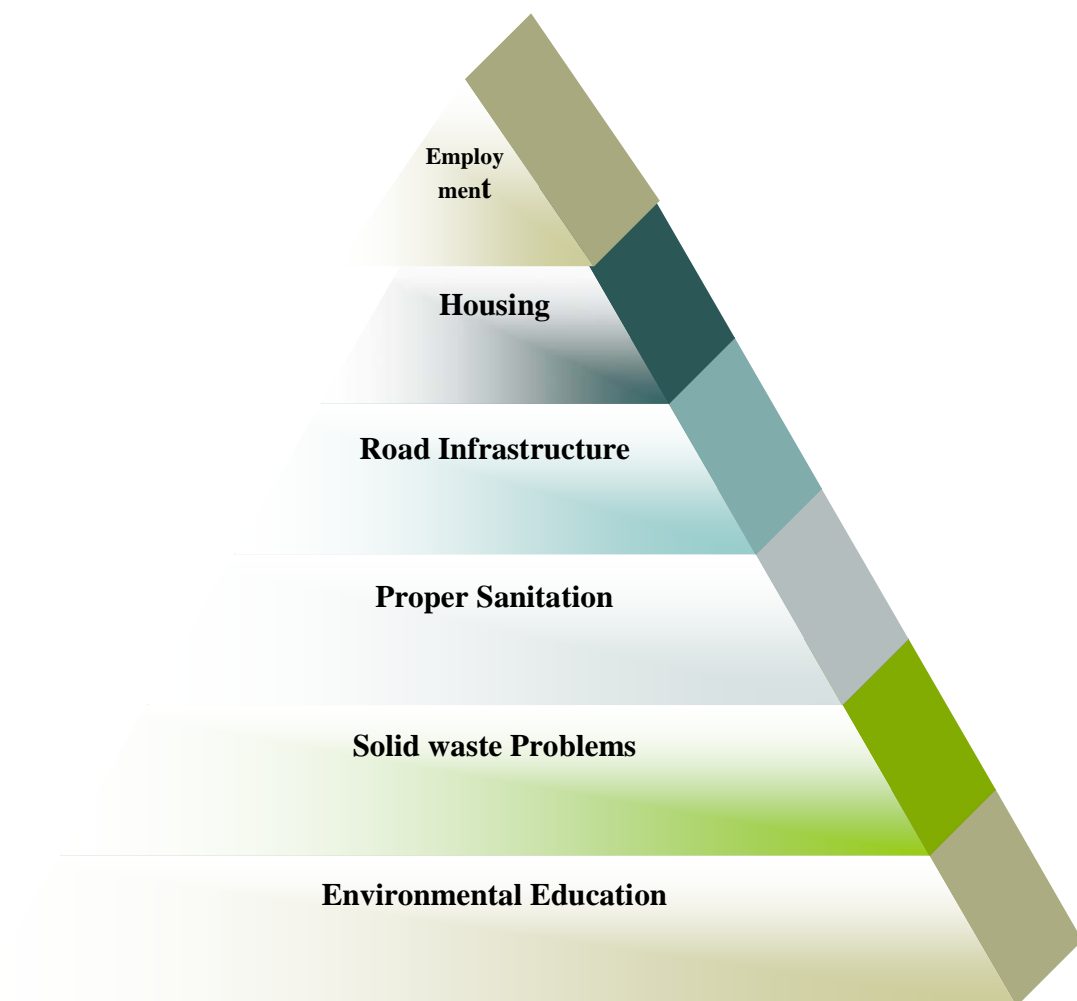
In general the research has shown that, if the waste can be collected twice a week and residents be provided with proper waste bags for relevant waste streams the problem of illegal dumping in Clermont could be minimized. Effective communication between solid wastes collecting companies and the community members is important. For an example residents were not informed about the main working principles of the solid waste collecting, like what time are they required to take the bin outside their houses. As a result, people end up disposing waste in open spaces. Although there was an alarming indication that recycling project is needed in the township there were no indications that the project can start soon. The main obstacle is the lack of capacity in that there are no environmental personnel that are available in Clermont.

There is a need for the authorities to promote township tourism, since it will encourage cleanliness in the area. It is natural for human beings to tidy up their space when they are aware that they are going to have a visitor.

Initially in this research it was noted that theory proves that the “higher the income, there will be an increase in waste generation”. However in Clermont the results of the research have clearly shown that there is a contradiction with this theory. Although the area is a low-income group, waste generation is high. The contradiction can be attributed to the fact that the majority of residents in Clermont Township practice informal trading in their homes. All the products that are purchased for "sipaza" shops informal trading comes with packages that need to be disposed after the products are consumed.

In Clermont residents can burn any kind of waste, with no restrictions. However this contributes to health related problems. To avoid the occurrence of such problems it is important for councillors or local authorities to create restrictions or regulations in terms of burning of waste, especially garden waste in the townships or any other public space.

Figure 5.1 Rating of needs in Clermont



One can deduce from this pyramid that the most pressing issue is unemployment in the township of Clermont. As a result environmental problems like solid waste management enjoy low priority in the community. Although observations have shown that there is illegal dumping in Clermont, people are more concerned about meeting their daily basic needs rather than worrying about the surrounding environment and its immediate problems. As one of the residents has pointed out that it is impossible to worry about the surrounding environment on an empty stomach, as the say says a hungry human being is always angry and acts like a hungry lion. Consequently there is lot of crime that is coursing major problems on top of the existing problem of solid waste management in the area. Housing problem and improper road infrastructure in other areas of Clermont results in very little hope for solid waste management to be considered as a pressing issue.

5.3 Recommendations

The company or industry must seek strategies to overcome waste management problems. In most instances many companies perceive themselves as financially incapable to implement solid waste minimization programmes. The industry must not give up in search for the low capital investment plan programmes. It is also recommended that the industry must review its customer's needs and carry out pilot testing of new processes and product. The company must aim at increased quality controlling manufacturer and opinions of the workers are very important in the future implementation of solid waste minimizations plan. Workers must point out what they think will be obstacles in the implementation of programmes. It is essential that the industry employ professional people who will handle waste minimization programmes, this is because these people must be able to compile reports that will state clearly all tangible and intangible benefits

of the project to be undertaken. Also the team must be able to provide alternatives such as cleaner technology.

5.3.1 Solid Waste services in developing countries

The provision of services in small rural areas is a serious problem in South Africa and neighbouring countries like Namibia. Contributing to this problem is long distances that are between the towns and rural areas. A recent research that was conducted by South African consultant produced the two purposes Refutip Tractor- Trailer system as part of implementation of integrated waste management strategies for the Northern Namibian towns. According to Wastecon (August, 2000) the lack of waste awareness together with invisible priority given to waste management as a municipality service was a core problem. Thus it is important to identify all potential problems in all government departments. The low priority given to waste management in the past has resulted in the lack of proper financing. The lack of capital creates a backlog in the infrastructure development. Consequently the capability to prosecute waste culprits is compromised.

There are a number of issues that should be addressed to appropriately deal with solid waste generated in developing countries. Isolated investments in equipment and technology do not address the key issues, and generally the investment is wasted. For investment in equipment and technology to be successful and suitable, they must be preceded by investment in the following areas: development of sound, reliable and achievable national policy preparation and implementation of policy.

Improvements in the provision of solid waste management services depend upon the existing systems of administration and urban planning. Generally, it is necessary to prepare a realistic comprehensive plan. The plan can have several names: master plan,

action plan, strategic plan, and others. Regardless of the name given to the plan, it should include accurate information on the type, quantity, and quality of the waste. In addition, the plan should set goals in terms of collection coverage, degree of reduction, levels of recycling, etc. The plan can be implemented only within certain legal and regulatory framework. This framework should be comprised of the set of ordinances, laws and regulations concerning the management of solid wastes. The laws should include appropriate responsibilities for enforcement and inspection.

One of the most important steps towards improvement of solid waste management systems in several developing countries deals with major modifications to organizational structures and improvement in human resources of local governments. Typically, the organization associated with solid waste management is poorly organized and lack hierarchy and importance that other public services (such as water supply and public services) are given. Generally, local governments are accustomed to receiving assistance from the central government and do not make any efforts to improve their MSW management capacity. As a results local government becomes dependence on the central government including decision making. Consequently local government may require assistance in the establishment of a specific department or authority to deal with solid waste management issues. The degree of autonomy between local government and central government may depend upon the size and degree of development of the particular city. Neighbouring small municipalities may decide to jointly establish a regional organization in order to deal with their solid waste management tasks.

5.3.2 Development of the National Waste Management Policy

The local government units in the developing countries cannot develop and implement reliable, efficient, and cost effective solid waste management programmes without clear national goal and priorities. However South Africa has tried to put in place an environmental policy, although it is fragmented in nature with little or no implementation. In the Bill of Rights government states that everyone has a right to a healthy environment, but there are no visible strategies in place that will help achieve this goal. In the development of goals and priorities, considerations should be given to some of the usual basic requirements of solid waste management, such as the provision of waste collection services to the entire population (including the urban poor) , the application of the waste reduction and minimization measures, the implementation of recycling programmes, and the improvement of final disposal procedures.

The national policy should be developed through the establishment of the national committees, composed of representatives from both the public and private sectors in the close consultation with the public. It has been demonstrated that there is no government policy or strategy will be successful without full acceptance and co operation of the public (the end users of solid waste management system). In order to be politically sustainable, the development of the national policy should be based on realistic goals, taking into consideration the social, political, cultural, and economic conditions and limitations of the country. Furthermore, the national policy should clearly define the roles and responsibilities of the various government entities and other pertinent organizations in order to avoid overlap, inefficiency, and controversy. A clear message should be included on the roles, responsibilities, and rights of the users of the system.

The national policy should be instructing the responsible entities to elaborate and enforce an appropriate regulatory and legal framework, which would allow those involved in the implementation of the policy to achieve and maintain the goals. Sanctions such as seizures and forfeiture were meant to be implemented, but there are no success stories that are associated with this law. The only way to minimize such damaging actions to the environment is to put in place heavy penalties for violation of these policies. The legislation should be able to draw differences in different types of land pollution. In this manner types of waste will have different penalties on different levels. The impact of irreversible situations has to be considered when proposing penalties. In the areas where the environment is damaged in such a way that they can not be reversible, the penalties must be very high opposed to the normal ones. In Clermont there must be penalties that are imposed to members of community and outsiders. The penalties must allow that individuals or companies that are suspected of illegal dumping will be prosecuted. Illegal dumping must be a criminal offence.

5.3.3 Resource recovery and recycling

Recycling refers to the concept of a material loop: the production of material, use of material, return of material to producer, and the recovery and re-production of material from itself. The most common materials are paper, aluminum, steel, glass and plastic. According to the Environmental Protection Agency (1996), Americans recycled or composted 24 percent of MSW in 1994, with composting accounting for 3 percent of that total. Commonly recycled MSW is paper and paperboard, glass, metals, plastics, rubber and leather, textiles, wood and yard wastes.

Crucial to recycling is the marketability of recycled material for businesses that will recover the recycled material and the marketability of affordable recycled products to

customers willing to purchase the recycled material. MSW must be first produced with material that can be recycled. For example, there are different kinds of plastics used in MSW and each is subjected to a different recovery process. Plastics must be separated according to types; or else the recovery process may become contaminated with the wrong kind of plastic, rendering the recycled product unusable. The Society of the Plastics Industry has developed a uniform code that manufacturers stamp on each product to assist in the sorting of different plastics for recycling. Glass also comes in different types, each having to be sorted and recovered separately (Folz, 1996).

Folz (1991) conducted a national survey of 264 community-recycling coordinators published in 1991. Based on survey responses from communities, he was able to draw conclusions on about what factors contributed most for successful implementation and management of recycling programmes. The ranking of problems involved in municipal recycling, starting with the most important problem, included: finding markets for recyclables; getting residents to participate in the program; lacking sufficient state grants or other financial assistance; securing adequate local government financial support; obtaining information/technical assistance for recycling; and, preventing theft of recyclables. Respondents reported a wide range of materials included in municipal recycling programs, everything from newspaper, glass and aluminum to scrap metals, waste oil, batteries and chipboard. They also reported that the most useful public information and education strategies were pamphlets-brochures-bumper stickers, speeches by officials to schools or local groups, and special programs in schools. Citizen participation had a significant effect upon the type of programme, decisions about curbside pickup, whether a private contractor picks up recyclable materials, whether composting is used for yard waste, the provision of bins or containers, same day pickup, and separation policy.

The recycling of paper and cardboard can also generate income that can help people to break the cycle of poverty. There are numerous benefits that can be achieved in recycling paper that in return protect natural resources, for example by recycling papers we are conserving our trees and in turn we have more oxygen which improves the quality of life. These percent increases dramatically in shops and offices and, in household most of papers are from packaging material.

If the residents in Clermont want to recycle paper material, they need to make private arrangements. There is no public facility that is dedicated to recycling of all waste streams. The process is privatized; as a result the majority of resident are not aware of such facilities. During the investigation the majority of the respondents indicated that papers are not recycled. The only option available for them is to dispose papers with the domestic waste.

Resource recovery provides income for a number of people in a lower economic sector, those who are underemployed and unemployed or pensioners. Material such as metals, bottles and papers are discarded as waste can be sold for recycling. Few residents however have access to these facilities where they are able to sell metal other materials, since most of them are not aware of the value of the material and furthermore the lack knowledge as to recycling benefits. There is also a problem of distribution of information within the township. There is also an element of selfishness whereby a select few have the information and are not willing to share it with the rest of the community. It is recommended that local authorities need to supervise process, so to ensure that everyone

has access to such facilities. During research it was clear that most of the people give away their material to those who have access to the buyer.

However if bottle and metal wastes are not the only wastes that can be recycled in the recycling of paper and cardboard can generate income that can help people to break the cycle of poverty. There are numerous benefits that can be achieved in recycling paper that in return protect natural resources, for example by recycling papers we are conserving our trees and in return we have more oxygen which improves the quality of life. The research has proven that papers makes up one-third of waste disposed off in bins. These percent increases dramatically in shops and offices and, in household most of the papers are from packaging material. Although there are positives in recycling of papers there are weakness that needs new improvement in terms of technology advancement. It is known that paper gets its strength from the wood fibers, however as the paper gets recycled the fibers get shorter and weaker. Consequently the paper can be recycled four to five times and another virgin pulp from trees is needed to maintain the quality.

The streets of Clermont are lined with plastic material that makes the area look untidy. However most of these plastics litter the area are not recyclable due to the fact that they are less than eighty microns. The only solution to such a problem is to reuse the plastics by making craft work out of the plastics and reusing them to carrying of things rather than disposing them in open spaces.

It is important to recognize that recycling alone cannot solve the problem of waste being illegally disposed in open spaces and managing our waste properly. However it is one of the options in integrated waste management that can help us to curb the problem. One of the disadvantages in recycling is that in some cases the energy use turns to be greater than

using prime materials at the same time by using prime materials. The use of prime materials, however impacts on resources, therefore it is wise to make a choice that will benefit the environment as a whole.

5.3.4 Source Reduction

Source reduction is defined as the elimination of waste by not generating the waste. The Environmental Protection Agency (EPA) defines source reduction as reducing the quantity of material that must be discarded, minimising toxic substances in products and manufacturing products with longer life expectancies. Consumers can reduce waste by avoiding the purchase of highly packaged materials such as microwave foods, using both sides of paper, purchasing bulk foods and storing it in reusable containers or by reusing foil and plastic or paper bags (Environmental Protection Agency, 1996). This can be implemented in Clermont.

5.3.5 Composting

Composting is the breaking down of organic materials such as grass, leaves and brush into soil-like sediment that can be used to support the growth of additional grasses, trees and bushes. Composting is aided by the mixing of food scraps and allows for the recycling of leftovers or spoiled food supplies. "Backyard composting" is ways that residential homeowners recycle their own grass, leaves and brush. Because most municipal landfills no longer accept yard wastes, there are an estimated 2,000-2,300 municipal yard waste composting sites that collect grass, leaves, and other brush along with restaurant food wastes. This compost can be in turn sold to golf courses, horticulture businesses, or used in municipal parks or as cover for municipal landfills (Darmstadter, 1992).

The use of compost as a soil amendment, fertiliser is crucial in many countries. This technique of recycling solid waste has been successful in Asian countries because it was their old tradition to make and use compost. On the other hand, Western Europe utilises a range of technologies to manufacture compost. In these countries producing compost is used as the solid waste management system. Over the past there are wide failures that have been witnessed in other countries, despite huge successes in India and China (Nozick, 1992). Compost systems have failed because of economic and technical reasons. What these failures have in common is failure to understand the role of composting as part of an overall waste management system. Many compost plants have failed because of the inability to secure waste or to the need to market the compost that produced.

In much of Latin America and Africa, however, efforts to organise composting have failed to secure enough waste. When dumping or land filling is inexpensive and not subject to effective environmental controls, composting is relatively expensive. In Europe, where land filling is subject to controls and fees and land is very limited, composting is much more attractive. Furthermore, European political culture gives government a monopoly over the waste stream, so a policy decision to give composting a priority over land filling can force waste to a composting facility even when it is not cost-competitive.

The second economic failure is on the marketing of the finish product. The cost of compost depends on external demand for soil enhancers, on perceptions of its value, on its quality, and on its accessibility to potential users in the immediate vicinity. It also depends if other alternatives are available to farmers and cultivators in the region, and on

the cost of those alternatives from chemical fertiliser to wastewater sludge relative to the cost of the compost.

- Compost marketing works when:
- The farmers or gardeners are located close to the source of the compost;
- The entity producing the compost is willing to transport it to the users; and
- The compost is priced below the price of commercial fertilizers, or is given away.

Composting has experienced two kinds of technical failures: first, a failure of the mechanical systems that manipulate waste streams before composting itself begins, and secondly, a failure of the decomposition process itself, largely attributable to failure to create the environment for the biological process to thrive. On another level, the failure of composting technology is a failure of the waste management sector to understand the nature of the waste stream or the biological composting processes, and to attempt to solve problems with over-designed machines. Since it has been indicated in chapter four, illegally dumping of both domestic and garden waste material on open spaces. The community of Clermont can use such waste to create compost. The members of the community can start community vegetable gardens using the compost to fertilize soil.

Failure of mechanical pre-processing: The technological failure of composting is primarily a failure of the mechanical pre-processing systems, and not of the biological composting process itself. Bio waste composting facilities have generally relied on

complex mechanical pre-processing to remove non-compostables. These systems have by and large failed at their tasks. It is an open question as to whether there is any mechanical system, which could ever adequately identify and separate all of the materials that occur in mixed waste, but no existing systems do this sufficiently to ensure good compost quality.

Pre-processing techniques based on manual separation aided by human eyes and hands have consistently produced the best compost in developing countries, and often in industrialised ones as well. There are small-scale bio waste composting facilities in both industrialised and developing countries that are successful because of the high degree of manual pre-processing. The larger facilities dependent on mechanical separation cannot accommodate the diversity of the waste stream.

The demand of high organic content is essential: While many bio- waste composting facilities are failures, the great predominance of source-separated composting systems is successes. Yard, garden, restaurant, and market waste composting projects quietly thrive in every corner of the globe. The biological composting process is so basic that it is very likely to succeed if there is an appropriate input stream and proper handling.

In developing countries, the high animal and vegetable waste content of the waste stream, combined with existing materials recovery systems, means that the mixed waste stream is sufficiently compostable to produce good compost at a small or medium scale. Support and enhancement of existing materials recovery activities and (where otherwise reasonable) limitation of new types of packaging can maintain the compostability of the waste stream and result in the production of good quality compost (www.ananzi.com).

Failure of biological processes: Where there is a failure in the composting process itself, this relates to the failure to understand the nature of biological processes. Compost bacteria, insects, and micro-organisms require certain environmental conditions to thrive. If these are absent or interrupted, they must be corrected (Nozick, 1992; KAB, 1996).

In order to build composting plants in Clermont Township, it is essential to conduct necessary research. High cost of the process must be considered because the community of Clermont does not have financial resources and necessary technology and aspect to implement this project. Although waste supply might be huge, most of the solid waste generated in Clermont is papers and bottles, domestic waste (Biological waste) only contribute five percent. Clermont can only capitalize on garden waste (60%) that seems to pose a major problem on disposal. The fact that there are no farmers around the township can cause a lack of demand. In that there will be no one to utilize the finished product (compost).

5.3.6.1 Formulation of guiding principles for privatization of solid waste collection Services

Although collection of waste in Clermont is privatized, there is a need for policy formulation and development of appropriate legislation and guidelines at the national level on privatization including the redefinition of the role of Local governments. There is also need to carry out privatization potential studies to identify and priorities specific municipal services that are appropriate for privatization in each city. It is advisable to undertake a thorough assessment of the likely impacts of privatization before embarking on it. The potential research areas for privatization include the

following municipal services: - transport; bus parks; public toilets; street cleaning; road maintenance; schools and health centers; and sanitation.

Mechanisms and guidelines should be developed and put in place to ensure that privatization does not exclude or impose burden on the poor. These may include some safety nets and cross-subsidization on poor people, the case in point is Clermont. In addition, municipalities may find it necessary to provide some basic services in low-income areas, especially health-care, education and collection of garbage. Cross-subsidizing such service provision to the poor neighborhoods would be seen to be more feasible through the "contracting" mode of privatization but not through pure privatization.

There is need for greater public education on privatization. The general public as well as stakeholders, including municipal councilors and officers, and urban communities need to be sensitized and informed on the rationale and benefits of privatization, as a system of providing municipal services. Where privatization results in retrenchment of employees in Clermont, innovative approaches such as retraining programme should be put in place.

Initiatives by informal sector entrepreneurs should be encouraged and supported by local authorities through enabling byelaws and other administrative incentives. The latter should take advantage of the former in order to increase access to basic services. This could start by recognition of the many current private operators in waste collection and disposal, for example. There should also be due recognition and encouragement of other self-help initiatives, partnerships, community based organizations and other associations, which have proved capable of providing services to themselves e.g. in the area of water supply, garbage collection and transport services.

Capacity building and training for local government official is an essential part of the privatization process. Collaboration with training institutions for collaborative training needs assessment; development and execution of training would greatly enhance the privatization process. The establishment of data banks and management information systems in local municipalities is essential. This will facilitate effective monitoring and management of service delivery by all actors involved in the process and thereby ensures sustainability in service provision.

Decentralization is a necessary framework for privatization. It entails giving decision-making power with corresponding financial resources to the local level. Greater decentralization should be encouraged and implemented in practice as a way of dealing with the expansion of municipal service development and provision. Greater devolution of decision-making authority, responsibilities and commensurate resources should be given to local authorities in the true essence of "subsidiary" principles

One can safely say that there is no healthy relation between stakeholders of solid waste collection, due to poor communication between the waste collecting company, the community and authorities. It is necessary for the solid waste collecting company to be represented during community meetings where all issues or problems that are plaguing the community are voiced out. The company needs to create a dialogue with the residents. This can be done through the voice of councilors or local authorities. Solid waste companies needs to listen to all concerns of the residents and be able to explain to the whole society how much they need to invest in order to maintain high standards of cleanliness in their area.

5.3.7 Environmental Education and dissemination of knowledge about Solid Waste Management Policy (SWMP)

The introduction of environmental education programme in the township of Clermont is essential. Residents of Clermont are not informed about environmental issues. The councilors are aware of general environmental issues, but are not concerned about Solid Waste Management Policy (SWMP). There is a general assumption that SWMP does not affect one's daily life. As a result, some of the respondents do not see the need to know and internalize the policy. During the interview with the councilors the problem of rate payment made headlines, it was recognized that people don't want to invest on services, but they want services to be excellent.

Ignorance about SWMP exists in all respondents that were participating during the study. Such ignorance matches perfectly with the fact that the local authorities are not informed about the SWMP, consequently the residents follow the same pattern. It is vital that the leaders become aware of the environmental policy as a whole. In this way they will be able to transfer such knowledge to the community. It is also important for them to adopt a holistic approach when thinking about development in their areas; this will incorporate environmental issues and service delivery. The high schools that were visited by the researcher showed the same pattern of ignorance. The learners and the educators were not informed about the SWMP. Although the school was involved in environmental issues like cleaning campaigns, they indicated that they do not know what Solid Waste Management Policy is all about. The project that involved the local schools was called Keep Clermont Clean Campaign. Educators are aware of penalties and policies because of the media exposure. This is especially so when individuals or the community is suing certain company for polluting their environment or putting their lives at risks. It is

important for the high school youth to be educated about their surrounding environment and the policies that protect the environment.

The level of education indicated how people respond to the environmental related issues. For example residents who did have any formal education and no skills did not care about the environment. Such individuals were concerned about their situation of being unemployed and how can they survive the jaws of poverty. However the group that has skills and means of income and formal education were concerned about the cleanliness of the environment. There is a major gap between the groups such that there is class division that exists within the community. As a result there is no unity in the community, with respect to caring for the environment. The members of Clermont Township need to stand together and try to come up with constructive solutions to solid waste management problems.

Educators also recognize that Clermont has a serious problem when it comes to solid waste management. The solution to most of the environmental problems in Clermont can be eliminated if teachers can be trained to educate children about their surrounding environment and how to keep it clean. In this way young people will be able to pass the knowledge to elders. Consequently it will be easy to implement it when the entire community is involved.

Adult literacy problems with skills development are currently in progress in Clermont. There is no reasoning why environmental programmes can not be incorporated into the adult literacy programme.

The tenants that have mushroomed in the township exacerbate the problem of solid waste. As a result the lack of ownership results in negligence. One case that was highlighted by the councilor during the interview was the case of a young woman who was renting the home in Clermont during the cleaning campaign. What was noticeable was that solid littered everywhere. The respondents pointed out that it was not her place to clean the yard, but it was the landlord's responsibility to clean the litter.

Furthermore she pointed out that the interior of her house was very clean, "it was very clean indeed". In general the tenants were far removed from those owning the dwellings. People who are renting the houses in Clermont don't see the reason why they must clean their surroundings, however they are the one's affected most by illegal dumping.

Ironically it is their waste that is expected to be cleaned by the landlord –there is a shift of responsibility. This indicates that if someone does not own the land or yard it is easy to pollute and degrade the environment without any concern. The implications of such dirty environment are serious health problem and degradation of the environment. Stereotype and attitude developed by tenants needs to be changed through environmental education. The world will be better place to live in if we start taking individual environmental responsibilities for our surroundings. It is amazing to note that the tenants have been living in Clermont far as long as ten years residing in the area and despite this fact they are still not concerned about their surrounding environment.

Clermont Township is situated near an industrialized area called New German where the majority of them are employed. In this area there is cluster of industries that produces waste material, as it is known that whenever a product is manufactured there will a generation of waste. The waste can be in a liquid or solid form depending on the product

that is being produced. In the case of Clermont the study revealed that previously there was a problem of solid waste being illegally disposed along the Palmiet River that runs through Clermont and. However the dumping site was later converted into a playground for young people. The biggest question is that what kind of material that was disposed in this site? Were there any researches that were done before converting the area into a recreational zone? There is a possibility that the waste that is buried under that ground maybe a time bomb waiting to explode and it might happen that it also contaminated underground water. River disposal was stopped by local councilors. Disciplinary actions were taken against companies disposing off waste in rivers. Companies responded by stating that they hired a contractor to take the waste and they had no direct involvement in the disposal. However at the end the councilors managed to win the fight to protect the well being of the environment.

5.4 Gender Issues

Garden waste could have been used for vegetable gardens. These gardens will use garden waste as fertilizers. Although it is stipulated that people in Clermont do not have land to practice agriculture, but people were willing to sacrifice part of their yard to start small vegetable gardens. Surplus garden waste can be given to outsiders who need it. People practice subsistence farming and they normally prefer organic fertilizers rather than chemical ones. For this to work there must be co-coordinated structure in place. The function of the structure will be to find out where is the waste needed, and negotiate deals with farmers or individuals on behalf of the community. Another important function for the structure is to arrange proper transportation that will move waste where it is needed the most, and to avoid dumping.

Another recommendation was that, it was essential for the authorities, together with members of the community to place guiding principles that will determine the general disposal and handling of waste within the township. This will be like a code of conduct that is put forth by the residents of Clermont Township. For example by prohibiting certain activities that can cause danger in the members of the community, like preventing people from burning garden waste or any kind of waste within the township. Burning waste eliminates one problem, but at the same time creates another problem of air pollution. To put it in simpler manner township residents must be able to lay down ground rules or house keeping principles where all residents are going to abide. In order to achieve such goals there is a need for all stakeholders to have access to relevant information and be able to communicate with surrounding areas for co-ordination and recycling programmes. Women of Clermont can play major role in the implementation of community gardens.

5.5 Introducing waste collection facilities and decentralization of services

Skips can be strategically placed around the township. When solid waste is not collected, it can be stored until the next collection day. This can be a huge achievement for the people in that there will space where solid waste can store. In this way illegal dumping will reduced dramatically.

It will be better if communities are consulted in awarding of contracts. Local residents have a better understanding of their area. Investigation reveals that in general local people have positive environmental prospects and are passionate about improving their surrounding environment and making it a better place. The research has shown that residents of Clermont have no direct communication with the solid waste company and

this has lead to numerous problems of disagreements. It will take a long time for such problems to be addressed.

5.6 Conclusion

Although there is hope for a positive change in Clermont, it will not happen over night. The councilors of the area have to initiate capacity building in the area by starting environmental clubs that will look at environmental issues including solid waste management, which is a pressing issue that is causing major environmental degradation and sabotage possible prospects of township tourism in the area. Solid waste associated diseases also negatively affect the health of people who reside in Clermont. The community at large needs to take a stand about their surrounding environment because they have a right to stay in a clean and healthy environment. Authorities or councilors need to assimilate important knowledge from the central government of how to go about in solving such environmental problems. Proactive planning is essential and this is possible by implementing principles that will better the situation. Currently in South Africa we have the best environmental policy in place but we need the capacity and strategies to implement it. Environmental education on the local level will be a best move towards a better environment.

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