A COMPARISON OF ATTITUDES TOWARDS AND PRACTICES OF WASTE MANAGEMENT IN THREE DIFFERENT SOCIO-ECONOMIC RESIDENTIAL AREAS OF UMTATA

by

Tobius Thobile Poswa

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I, **Tobius Thobile Poswa**, do declare that this dissertation is representative of my own work and the use of work of others has been duly acknowledged in the text.

Tobius Thobile Poswa — **Date** 29/03/2001

Approved for Final Submission

Supervisor, Jane Combrink, PhD (Science) UND — **Date** 29.03.01

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PREFACE

This research was prompted by the absence of data on solid waste management practices, particularly on household waste disposal practices which have hindered the process of proper solid waste planning. As a result, the approach to solid waste management in South Africa has been reactive to address pressing current and urgent needs on an ad hoc basis. As such solid waste practice has been characterised by a reliance on costly remedial measures and ineffective law enforcement coupled with the low rating of solid waste management in relation to other municipal services.

This study provides a holistic investigation into factors that should be considered when planning and operating domestic solid waste management programmes. The commonly neglected issues in solid waste management such as consumption patterns, lifestyle of households which indicate who disposed of what, and how local conditions, demographics and perceptions of households affect the selection of appropriate solid waste management strategies are examined. The possible role of households and other stakeholders in the planning and implementation of a domestic waste management system is also assessed.

The study has revealed, *inter alia*, that solutions to solid waste problems can be found by examining local conditions and consumer participation in decisions on service provision. This is essential to build a mutual trust between the service providers and the service recipients. In this regard, solid waste planners should develop citizen-orientated management approaches based on local conditions and realities of the communities they serve.

During this research, the author has written and presented a number of papers at National and International conferences to invite debate and to obtain the opinion of a wide audience on the observations made in the study.

These include:

- Poswa, T.T (2000). A holistic investigation into the effect of social and demographic factors in the planning of a domestic solid waste management system in a developing urban area. Unpublished paper read at a Biennial International SA Institute of Waste Management. Lord Charles, Somerset West near Cape Town, 5-7 September 2000.

- Poswa, T.T. (2000). Evaluation of a solid waste management system: Approach and Solution Plan. Unpublished paper read at a National SA Institute of Environmental Health (SAIEH) Conference. International Conference Centre (ICC), Durban, South Africa. 2-4 August 2000.

- Poswa, T.T. and Combrink, J. (2000) Integration of theory and skills development-A Partnership between learners, communities and service providers. Unpublished paper read at a National South Africa Society for Co-operative Education (SASCE) 2000 Conference. Technikon Natal, Durban, South Africa. 3-5 April 2000.

- Poswa, T.T. (1999) A work-based solid waste management solution plan in a developing town: A Case study in Umtata: Eastern Cape Province. Unpublished paper read at Africa Energy and Environment Development Conference. Port Elizabeth, South Africa. 4-6 August 1999.

- Poswa, T.T. (1998) "Anti-litter strategies: Addressing the key factors towards the failure of municipalities in rendering efficient solid waste management services". Unpublished paper read at an International Conference and Exhibition on Integrated Environmental Management in South Africa. CEMSA'98. East London, South Africa. 9-11 February 1998.

DEDICATION OF THE STUDY

The author dedicates this dissertation to:

- My dear mother, Mrs. Sarah Poswa, who has sacrificed so much in ensuring my education. Her, love, commitment and sacrifice have given me the courage and determination to face all challenges of the present and those in the future to come.

- Secondly, this project is dedicated to Nozuko, my lovely wife for her endless support, encouragement and sacrifices throughout my studies. Thank you. Without you, it would not have been possible to even initiate this work.

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ABSTRACT

The purpose of this study was twofold. Firstly, the effect of the social dimensions of households on solid waste practice was investigated in order to examine relationships between socio-economic status and current solid waste practices. Current perceptions and solid waste practices of households with different socio-economic backgrounds were assessed and compared to explain the influence of socio-economic factors in the planning and operation of a solid waste management system in developing urban areas. Secondly, a waste stream assessment was carried out to examine waste generation and composition trends among different social status residential urban areas.

The generally poor state of solid waste services in most developing urban areas in South Africa and the chronic absence of data on domestic solid waste practice in the study area prompted this research initiative. A case study in Umtata involving three residential areas with different socio-economic status was used to assess and explain trends in solid waste practice and contributory factors to variations between different households amongst developing communities from a socio-economic perspective. Data were collected by a waste stream assessment survey involving measuring waste generated from the selected households and analysis of its composition. The waste stream assessment was complemented by a descriptive survey questionnaire, administered by means of personal interviews to each householder or resident in randomly selected households situated in the study area. The survey provided baseline information on solid waste practices and showed that local conditions were unique and thus require a local solution to the solid waste problems.

The study showed that the understanding of the relations within households is vital for planning appropriate, effective and sustainable solid waste service programmes /systems. Gender relations, age, educational status and income are significant factors to be considered in planning and effectively operating solid waste management plans.

The analysis of data for domestic solid waste practice showed that the evaluation of both the socio-demographic and solid waste generation rates of each community, is crucial in providing the required information. This in turn could provide guidance on the possible roles that households can play in the planning and implementation of domestic solid waste programmes. Among others, the consumption patterns, perceptions about waste management practice and preferences for service provision were interpreted.

Based on the findings of this study and the review of related literature it was concluded that the recipe for successful domestic solid waste practice is proper planning based on current realities in the areas of operation. This requires the responsible solid waste management personnel to produce local community profiles in order to gain knowledge of the local conditions and then to develop appropriate interventions that would meet the needs of the service community. Merely copying plans designed for elsewhere could lead to disastrous and unhealthy situations and rejection of such plans by the same communities they were meant to serve.

The major challenge for obtaining an optimum solid waste practice is to address the existing mistrusts between the solid waste service providers and service recipients. This requires the changing of mindsets towards both service provision and service payments, coupled with forward planning. An interactive solid waste participatory planning mechanism is highly recommended through which all the stakeholders are made part of the solid waste planning deliberations.

CONTENTS

CHAPTER TWO

2. FACTORS AFFECTING SOLID WASTE MANAGEMENT PRACTICE IN URBAN DEVELOPING COUNTRIES 9

CHAPTER THREE

CHAPTER FOUR

LIST OF FIGURES

LIST OF TABLES

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

The fundamental goal of creating municipalities is to ensure provision of efficient, effective, accessible and integrated services to all citizens in an equitable and sustainable manner. This entails the provision of municipal services that include adequate water supply, sanitation, local roads, stormwater, drainage, refuse collection and other infrastructure and essential health services (Hardoy *et al.*, 1992; Department of Constitutional Development (DCD), 1999). The greatest challenge to accomplish this enormous task is in trying to maintain the same pace of supply to the rapidly changing demands and expectations of the service recipients. This is complicated by the fact that while service demands are sensitive to changes in the community settings, the available resources are often limited and static, thus creating a supply gap resulting in inefficient and ineffective services.

Local government is entrusted with the responsibility of providing basic services because it is the sphere of government closest to the people and responsible for the delivery of municipal services to all its citizens. The United Nations Conference on Environment and Development (UNCED), (1992) has mandated local authorities to develop sustainable development plans for their cities. Accordingly, local authorities could, through consultation and consensus building, learn from citizens and from local, civic, community, business and industrial organisations and acquire the information needed for formulating the best strategies (Gilbert *et al.*, 1996; Tannerfeldt, 1995).

Towns and cities in developing countries find difficulties in providing infrastructure and services that keep pace with the fast growing urban population. This is posing serious challenges for the policy-makers in the local government to periodically adjust their service programmes. The adjustment of service programmes requires thorough planning based on holistic investigation for policy alternatives involving a combination of techniques or strategies.

The process of realigning municipal operations with the increasing demands and expectations on delivery is made difficult by the lack of a participatory planning process. It is for this reason that it is imperative for local governments to determine the needs of their citizens for municipal services and to decide how best to provide those services. This involves the determination of the priorities for improving the services; the quality of the present services; the needs of the community and planning how to deliver improved and affordable services (DCD, 1999).

The main focus of this study was on solid waste management, which is a world-wide problem that presents one of the most immediate and serious challenges facing communities and local governments in developing urban areas. Several authors (Hardoy, *et al.*, 1992; Water Research Council (WRC), 1995; United nations Educational, Scientific and Cultural Organization (UNESCO), 1996) have pointed out a number of problems associated with solid waste management practice. Apparently, the improper disposal of municipal solid waste has created unsanitary conditions which in turn have resulted in the pollution of the environment and outbreaks of vector-borne diseases (that is, disease spread by rodents and insects) (Encyclopaedia Britannica, Web, undated).

The nature of the solid waste problem varies widely from country to country. The most notable difference is between developed and developing countries due to disparity in social development and social services (see Table 2.1 in Chapter two). Developed countries like the United States of America generate enormous amounts of solid waste, as much as one tonne per person per year (Diederich, 1995). The task of collecting, treating and disposing of such waste in a safe, efficient and environmentally acceptable manner present complex technical challenges and a wide variety of administrative, economic and social problems that must be managed and solved. Accordingly, society has to reassess both the solid waste policy and practice, as well as the role of municipal governments in providing the necessary services. The final responsibility rests with the state and local governments to take correctional measures to address unresolved problems (Diederich, 1995).

Developing nations have found many creative ways to reduce and better manage their waste through a coordinated mix of practices that includes source reduction. Many developing countries have also adopted minimisation methods such as recycling where fines have been imposed on individuals who have failed to comply (Marowski *et al.,* 1992). Contrary to this, solid waste services in South Africa have suffered neglect and low prioritisation compared to other municipal services (WRC, 1995). This has resulted in the allocation of insufficient funds and human resources with the resultant impediment of long term planning. Poor planning coupled with lack of skilled personnel has created a situation where the approach to solid waste management has been reactive, only addressing pressing current and urgent needs on an *ad hoc* basis. This is made worse by the lack of accurate data on waste generation and composition rates and of information about the socio-economic status of the various communities concerned. This lack of understanding has exacerbated poor service delivery such as in countries like India (Van Beukering, 1999) and South Africa where waste analysis has been hampered (Department of Environmental Affairs and Tourism (DEAT) and Department of Water Affairs and Forestry (DWAF), 1997).

One of the major contributors to the difficulties in solid waste management is the social dimension of the solid waste generators. Experience in both developed and developing countries has shown that greater attention has been focussed on the technical aspects of waste management. Issues such as consumption and lifestyle (which indicate who disposed of what and why, what is purchased and how the purchased items are used) have all been neglected. This has happened regardless of the fact that the dynamic nature of society has changed the lifestyle patterns of individuals. In turn, the change has increased waste generation. It follows then that the growth of the waste stream which has caused many problems for local authorities can best be understood by reviewing the social aspects of communities receiving services. The literature has shown that increasing household waste is attributed to the changing status of families. To this end, Godbey *et al.*, (1998) have pointed out that the increased rate of working women has prompted families to purchase convenience goods which in turn have created more waste per capita than unprocessed goods because they are so heavily packaged.

Strategies to address waste increase and to minimise associated problems require the understanding of culture, attitudes and solid waste practices of the generators in particular households. The understanding of the relations within the households is vital for planning and implementation of appropriate service plans that are both user-friendly and gender sensitive. Experience has shown that in some urban developing communities in South Africa services provided have not been suitable for those for which they were intended. For example, large communal skips placed at strategic positions by local authorities, were too high for children to reach and perhaps too far for some women to travel to. This resulted in the dumping of waste adjacent to and the under utilisation of the skips (Blight and Mbande, 1994).

The focus of this investigation was to determine the possible role that households can play in the planning and operation of a domestic solid waste management system. This was done by evaluating the perceptions and current practices of households towards solid waste management in three suburbs with different socio-economic status in a developing urban area (Umtata). One of the aims of the evaluation was to assess the effect of socio-economic factors in the planning and operation of a solid waste management system, hence the selection of three areas with different socio-economic backgrounds.

This study was designed to provide information on local socio-economic conditions of a community and to investigate how these influenced solid waste management services. The fundamental belief is that information on the socio-economic status is critical to the solid waste management planning process. To this end, the study assumed that when household waste disposal practices are known, it will be easier to introduce measures to reduce the amount of waste generated by the affected community. Added to this, is the belief that the understanding of the diversity of the local culture of home-owners can assist the planning of a domestic solid waste management system. The ultimate goal of the research initiative was to make a contribution to the improvement of service provision, in particular solid waste management, to the residents and local authorities in developing communities.

The study was based on two premises. First, that solutions to problems caused by inadequate management of solid waste are not universal but depend on specific local conditions that prevail in the area to which the management system applies (UNESCO, 1996). Hence, Umtata was used as a case study to illustrate solid waste management practices among households with different socio-economic status. Second, the study recognised that local governance is a necessity for the provision of sustainable solid waste services in that it promotes the development of citizen-orientated management approaches (Ismael *et al.*, 1998). Local research is significant in local government in order to develop new approaches, especially as South Africa's history has resulted in the uneven distribution of services.

1.2 AIM AND OBJECTIVES OF THE STUDY

The purpose of the study was to examine and evaluate waste management attitudes and practices (including waste generation, composition and disposal) of households in three different socio-economic residential areas of a developing city, and to investigate the effects of socio-economic factors on domestic waste management in order to make recommendations for an appropriate solid waste management strategy for the city of Umtata.

The objectives of the study were to:

(a) Review problems affecting domestic solid waste services and practices in developed and developing communities as found in Umtata;
(b) Review and define factors influencing the planning of an urban domestic solid waste management system based on the demographic characteristics of residents in the surveyed households in Fortgale, Northcrest and Ngangelizwe in Umtata;
(c) Investigate attitudes towards waste and waste management in Fortgale, Northcrest and Ngangelizwe in Umtata;
(d) Measure household waste generation and composition rates of the different study areas in Umtata;

(e) Identify different waste management practices in the study area and determine the correlation between waste management practices of households and their social and economic status in relation to the quantity and characteristics of their waste stream; and

(f) Make recommendations for future solid waste management in the city of Umtata and other similar communities in South Africa.

1.3 LOCATION OF THE RESEARCH

Umtata is situated in the Transkei region of the Eastern Cape Province, South Africa. It is situated on the N2 National road approximately 240 km from East London to the South and 480 km from Durban to the North. It is an en-route stop-off point to the Wild Coast tourism resorts along the Indian Ocean to the East (Figure 1.1).

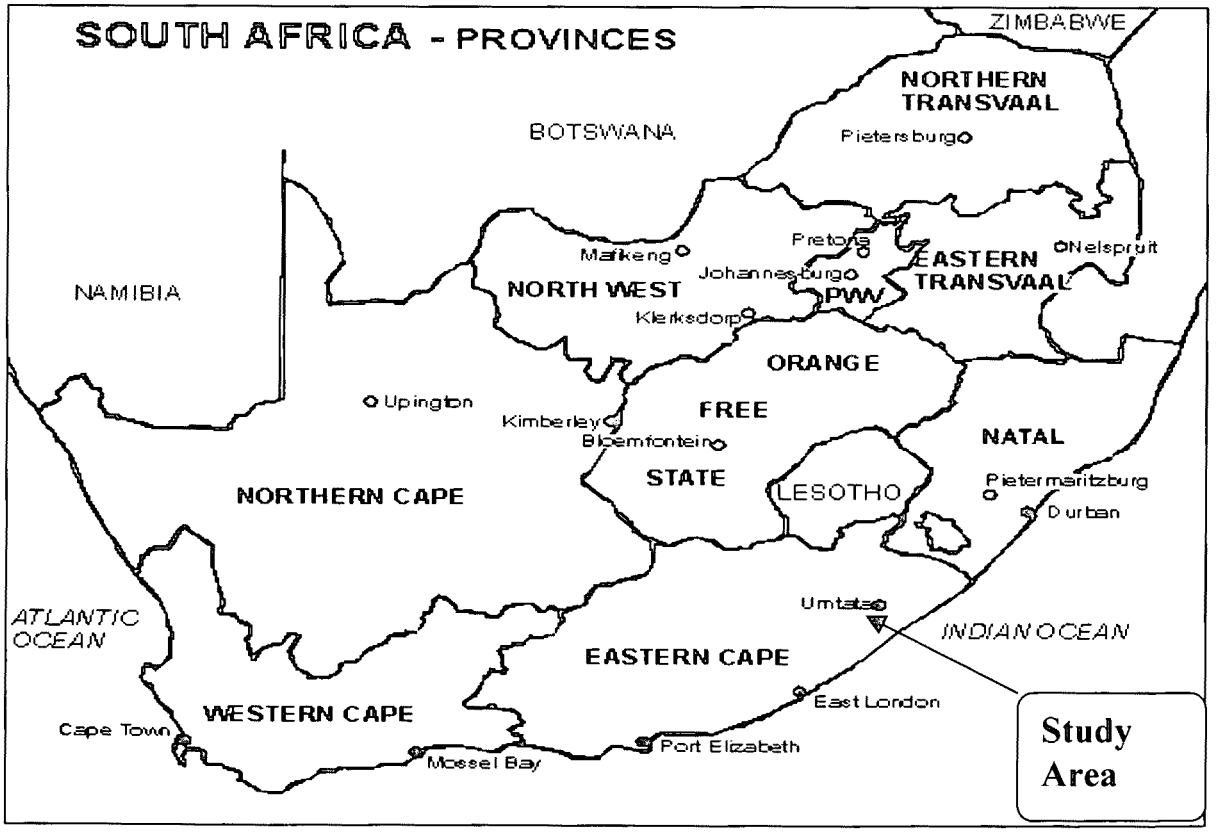


Figure 1.1: Location of Umtata (the Study area) on the South African map (Map adapted from http://www.places.co.za/assets/images/rsa_map.gif)

Umtata was the former capital for the Transkei homeland government, a status which was lost after the 1994 general democratic elections. Umtata covers an area of 45 km^2 which was increased to 70 km^2 in 1995 when certain government farms within the municipal commonage of Umtata were incorporated into the municipal boundary with no extra resources.

As a result of these developments, this area has in recent years experienced tremendous growth in social, commercial and residential spheres coupled with fast growing informal settlements on the outskirts. A further expansion of municipal boundaries to cover an area of 2789 km^2 is envisaged after the November 2000 general municipal elections (Municipal Demarcation Board, 2000). This is translated into a size increase of 62 fold of the original size and 40 fold of the 1995 size. The urban population is estimated to be 100 000. However, since 1994 the town has been catering for 300 000 people including the Umtata district rural population and surrounding village towns. The Municipal Demarcation Board proposals for the upcoming November 2000 municipal elections suggest a further population increase of up to 375 000 people.

All these issues indicate a further increase in the responsibilities and demands for solid waste management services. The major challenge for the Umtata Municipality is to come up with a mechanism that will address these issues, knowing that areas which were incorporated into the municipal boundaries in 1995 have never received any form of solid waste management services. Hence, the need for the evaluation of existing waste disposal practices so that a database can be obtained that will assist in the development and implementation of new service plans, was recognised.

1.4 SCOPE OF THIS STUDY

This dissertation is divided into six chapters, each dealing with specific issues of domestic solid waste management relating to the objectives of the study. Chapter one provides introduction with aims and objectives for this study. Chapter two presents a review of the related literature focusing on trends in the domestic solid waste management practices from both developing and developed community perspectives. The concept of integrated waste management is introduced as an ideal approach to waste management and factors contributing to solid waste management problems in developing communities are discussed. The chapter ends with a discussion of strategies (particularly those suitable for the South African situation) for successful solid waste management.

The design and methodology applied in the study are outlined in Chapter three. The need for the combination of qualitative and quantitative methods of data collection and the rationale for selection of households are explained. The waste assessment study to determine basic aspects (quantity, composition and source) of local waste stream was complemented with a comprehensive household survey using a questionnaire. The interview schedule provided more detailed information regarding the generation and management of solid waste in Umtata.

A detailed description of the social aspects including demographic factors, attitudes, current solid waste practices and perceptions of households are presented in Chapter four. The influence of each factor on the delivery of domestic solid waste management services is described from a socio-economic perspective. Chapter five follows with the presentation and discussion of waste generation and composition data. A comparison is made between South African and international waste generation and composition trends. Finally, the summarised contributions, benefits and conclusions of this study are presented in Chapter six.

CHAPTER TWO

FACTORS AFFECTING SOLID WASTE MANAGEMENT PRACTICE IN DEVELOPING URBAN COMMUNITIES

2.1 INTRODUCTION

A sound solid waste management practice encompasses the principles of integrated waste management (IWM) which is a holistic approach that extends over the entire waste cycle from cradle to grave (United States Environmental Protection Agency (USEPA), 1989). Integrated waste management covers the prevention, generation, collection, transportation, treatment and final disposal of waste. This system is designed to address a specific set of local solid waste management problems and its operation is based on local resources, and on economic and environmental impacts. The idea behind an IWM system is that a combination of approaches can be used to handle targeted portions of the waste stream. Through this approach waste is dealt with in an environmentally responsible manner, from its generation at source to its ultimate disposal (USEPA, 1989; Fuggle and Rabie, 1992; DEAT and DWAF, 1999).

Most notably, trends in solid waste management practice particularly in developing communities indicate that more often than not the service providers fail to apply the IWM approach. The result of these trends is an increased rate of solid waste problems. The problems associated with inadequate solid waste management are however, not universal but are localized (UNESCO, 1996). This pattern of localized problems, followed by no universal method for addressing solid waste problems, is significant in the understanding of the specific conditions that prevail in the area and the type of communities to which a solid waste management system applies. Added to this is the need to understand that the success of any selected waste management system depends on the dedication and expertise of local decision-makers (USEPA, 1989).

The purpose of this chapter is to review factors that affect solid waste management practice in developing communities. The principal factors affecting solid waste management solutions and the delivery process are reviewed. Important information and data to assist solid waste decision-makers in understanding and developing appropriate and sustainable solid waste management plans are presented. This chapter ends with the review of a number of strategies that can be put in place in order to solve domestic waste management problems in developing urban areas.

2.2 TRENDS IN SOLID WASTE MANAGEMENT PRACTICE IN DEVELOPED AND DEVELOPING COMMUNITIES WITH REFERENCE TO DOMESTIC WASTE

Trends in solid waste management reveal, among others, that service delivery differs between the developed and developing countries. The differences are related to the degree of social development (for example education, literacy rate, health care), per capita income, and degree of industrialization, which are all higher in developed countries and hindered in developing countries (UNESCO, 1996). Solid waste management is greatly influenced by these differences. Subsequently, appropriate solutions to management problems can be expected to vary widely from country to country and from area to area and from community to community within the same urban area. Table 2.1 below reflects those areas in which solid waste management practice varies between developed and developing countries. The causative factors and consequences of the variations are reviewed in the following paragraphs.

Solid waste management services in developed countries are characterised by the increasing use of sophisticated technology with more emphasis on waste minimisation and recycling. To mention but a few case studies, a novel scheme to curb waste increases in Belgium was implemented by introducing a specific tax for those municipalities where household waste generation rates exceeded a specified level. The tax aimed at encouraging municipalities to reduce waste increases.

A waste strategy to create greater public responsibility for waste generated in France created public awareness of the need for source separation, a better distribution of household waste management costs and improved collection systems adapted to local needs. Similarly, in Italy, the introduction of home composting has demonstrated an ability to deliver impressive waste minimisation. Through this scheme municipalities experienced increased public enthusiasm for source separation (Warmer Bulletin (WB), 2000).

Developed countries also have stringent application of legislation on all aspects of waste management processes, which does not happen in developing countries. In Sweden for instance, the Swedish Environmental Protection Agency (1997) has reported that municipalities have a regulatory responsibility in all matters relating to human health and the environment. Waste disposal, especially household refuse, is a major concern and each municipality is required to draw up a comprehensive municipal disposal plan. This plan must contain an inventory of the waste stream and include all kinds of waste within the municipality, including those items that the municipality does not collect. Additionally, the plan should stipulate how the municipality plans to reduce the quantity and toxicity of waste.

Industries in Sweden apply "producer responsibility" ethics, which require of them to internalise the cost of recycling and management of the end-of-life products. In areas where no collection system exists, consumers are entitled to take the products back to the place where they bought them at the end of their useful life. The Swedish waste legislation requires consumers to sort the waste and deliver it to the right type of disposal receptacle. Furthermore, the waste disposal firms and waste haulers have a legal obligation to make sure that waste products are carried from the generation points to the treatment plants. Waste disposal firms have the additional responsibility of educating and informing consumers and producers to separate waste and to ensure that waste is handled in an environmentally sound manner. The advantage of this arrangement is that it makes the municipal regulatory work easy.

Table 2.1: A comparison of solid waste management services between developed and developing countries (Adapted from WRC, 1995 and UNESCO, 1996)

Waste management component	Developed countries	Developing countries
Solid waste quality	-less density -less moisture content -less organic content (20-40%) -higher paper content (20-40%) -higher metal content (2-10%) -higher plastic content (2-10%) -larger particle size >50mm (10-85%)	-higher density -higher moisture content -higher organic content (40-85%) -less paper content (1-10%) -less metal content (1-2%) -less plastic content (1-2%) -smaller particle size >50mm (5-35%)
Solid waste quantity	-higher per capita generation rates -exceeds 1kg per day	-lower per capita generation rates -below 0.6kg per day
Waste collection	-house to house collection system -use of compactor vehicles -regular collection frequency (once/week) -highly mechanized, hence lesser staff involved -better infrastructure and effective management arrangements	-community bin system of collection -manual collection by handcarts -no regular collection frequency -manual operation requiring more manpower -no access to vehicles, hence indigenously designed collection system are used (donkey carts)
Street cleaning	-mechanical with no supervision	-manual on beat basis needing supervision
Household storage	-in standardize disposable plastic bags and specially designed containers	-non-standardized assorted type of containers (cardboard cartons, shopping plastic bags) -metal bins, standard bins are attractively used as food and water storage; standard plastic bags are prone to burst in hot climate and from scavenging
Transportation	-solid waste is transported via transfer station -well equipped garages and workshops exist	-solid waste is directly transported from collection points to disposal site in open body trucks involving manual loading and unloading -inadequate or no garages and workshops
Resource recovery	-planned resource recovery system with more household awareness resulting in co-operation and voluntary participation in recycling programmes	-unplanned resource recovery making it difficult to run a recycling programme. In some cases there are economic incentives to encourage participation but scavenging is common and widely used at all stages of waste stream from generation to final disposal
Energy recovery	-energy is recovered by incineration and biogas is extracted from landfills	-no energy recovery and large scale of biogas recovery is not adopted
Disposal	-sanitary landfills are extensively used	-disposal is mainly by crude dumping
Legislation	-Acts and by-laws regarding waste are strictly followed	-old and inadequate by-laws exist which are not strictly followed or enforced

The situation with regard to waste disposal in developing communities is different from that in developed countries. In many developing countries experience has shown that there is a tendency to adopt the methods and technology from prosperous developed countries which often prove inappropriate and more often than not lead to disastrous consequences (WRC, 1995; UNESCO, 1996; USEPA, 1997). In countries like India, Vietnam and Kenya, solid waste management is generally in bad shape and most of the legislation used to govern urban waste disposal is old, inadequate and inappropriate. Problems include inadequate municipal services due to limited resources, a lack of public awareness for the need for waste management, resulting in high levels of unsorted waste generation and littering (Nguta, 1986; Van Beukering, 1999).

Pollution levels are exacerbated in developing countries due to poor waste management. Stentiford (1999) has reported severe levels of pollution due to the absence of formal municipal waste collection services in Vietnam. Primitive methods of collection are used in areas where alleys are too narrow for trucks to enter. Waste collection is carried out by primary collection methods involving tricycles and handcarts and then loaded onto small compactor trucks at designated points and transfer stations. Finally waste is transferred to larger trucks for shipment to landfills. This method has been adopted because alleys are too narrow at some points for trucks.

Another factor exacerbating solid waste management problems in developing communities is the difference in climatic conditions, which results in more dense wastes due to high moisture content. Highly dense wastes reflect a relatively high proportion of organic matter and lower levels of recycling. This occurs because some developed countries lie in the temperate regions of the world while many of the developing countries have a tropical climate (UNESCO, 1996). High temperatures combined with humidity cause solid waste to decompose more rapidly in wet months. Collection and disposal of wastes as a result become problematic, requiring more frequent collection which is not possible due to limited or no resources (WRC, 1995).

The consequence thereof, is uncollected waste, which leads to blocked stormwater drains and flies. As a result, poor solid waste services degrade the living environments to levels that put human health at risk. An unstable economy in most local governments in developing countries has constrained the promotion of environmental health and provision of basic infrastructure and services for a healthy and a decent living environment (Gilbert *et al.*, 1996). This condition can be attributed to the absence of or limited human, technological and financial resources to meet the operational and maintenance needs. The resultant effect is inequalities in solid waste services between the different socio-economic groupings in metropolitan areas.

The service inequity has inevitably created a situation where the wealthier municipalities have continued to enjoy better services, whilst the poor ones, due to their social and economic development status, do not have the necessary infrastructure nor the economic base for the provision of reliable solid waste services (DCD, 1997). The situation has been complicated by the poor record keeping and inability of municipalities to collect substantial amounts owed in taxes and levies. Added to this problem is the chronic shortage of technical resources such as computers that can facilitate the municipal operations and the lack of skills, systems, software and maintenance facilities to keep the equipment operating efficiently (Gilbert *et al.,* 1996).

The racial segregation policy of the Apartheid government, which created Black Local authorities with no significant revenue base, is the main contributor to the solid waste service problems in South Africa. Municipalities in black areas were deprived of the means to meet the needs of local residents. The white municipalities on the other hand had small populations to serve and large concentrations of economic resources to tax (DCD, 1999).

In attempting to redress the inequalities, the current government merged the previously divided jurisdictions, combining well serviced areas with those with inherited inefficiencies and inequities. This process resulted in the creation of a total of 843 municipalities, one third of which are experiencing serious financial problems (DCD, 1999).

The financial stress is aggravated by problems relating to non-payment for services, coupled with inadequate financial management capacity and poor municipal planning. These are all realities that need to be taken into consideration by decision-makers when planning a solid waste management system.

2.3 RAPID URBANISATION AND POPULATION GROWTH

One of the greatest challenges facing urban local governments is the provision of household infrastructure and services to ensure healthy and stimulating environments for their inhabitants. The services include adequate water supply, sanitation, local roads, stormwater drainage, refuse collection and other infrastructure and essential health services (Hardoy *et al.*, 1992; DCD, 1999). In practice more often than not local governments are unable to meet this responsibility due to, among other issues, rapid urbanisation and population growth.

There are a number of reasons that cause urban population growth and these vary from country to country according to the socio-economic development. Population growth trends have shown a higher degree of urbanisation (percentage of population living in an urban area) in developing countries than in developed countries. To this effect, Miller (1998) stated that the number of people living in the world's urban areas has increased almost 13-fold from 200 million to 2,5 billion between 1950 and 1996. It is projected that by 2025 the population growth will reach 5.5 billion and about 90% of this urban growth is expected to occur in developing countries. Miller estimated that every day, roughly 150 000 people are added to the urban population of developing countries. The complicating factor to the urban population growth is the fact that the growth occurs in cities which already have trouble in supplying their residents with water, food, housing, jobs, sanitation and basic services.

Urban population growth is generally caused by the migration of people from rural to urban areas with the aim of enjoying better employment opportunities, improved food supplies, better sanitation, higher incomes, access to health care and emergency services and educational opportunities. As a result, towns and cities find difficulties in creating infrastructure and services that can keep pace with the fast growing urban population.

Consequently, living and environmental conditions deteriorate as unplanned informal settlements without basic services are mushrooming (Tannerfeldt, 1995; Miller, 1998). This has put a strain on the conventional municipal service systems, in particular solid waste collection.

The World Bank has estimated that 25% of the urban population of developing countries live in absolute poverty (Tannerfeldt, 1995). Experience in many developing countries has shown that cities are encountering solid waste problems largely due to increased urban population. One example is in China, where the massive population growth has resulted in the generation of more than 300 000 000 tonnes of total municipal solid waste per year (Henderson and Chang, (Web, undated). According to Gies (1996), the Canadians generate 20.3 million metric tonnes of refuse and recyclables annually. About 56% of the waste generated comes from the residential sector, which translates into 1,908 kg/household. In Africa, Hardoy *et al.*, (1992) and WRC, (1995) have reported that in Dar es Salam (Tanzania) two-thirds of all solid waste from both residential areas and commercial enterprises remains uncollected. Likewise in Kampala (Uganda) where 90% of households have no formal disposal facilities and in Nigeria, where 67% of households dump their refuse.

Miller (1998) has stressed that urban growth is fueled by government policies that distribute most income and social services to urban residents, especially in capital cities. Miller's argument is true for the South African urban areas. For instance Mabin (Web, undated) has reported that the impact of Apartheid at a national scale was the creation of an increased number of non-rural, yet non-urban closer settlements in areas characterised as reserves, where black people could move without passes required in urban residential areas. The existence of such areas resulted in massive population growth.

The profound consequence for the settlement patterns was the lack of formal local government, service provision and facilities which existed in urban areas. Those areas possessed no institutions to organise financing of service provision and maintenance.

The growth of the settlements was further encouraged by the provision of limited schools, health facilities and rudimentary services by the governments of self-governing territories and institutions of civil society like churches. Such actions gave permanence to many residents of the closer settlements. High population densities tended to be in reserve boundaries closest to cities and towns outside the reserves and the densities declined with distance from towns. Population densities of 8 500–25 000 per square kilometer have been reported in some informal settlements (Lombard, 1996).

Mabin (Web, undated) believes that the interpretation of the South African 1996 census figures has been affected by the above population trends. The rationale for this belief is that there is so much continuous movement taking place between the closer settlements and towns and cities that the urban population cannot be considered as being merely that enumerated at any particular time. On the basis of this notion it is highly probable that South Africa is an even less rural country than the 1996 preliminary census results suggest.

Statistics South Africa (1998) reports that more than half (54%) of the 40,5 million people in South Africa, already lived in urban areas in 1996 where waste disposal practices were not satisfactory. Only just over half (52%) of households were receiving at least once a week refuse removal service at the time of the census. The merger of the previously divided population into municipalities with no corresponding resources has contributed to the massive increased urban population in South Africa. The largest challenge that municipalities face is the creation of service delivery systems appropriate for the population densities and economic base to meet the levels of affordability of households. Urban population growth poses serious challenges for the policy-makers in local government to periodically adjust their service programmes.

The process of realigning municipal operations with the increasing demands and expectations on delivery is, however, complicated by the lack of or no resources. This requires thorough planning based on an holistic investigation for policy alternatives involving a combination of techniques/strategies.

2.4 LOCAL GOVERNANCE

Governance is often confused with government. Ismael *et al.,* (1998) provide a clear distinction between the two concepts. Government relates to the power to govern whilst governance refers to the act of governing. Governance is linked to the global acknowledgement that organs of the civil society need to be empowered to share the responsibility for governance. This requires government institutions to have a citizen-orientated management approach.

Government's power can be divided to promote opportunities for citizens to participate in public policy. The citizen participation in public policy is essential for democratic local governance (Ismael *et al.*, 1998). Such participation is, however, meaningless if local authorities have no sufficient functions, powers and resources to implement policies and decisions. In realising the need for a functioning local government, the South African government has provided mandates for local government in the Constitution. Accordingly, Section 152 (1) of the Constitution of the Republic of South Africa (Act 108, 1996) provides that the objects of local government are to perform the following duties:

- To provide democratic and accountable government for local communities
- To ensure the provision of services to communities in a sustainable manner
- To promote social and economic development
- To promote a safe and healthy environment and
- To encourage the involvement of communities and community organisations in the matters of local government.

For local government to be able to perform the above functions, it needs to be representative and make political decisions with community participation. This will ensure the attainment of service delivery, social and economic development and a healthy environment (Chipkin, Web, undated). The Constitution implies that local governments are responsible for setting the developmental framework in their respective jurisdictions.

Obviously, if municipalities properly represent their communities in a democratic and accountable manner, the developmental frameworks can be expected to vary from municipality to municipality in order to reflect the diverse forces in the respective areas. Section 151 (3) of the Constitution provides that a municipality has the right to govern, on its own initiative, the local government affairs of its community subject to national and provincial legislation. Section 151 (4) further protects the municipality from interference from higher tiers of government, in discharging its duties and exercising its powers.

Contrary to what has been mentioned above, experience in developing countries has shown that the nature of governments affects the quality of solid waste delivery. To this end, Hardoy *et al.*, (1992) reported that developing countries tend to have unrepresentative governments which still retain undemocratic structures at local level. Such governments tend to ignore the implementation of environmental policies. This was typical of the past South African government. The then racially based municipalities created by the Apartheid government promoted separate developments where millions of black people lived in townships and homeland states which had little or no access to basic services. Due to this type of governance about 50% of communities from the disadvantaged groups had no access to solid waste services (WRC, 1995).

During the apartheid era the system of local government had no constitutional safeguards. Local government was viewed by many as an agent of the state. Local authorities were created along racial lines and were characterised by differentiation and fragmentation (Ismael, *et al.*, 1998).

The development patterns differed from one race to the other and one province to another. In most black designated urban areas, the past government was forced to allow the subletting of rooms and back yard shacks, and the emergence of large informal settlements due to its inability to provide any alternatives (Mabin, Web, undated).

The urban local authorities generally did not have to deal with the consequences of the massive rural upheavals. The management systems and by-laws the government used for matters such as health and safety were adequate as long as influx control and the police kept population growth low and as long as the group areas act and related practices kept most poorer residents in selected parts of the urban periphery. The removal of the apartheid framework of influx control, group areas and police action has left South African urban areas open to changes which its management systems and local government laws are unable to deal with.

These are among the most urgent and fundamental problems which South African local governments have to address. Most of the small town municipalities do not have the service delivery potential to provide adequate services and governance without external support. Attempts to redress this arrangement require local governments to find sustainable ways to meet their needs and improve the quality of life of their residents. The most acceptable governance structure according to the DCD (1999) is the one that includes citizens and community groups in the design and delivery of municipal programmes. This process should enhance rather than impede the delivery of services.

2.5 SOCIAL AND ECONOMIC ISSUES OF THE COMMUNITIES FROM A DOMESTIC SOLID WASTE SERVICE DELIVERY PERSPECTIVE

For the purposes of this study, the social and economic issues are discussed from a service delivery perspective. The nature of service delivery varies greatly, due to the different capacities of local governments and existing situations in the service areas. There are for instance at the one extreme, towns and cities with established municipal structures with comparatively low demands for services.

Conversely, there are those areas with virtually no existing local government capacity (Palmer, Web, undated). Apparently, service delivery inequities exist and therefore the ways of addressing social and economic issues can be expected to vary accordingly.

Mayet (1993) has provided a comprehensive description of socio-economic factors. These factors relate to the state of infrastructural development in a residential area, lifestyle and value systems, aspirations and attitudes, migratory patterns, levels of education and a willingness to recycle or reduce waste output. This includes the ability of people to pay for services based on income and willingness to pay (Sadler, 1997). The South African Constitution (1996) has tasked local governments with the responsibility of promoting the social and economic development of communities by empowering them and developing their capacity to enhance service delivery processes.

The White Paper (1998) on local government has suggested that municipalities should promote job creation and boost local economy by providing good quality cost-effective services and making the local area a pleasant place to live and work (DCD, 1999). Implied in this statement is the provision of appropriate and satisfactory services to the consumers. Experience has shown that solid waste management practice in South Africa, like in most developing communities, has largely been focussing on the technical issues of waste disposal with little or no attention paid to the social and economic aspects of households.

Attempts to address the social and economic issues are always constrained by limited resources and expertise. These limitations require an in-depth review of the existing situation and a thorough planning in order to develop performance management plans. The involvement of the affected communities is vital for the understanding of priority areas. Some communities for example, may prioritise the amount of time it takes the municipality to answer a query, while others might prioritise the cleanliness of an area (DCD, 1999). It is therefore imperative that municipalities adopt a responsive and sensitive attitude to people's needs, coupled with effectiveness to its responsibilities.

According to Christopher *et al.,* (1998) public participation is important for two reasons. First, by broadening input, public participation can improve and expand the information base of administrative decisions. Second, public participation can enhance accountability by opening deliberations to public scrutiny.

One of the critical areas that needs to be addressed when reviewing the impact of social factors on service delivery is the gender issue. In all societies, women have a different role from that of men. As mothers and homemakers as well as educators, entrepreneurs and producers, women more than men, have to play multiple roles. The demands of these multiple roles in poorer countries place women, particularly the non-elite ones, at a special disadvantage (United Nations Development Fund for Women (UNDFW), 1998). This problem is huge considering the fact that women constitute 60% of the world's one billion poor, and out of 1/3 billion people living in absolute poverty, over 70% are women.

Research according to Scheinberg *et al.,* (1998) has shown that across many cultures, women handle waste in their homes, although the richer women delegate this task to servants. In general, women are not paid to handle waste, while men only do so when they are to be paid. Due to their lesser mobility and access to public spaces, some women who cannot leave their homes for cultural or religious reasons, will find it difficult to deliver waste to a neighbourhood collection point. Therefore, in orientating and directing policies, it will be important to take into account the specific needs of women to ensure that they can have equitable and affordable access to facilities and services (UNDFW, 1998). All these are issues that need to be addressed when planning waste management systems.

The main socio-economic factors relating to solid waste management in South Africa according to DEAT and DWAF, (1999) include:

- Limited awareness of the need for effective waste management in the high density low-income communities;
- Difficulties to obtain finance for capital investment in machinery and equipment, especially by small contractors;
- Non-payment for services because of insufficient transparency, credibility, undemocratic practices and inappropriate service delivery;
- In some cases, the services provided are not appropriate, adequate nor affordable for the recipient community;

- Service charges levied by the local authorities are not a true reflection of the actual cost of the service.

The socio-economic factors are also important regarding the composition of waste within a given urban area. The waste composition varies significantly with socio-economic status because income determines lifestyle, consumption patterns and cultural behaviour (United Nations Centre for Human Settlements (Habitat), 1989; UNESCO, 1996; Mbande, 1997). By considering socio-economic factors such as the demographics of the community, the level of environmental awareness and waste generation, Alderden (1990) and Rhyner *et al.*, (1995) found that participation of households in a recycling programme is influenced by the educational level, the size of populations and income of households.

The DCD (1999) has suggested that social and economic status of communities can be boosted by bringing together coalitions and networks of local interest through political leadership. Political support is necessary to obtain financing and resources needed to develop and efficiently operate a solid waste disposal programme (USEPA, 1995). The USEPA has also recommended that the political leaders be regularly kept informed of the programme progress and be educated about waste management issues in order to solicit political support for the programme.

Solid waste planners can also make the best use of all available community resources which include elected officials, the news media, interested groups and community organisations, all of which have the ability to generate community support. The support of the business and political interest groups and recyclers is equally important. It is therefore essential to involve all the players early to ensure integration of public concerns and to make planning more efficient and effective.

Last but not least, trust between individuals and accommodating relationships between stakeholders need to be built and active participation of the marginalised groups be encouraged. The importance of socio-economic factors in service delivery can further be emphasised by the democratic values and principles governing the public administration, enshrined in Section 195 (1) of the South African Constitution. These principles stipulate amongst others the promotion of efficient, economic and effective use of resources; provision of services in a fair, equitable and unbiased manner; a response to people's needs and encouragement of public participation in policy-making and the fostering of transparency.

2.6 ATTITUDES TOWARDS SOLID WASTE MANAGEMENT

The relationship between the environment and human beings is best understood by examining humankind's attitudes towards the environment. Today the society tends to turn away from waste (Mantel, 1975). The negative attitudes adopted by some members of the community include the "they and us approach", "it's not my problem", and "somebody must do something" (Black, 1990). These attitudes need to be altered and active co-operation be promoted in order for the society to take responsibility for its environment.

Another problem of attitude is that many people feel that they have no impact on the decision-making process and as a result do not bother to register complaints with the authorities. This attitude differs among socio-economic groups. The higher socio-economic groups are more likely to complain about environmental problems or become involved in doing something about them because they feel that they have a contribution to make. To the contrary, people of the lower socio-economic groups tend to have less regard for environmental issues on the basis that employment and housing are their main problems (Viljoen *et al.*, 1987).

The significance of Viljoen's premise in this study is in explaining domestic waste management trends amongst the different groups in the study area. Further interogation of the validity of Viljoen's premise is however, beyond the scope of this study.

Young people have been found to litter more than older ones and males more than females and people who are alone litter more than those in groups (Bell *et al.*, 1990). People from the rural areas are more likely to litter than the urban residents, but the latter are less likely to comply with litter regulations than visitors (Viljoen *et al.*, 1987). The lack of interest in the environment creates a culture of non-participation of communities in decision making processes. That stance enhances lack of responsibility for pollution and waste issues. Ultimately this produces communities that have little knowledge of or concern for their impact on the environment (DEAT, 1996).

Various case studies in different urban residential areas in South Africa have highlighted a variety of attitudes of residents to waste. These ranged from a high level of concern and awareness of the problems associated with uncollected waste, to a general absence of interest amongst the larger community. Such attitudes can have implications for issues such as willingness to pay, recycling efforts and the types of service that would be found acceptable by communities (WRC, 1995).

Byrne (1996) has pointed out that the absence of formal waste management services creates situations where suburbs of a town are normally clean while the townships of the same town are dirty. Under such conditions, it is hard to expect people who live in waste- and litter-strewn conditions, brought about as a result of low or no waste removal services, to have respect for such areas.

However, the attitude and behaviour of individuals can be positively influenced by implementing quality waste management systems to properly manage waste generated.

The above statement can best be understood by knowing that when requirements for basic food and shelter absorb the attention of the largest portion of the community, then many environmental values are neglected. To this end, Scarlett and Shaw (1999) have stated that when the basic survival needs of most people have been met, people become more willing to devote income to greater environmental protection. A good example is the United States.

This premise concurs with that of Mbande (1998) who argues that solid waste management is not a basic need. As a result it is not expected that people who are struggling to satisfy their basic needs (food, water and air) will be sensitive to waste management.

The negative attitudes to the environment have serious consequences. Research has shown that it costs up to ten times more to remove litter than clearing waste from the waste containers (Skarba, 1992). Viljoen (1987) has also stated that it takes 15 workers about a week to restore a large sports stadium to its original state of cleanliness after a major sport game. Moreover, the lack of a sense of responsibility is manifested by the accumulation of huge amounts of litter in public places such as parks, highways and recreational facilities and in private areas such as business places. This can be explained as a function of ownership.

Aristotle (undated) cited by Scarlett and Shaw (1999) said: "What is common to many is taken least care of, for all men have greater regard for what is their own than for what they possess in common with others". This simply means that people who own property have the incentive to take care of it, unlike the one owned by a large number of people or where there is non-ownership like public places.

2.7 PROBLEMS HINDERING SOLID WASTE MANAGEMENT PLANNING

Some of the factors that play an important role in hindering solid waste management planning in developing communities are discussed below.

Most small and medium sized municipalities have little or no resources to hire staff dedicated solely to solid waste management. As a result the provision of efficient solid waste management services is hindered (USEPA, 1997). It is therefore not surprising that there is a commonly held belief that solid waste planners in developing countries do not take into account the local patterns of living when planning, designing and implementing a solid waste management system.

While the developed countries have a wide spectrum of highly qualified personnel, the developing countries do not have training programmes to equip indigenous workers with professional skills to ensure a self-sustaining supply of manpower (UNESCO, 1996).

The unskilled solid waste managers lack skills and knowledge of equipment, personnel management, cost accounting, demographics, choice of equipment, operational and maintenance and replacement costs for waste collection (Glasson, 1992). The untrained personnel do not have the ability to identify, predict and rectify problems timeously. Additionally, experience has shown that despite people's rating of waste management as a high priority need, metropolitan authorities rate these services as relatively low priorities in relation to other services in the municipality (Lombard, 2000). This erroneous perception has resulted in the allocation of insufficient funds and human resources to waste management, and consequently long-term planning has been hindered.

The DEAT and DWAF (1999) have confirmed that up to 1997, waste management was not regarded as being a priority issue in South Africa. The waste management that took place focussed mainly on disposal and was reactive only to address pressing current and urgent needs on an *ad hoc* basis. The low priority given to waste management has consequently resulted in waste impacting detrimentally on the South African environment and human health. Exacerbating the problem of poor planning, is the general lack of capacity to fully enforce legislation where it exists.

The absence of legislation to enforce or promote recycling in South Africa has led to the non-existence of recycling in the industrial sector. This is usually explained as a result of the cost of recovered materials being higher than the cost of transporting raw materials (Danish Environmental Protection Agency (DANCED), 1996). As mentioned in paragraph 5 of section 2.5, another contributing factor to poor planning is the lack of community participation in public policy making. This has resulted in situations where service providers do not have the support of the stakeholders and do not provide acceptable services.

The WRC (1995) has pointed out that in the past, waste management in South Africa was largely treated as a technical issue and the participation and co-operation of the households were overlooked. The outcome of non-participation of communities in waste management is manifested in careless and irresponsible disposal of waste in public thoroughfares, along the roads and highways, and around communal bins for residential waste. A problem of this kind highlights the need for the implementation of vigorous programmes of public education (UNESCO, 1996).

2.8 STRATEGIES FOR SUCCESSFUL SOLID WASTE MANAGEMENT

The aim of developing a solid waste management strategy is to establish a set of actions which will best achieve the aim of managing available resources, within accepted and imposed limits, for the set objectives (Institute of Municipal Engineering of Southern Africa (Imiesa), 1993). Generally an acceptable strategy is the one that ensures a balance between the costs of actions against their effects and consequences to achieve optimum results. Schubeller (1997) has emphasised that for a Municipal Solid Waste Management (MSWM) system to be sustainable, it must be appropriate to the local conditions and needs, and be affordable and supported by the respective urban society and its communities. Implied in this statement is the need to accommodate the dynamics of the service area and the adaptability of the strategy to both social and geographical dimensions of the area (UNESCO, 1996).

The success of a solid waste management strategy depends on thorough planning which requires a continual monitoring of the design and operation parameters of a solid waste collection system in order to assure that maximum cost-effectiveness is being realized (Wilson, 1977). Some of the important aspects in the planning of a solid waste management strategy are briefly discussed in section 2.8.1 below, followed by a review of few examples of relevant strategies for solid waste management in section 2.8.2.

2.8.1 Planning and development of Strategies for Successful Solid Waste Management

The fundamental aim of solid waste management plans is to collect and dispose of solid wastes of a community at minimal cost while preserving public health and ensuring negligible impact on the environment (UNESCO, 1996). It is however, often difficult to attain this objective due to a number of constraints, some of which have been outlined in the previous sections.

There are basically two reasons for developing solid waste management strategies. First, is the proper management of waste at source, which involves consumers and modification of their behaviour to reduce waste generation. Second, is the collection and disposal of waste generated. The latter involves a series of steps to ensure that waste is properly managed in an environmentally acceptable manner. Key factors that need to be considered when planning solid waste management service programmes are reviewed below.

Schubeller (1997) has recommended six strategic aspects that should be incorporated in the planning of Municipal Solid Waste Management Systems. These aspects include the political, institutional, social, financial, economical and technical issues outlined in Table 2.2 below. Other important issues that need to be considered additionally to the factors outlined in Table 2.2 are briefly discussed in the following paragraphs.

Successful plans for solid waste management service programmes should have clear, attainable objectives or goals. The primary goal is to provide a system tailored to the needs of the individual community and to manage solid waste in a manner that will protect the environment at minimal cost (UNESCO, 1996; USEPA, 1997). To meet this goal, municipalities need to understand the dynamics within their operational areas.

Table 2.2: Summary of key factors to consider in solid waste management systems planning (Schuebeller, 1997; Mbande, 1998)

Key Factor	PURPOSE
1) Political	(a) To formulate goals and priorities regarding waste management, environmental protection and service provision to facilitate the mobilisation of public support. (b) To determine roles and jurisdictions to enable an efficient division of tasks and to ensure that the solid waste management system is politically sustainable. (c) To establish an effective legal and regulatory framework. This entails reviewing of supporting by-laws, ordinances and regulations for ambiguity, fairness and transparency. (d) To make decisions on priorities.
2) Institutional	(a) To ensure distribution of functions and responsibilities for solid waste management among different stakeholders including private sector and community participation. (b) To address training and human resources needs for the solid waste disposal programme. (c) To introduce appropriate management methods, procedures and service targets. (d) To build Municipal capacity for Municipal Solid Waste Management. (e) To establish effective municipal institutions.
3) Social	(a) To deal with waste generation and handling patterns of households and other users. (b) To raise people's awareness of Municipal Solid Waste Management problems and priorities. (c) To protect health and socio-economic security of waste workers (earnings and working conditions)
4) Financial	(a) To establish a practical and transparent cost accounting and budgeting system. (b) To deal with capital investments, cost recovery and cost reduction of the solid waste disposal programme. (c) To describe the user charges method and subsidisation where applicable. (d) To raise sufficient revenues for recurring expenses and to ensure adequate operational and maintenance costs.
5) Economical	(a) To address the impact of services on economic activities, and to ensure the cost-effectiveness of the solid waste management system. (b) To increase efficiency and labour productivity and to agenerate employment and incomes in waste management. (c) To promote waste minimisation and material efficiency.
6) Technical	(a) To plan and design, a collection and transfer system (b) To use technology that facilitates user and private sector collaboration. (c) To ensure that technical systems effectively limit environmental pollution.

Attempts should be made to ensure the involvement of all stakeholders in the early stages of the planning process in order to encourage public input and acceptance of the solid waste management plans. Public involvement ensures a dialogue or a two-way communication that involves both getting information out to the public and getting back from the public ideas, queries and concerns (USEPA, 1995; 1997). Through this interactive process, the public on the one hand becomes educated about the economic and logistical realities of managing MSW. The solid waste planners on the other hand gain a better understanding of the public's concerns.

Where an existing solid waste system is being assessed, the current community solid waste management system and practices need to be evaluated in order to pinpoint areas needing improvement. This exercise involves the reviewing of a number of issues. These include the types and quantities of waste; public/private collection equipment and manpower; available collection services; collection frequency; geographical coverage of collection service; storage facilities; collection charges/costs and methods of paying collection fees. Lastly, transportation of waste and destination of collected wastes (transfer station, mixed process facility, material recovery facility, compost facility, landfill or other land disposal facility) also need to be assessed (USEPA, 1997).

Knowledge about the waste generation and composition of the area under review is critical for planning appropriate and sustainable solid waste programmes. The assessment of the composition of solid waste is the process of getting at the source of municipal solid waste problems by accurately understanding what and by whom materials and products are generated (USEPA, 1995).

Information on current waste generation and composition rates can be used to calculate future waste generation estimates and to devise effective policy strategies. It is also possible to target certain waste materials for source reduction efforts. Adding to this, Tworeck (1979) has pointed out that the mass per capita per day relationship for domestic solid waste is the most reliable parameter on which to base the design of disposal facilities.

Waste planners should however, take note of the fact that waste generation and composition data are often unavailable in developing areas and vary widely from area to area. For this reason, Flintoff (1984) has recommended that every country must evolve an indigenous technology based on the quantity and character of wastes generated and the level of social and economic development. This is why waste generation and composition studies like the present study, are essential to assist in the planning of solid waste management strategies.

2.8.2 Examples of Solid Waste Management Strategies

A comprehensive National Waste Management Strategy (NWMS) has been developed in South Africa (DEAT and DWAF, 1999). The strategic goal of NWMS can be broken into three components. First, the strategy was developed to reduce the generation and environmental impact of all forms of waste. Second, government seeks, through the strategy, to minimise or prevent negative impacts of waste management on the socio-economic development of South Africa, the health of its people and the quality of its environmental resources. Third, the strategy aims at redressing the uncontrolled and uncoordinated waste management practices of the past. This strategic goal serves as a broad framework from which provincial and local government regulations for waste collection services will be developed

The following paragraphs briefly outline few strategies that could be used for managing domestic solid waste in urban areas in developing communities. It should however be noted that there is no 'one-fits-all' strategy, but one or a combination of strategies may be appropriate for a particular situation. Therefore, the strategies mentioned here are not exhaustive but are mere examples. They are not arranged in any order of significance.

2.8.2.1 Waste Minimisation Strategy

The NWMS describes waste minimisation as activities taken by a generator relating to source reduction and recycling. The key processes for waste minimisation include source reduction, recovery, reuse and recycling of waste materials. Below are elements suggested by the DEAT (1996) for achieving a culture of waste minimisation among communities:

- The first element is promotion of environmental education and information as well as provision of funds for waste minimisation research. This should involve provision of technical advice and assistance primarily by the government.
- The second element is the publication of waste generation and waste minimisation statistics on each industry, local government and community. This requires compulsory data of disposal methods, hazard rating and success in minimising waste.
- The third element involves the publication of codes of practice, setting of guidelines and minimisation targets for each sector and strict enforcement of set procedures.
- The fourth element involves the processing of waste at special facilities to recover useful products from all waste generated. This requires that all undertakings be commercially driven and that government plays an active role in developing markets and subsidising collection, transport and processing of waste. Community involvement and capacity building are necessary for sustainable development.

The above elements provide a checklist of items that should be undertaken to address waste minimisation and recycling issues and problems in South Africa. The waste minimisation proposal currently underway promotes a multi-stakeholder partnership. Accordingly, local governments, local entrepreneurs and small scale recyclers are required to collaborate with stakeholder groups such as Community Based Organisations (CBOs) and Non-Government Organisations (NGOs); organised labour and trade unions; salvagers at landfills; waste professional bodies like the Institute of Waste Management (IWM); industry; private sector organisations and existing waste minimisation clubs.

This strategy has brought about a three way approach where government departments, the industry as the principal generator of waste and the public or civil society work together for the common goal of promoting a healthy and safe environment. The advantage of this arrangement is a shift from the end-of-pipe solutions to avoidance, minimisation and focussing on the source of waste. The strategy is based on a transparent and participatory process, which can enhance environmental awareness levels among communities. The two main components of waste minimisation include source reduction and recycling, which are briefly explained below.

Source Reduction

Source reduction is described as a method that involves the reduction of waste materials to minimum quantities at the place where they are produced (DEAT, 1996). The operation of a source reduction method requires communities to collect, process and dispose of less waste, thereby reducing both their waste management costs and environmental impacts (Fishbein and Gelb, 1992). The advantage of avoiding the generation of waste is that it prevents the building of expensive waste disposal and processing facilities. Moreover, there is no need for the collection of waste materials nor for the marketing or selling of recycled waste goods.

The successful operation of source reduction is dependent on consumer behaviour. When consumers consume less, they in turn produce less and this results in less waste generation. A simple example of source reduction is the backyard composting where individual households keep their grass clippings and leaves in their own backyards to decompose and reuse the decomposed material as compost in their gardens. In this case, the organic waste does not enter the waste stream and the municipality is not required to collect, process or dispose of such waste materials. Home composting therefore is prevention rather than recovery, as the organic matter never actually enters the waste stream.

The introduction of source reduction in most developing communities is hindered by the absence of incentives and the allocation of enough resources to develop plans or implement the developed plans. This problem is exacerbated by the lack of knowledge about steps that municipalities can take to get businesses and citizens to produce less waste (Fishbein and Gelb, 1992). The ever-increasing amount of per capita waste generation rates indicates that a source reduction strategy remains neglected. Perhaps an educational awareness could encourage source reduction initiatives in most developing communities.

Recycling of Waste Materials

Recycling, unlike source reduction, is a strategy for managing materials that would otherwise be treated as waste. Recycling does not reduce the amount of waste generated but reduces the amount of materials requiring disposal. It is therefore a vital strategy for conserving energy and natural resources (Fishbein and Gelb, 1992). Recycling is a waste reduction and not source reduction process. Costs are incurred as the recyclables must still be collected, processed and remanufactured into new materials or products. It is highly possible that the recyclables may cause pollution during their handling or processing.

Recycling is only one aspect of an integrated approach to waste management and is not the key approach to waste minimisation (Kneale, 1998). It is a method involving seven stages. The stages include separation preferably at point of generation; collection of materials; delivery to sorting/cleaning/processing centre/s; sorting to a quality that makes the material re-usable; delivery of the clean reclaimed material to the manufacturer; processing of the recovered material to produce a new product; and purchasing of the recycled product.

Recycling should rather be viewed as a way of adding value to wastes by recovering materials that are disposed of once their useful life has ended. It is achieved by separation of recyclable waste materials such as paper, glass and metal at the point of generation (home or office) by the generator (Tworeck, 1979; USEPA, 1995). Such a step reduces the amount of waste before it reaches the waste stream for final disposal.

The success of this exercise depends largely on the willingness of the community members to participate in the sorting of waste materials at home. Recycling may be implemented in two ways. First, it may be voluntary, where residents separate waste material voluntarily. Second, it may be mandatory where residents are compelled to separate recyclables at source. This can be encouraged by the supply of separate containers where households deposit their waste items (WRC, 1995).

The advantages of source recycling is that other wastes do not contaminate materials and there are economic gains for low income groups, but these can be undermined by health risks facing people involved in these activities (WRC, 1995). Scavenging (preferably referred to as salvaging) which is widely practised at all stages of the waste stream from generation to disposal, is one of the few avenues of self-help open to the very poor people (UNESCO, 1996).

Recycling initiatives are constrained by the lack of funding, and by the long distances to market centres for recyclables (Bureau of Industry Economics (BIE), 1994). Notwithstanding the problems facing recycling, it is a method that has been included in all waste management strategies worldwide. For instance waste strategies for America, Scotland, Vietnam, Japan, Australia (Sydney 2000 Olympic Games), India and South Africa have all incorporated recycling in their targets to reduce waste quantities (Thurgood, 1998; Scottish Environmental Protection Agency (SEPA), 1999; Van Beukering, 1999);

2.8.2.2 Community Empowerment

A community empowerment strategy has been applied in a selective number of developing areas in South Africa. The strategy promotes the involvement of communities and community groups in the solid waste delivery process. The municipality is responsible for providing the necessary support, leadership, encouragement and resources for community actions. Better results are attained when communities are highly motivated and have adequate levels of education, awareness and appropriate skills with regard to waste and environmental issues (WRC, 1995).

According to the WRC (1995), communities should be required to take responsibility of their own waste collection and disposal. Through community self-help, waste management costs are reduced and community self-interest is increased. The advantage of this strategy is its emphasis on community involvement in the reuse of waste materials. The DEAT (1996) has suggested the following steps to encourage community involvement:

- Promotion of environmental education, information and capacity building in communities;
- Promotion and provision of support for community-based initiatives to seek solutions to waste management, sanitation, and access to resources;
- Creation of community forums responsible for developing integrated environmental, developmental and spatial plans.

A good example of the community empowerment strategy is the Masakhane campaign launched in various communities in South Africa in 1995. The primary objective of the Masakhane strategy was to facilitate development through mobilisation of the public, private sector and community resources. It encouraged partnerships and civil responsibilities.

According to The Palmer Development Group (1999), the fundamental principles of Masakhane include the following:

- Involvement: The participation of each sector generates an overall feeling of pride, ownership and endurance
- Responsibility: When every member of the sector does his/her duty a law-abiding society is created;
- Cooperation: Focus on a common objective helps to narrow the areas of difference between sectors;
- Inclusiveness: This enlists participation of different sectors;
- Initiative: Each sector is encouraged to take the initiative to deal with and develop its own interests;

- Empowerment: Information, skills and knowledge give each sector the power to participate fully in the projects;
- Compromise: Each sector must be prepared to subordinate some of its interests to the long-term objectives of growth and development.

These principles are generic and can be applied by many municipalities in the developing communities. The same principles were applied to the Clean and Green Masakhane projects (1996-1998) in four towns in the Eastern Cape such as Ngangelizwe (Umtata), one of the sites for this study; Mqanduli; Butterworth and Zwelitsha (King Williams Town). Community participation in the said projects has brought about a change in waste management handling and a spirit of cooperation, trust and tolerance between the municipality (service provider) and the households (service recipients) (Poswa, 1997a).

There are three strengths of the Masakhane strategy. First, the communication of the goal of the project has built awareness among the public. Second, the project encouraged different sectors to participate freely without reservations. Lastly, the project succeeded because of continuous monitoring and incentives for participants. A weakness of the strategy was the failure of the local authorities to continue supporting the communities and integrate the projects into their day-to-day activities. As a result, the environments in the pilot areas reverted to their original bad state, except where extra funding was available to sustain the projects.

In the light of the transformation of local government in South Africa, the Masakhane strategy has become more relevant, provided that all parties are committed to the projects and mistakes such as those pointed out in the previous paragraphs are avoided.

2.8.2.3 Community- Based Contracting Strategy

Community-based contracting is another strategy that has been applied in some municipalities in South Africa. Unlike the community empowerment strategy discussed in 2.8.2.2 above, community-based contracting involves the contracting of a member or members of a community, by a local authority, to provide solid waste collection services within that community (WRC, 1995b). The WRC has pointed out that this method of collecting domestic solid waste addresses the concerns of high unemployment and the lack of community involvement in the provision of services. Community-based contracting can be executed in three different ways, namely:

(a) Primary Collection - Contract; Secondary Collection - Local Authority

The contracted member (or members) of the community collects waste from the households and take it to a transfer point. The contractor can do the collection on foot or use a vehicle, depending on the resources of the contractor and the requirements of the contract. The transfer point may be a communal skip or a designated collection point. The contractor can be an individual who cleans an area on foot or one who uses a mobile refuse container. The local authority collects the waste from the transfer point by means of a refuse vehicle/s for final disposal.

(b) Primary and Secondary Collection - Single Contract

A single contract is awarded for the collection of waste from an entire area. The contractor decides whether or not to sub-contract one of the collection activities or to undertake the whole process independently.

(c) Primary and Secondary Collection - Split Contract

The whole collection activity is privatised but different contractors are responsible for the primary and secondary collection activities. The local authority has the following responsibilities:

- Community Interaction: Local authority (LA) identifies appropriate levels of service and determines whether or not community contracting is appropriate, based on its needs.
- Tendering: LA is required to conduct training of potential contractors about the tender process and also determines appropriate forms of performance guarantees from the contractors.
- Contract Specifications: The LA draws up the specifications of the contract, which include service efficiency and criteria for remuneration; and employment requirements to address unemployment problems. The contract also specifies that the collection of waste has to be labour intensive; the training needs of the contractors and their employees and lastly, education of the community to create awareness about waste related issues.
- Monitoring: It is the duty of the LA to ensure continuous monitoring of the contractors and to promote a positive relationship with the community.
- Administrative Assistance: LAs have a duty to ensure good administration of the community-based projects and timeous payment of contractors.

2.8.2.4 Public/Private Partnership (PPP) Strategy

Public/private partnership is one of the alternative and creative ways of delivering a high quality service to all residents. The PPP strategy has been tested and was successfully implemented in a number of developed and developing countries, including South Africa. Some case studies are described below to show the operation of the PPP strategy.

According to Chaturvedi (1999), a PPP enterprise was initiated in India where almost all inorganic waste recycling was carried out through the efforts of the informal sector. This sector consisted of ragpickers, waste traders, shanty recyclers and factory owners across the country. The system included men, women and children who scavenged unsegregated garbage including paper, plastics, glass, metals and aluminium cans to sell to middle men who further sold it to the recycling factories. The ragpickers were identified and trained by the Citizen groups and NGOs to collect waste at source for a small sum of money. The organic waste, which constituted 65% of the waste generated, was composted on site. These groups managed 12-15% of the total municipal solid waste produced in urban India.

Attempts were being made to involve major recycling companies to subsidise the projects on the basis that these companies received waste free without having to collect it. The involvement of the informal sector (ragpickers) in waste collection has saved the municipalities huge sums of money that could have been spent on labour costs if they had been on the municipal payroll. The ragpickers therefore provided an unacknowledged subsidy to municipalities in India. They also partially emptied the overflowing bins by processing organic waste. The growth of the Indian PPP enterprise has, however, been constrained by the lack of municipal support, the existence of a solid waste management system not geared to accommodate decentralised systems, and informal means of implementation.

In the Philippines, a PPP strategy was developed as an attempt to solve the waste crisis. The strategy involved three scenarios. As explained by Lapid (1999) the traditional approach where collection, transportation and disposal of waste were all undertaken by local governments, was done away with. Government turned to the private sector for financial and technical support.

First scenario: The services of the private contractors were engaged to collect and transport waste to the landfill. The management and operation of the landfills were assigned to a private contractor. This was necessary due to the inability of the local government to meet and sustain the community waste service needs. Local government officials had little technical knowledge of municipal solid waste management, and thus had no option but to outsource these services.

Second scenario: The Philippines local government was made a project leader. The primary role of local government was to bear the cost of the loans and retain much of the decision and policy-making powers on how to conduct solid waste management. Additional duties included the responsibility to provide a proper service to the community to ensure cleaner surroundings and a better environment; and the promotion of waste minimisation and recovery. All other waste services were in the hands of the private sector.

Third scenario: The informal sector was assigned with the duty of performing door-to-door collection and street sweeping in densely populated areas where road networks and pathways were not suitable for normal refuse trucks. The advantage of the informal sector involvement was its potential to provide alternative services more efficiently and less expensively.

The Department of Public Works (DPW) in South Africa has decided to explore opportunities to involve the private sectors in the future management of State properties and services. This was an attempt to improve the cost and quality of services and to increase contribution to the upliftment of previously disadvantaged groups. The rationale for working with the private sector was to extend the DPW's capabilities whilst transforming the oragnisation towards more service orientated and commercial modes of orientation. The underlying principles for the DPW's initiative were, among others:

- The creation of partnerships with the private sector that are sustainable, empowering and able to address the needs of the public sector;
- The reinforcement of the principle of co-operative governance;

- The opportunity to create empowerment opportunities for business enterprises owned and managed by individuals from previously disadvantaged communities in South Africa;
- The creation of sustainable employment opportunities, empowerment and building capacity, especially among individuals from the historically disadvantaged communities and SMME's in the public sector service provision sector.

The advantage of the DPW initiative is its emphasis on the participation of both the private and public sectors in a collective manner to ensure that the overall benefits are optimised for the long term sustainability of the programme. In 1996-1998 the DPW launched a National Clean-up Campaign (NCC) throughout the Republic of South Africa. The NCC involved local government in the initiation of community-based solid waste management cleaning programmes in areas where services were virtually non-existent.

This initiative was in recognition of a clear and immediate need in the country to assist in the upliftment of disadvantaged communities by providing a demonstration of waste disposal programmes. Through the DPW initiative a partnership between the communities (service recipients), the local authorities (service providers) and private sector (co-funder) was forged. The projects were largely funded by the DPW and the management fees were sponsored by the South African Breweries (Beer Division). The project management was left to the Keep South Africa Beautiful Association an (NGO). The NCC project succeeded as a government social upliftment initiative to join forces with the private (corporate) sector, NGOs and communities to teach residents to value their local environments (Keep South Africa Beautiful, 1996).

The PPP strategy is seriously considered for the newly established municipalities in South Africa to meet the challenge to deliver better services to residents within the constraints of limited financial and human resources. The South African local governments propose to involve the private sector in selected infrastructure service delivery. The partnerships are intended to promote competition among several potential suppliers.

The principles governing the proposed PPP strategy in South Africa according to the DCD (1999a) include, among others, the following:

- Ultimate responsibility lies with the Municipality: The private sector involvement in service provision does not relieve the municipality of its responsibility to regulate and monitor the delegated duties.
- Service providers have to be accountable to the people they serve: The organisation that provides the service has to be accountable to the people that are being served. This requires the development of mechanisms to enhance accountability to the end-user.
- Equitable coverage: The services have to be extended as fast as possible to the historically disadvantaged sectors of the population. Services must be affordable to those sectors and be sustainable. For this to happen, the service provider has to implement various options including multilevel services and corresponding multilevel tariffs, which will allow for cross-subsidisation from higher income areas to lower income ones.
- Service providers must adhere to sound environmental principles: The services should always be provided in a manner that does not cause the degradation of the environment. This necessitates capacity building to empower the local government personnel with the necessary skills to evaluate the performance standards of the service in question. Combined with this principle is the one of ensuring technology and capacity building.
- Service providers must respond to the needs and problems of customers: This principle requires the development of mechanisms to allow rapid response to customer on the needs on the one hand and to afford the end-users means of voicing the nature of services they require from the service industry on the other hand.

It has become clear from the above discussion that partnerships can only be effective if the public and private sectors, labour and communities, work together to achieve sustainable socio-economic development. Most important, is the need to have clearly defined roles and checks and balances built into the system. The private sector involvement in municipal service delivery can bring real benefits to local communities in terms of better services at cheaper prices for more residents.

The DCD (1999a) has however, warned that this involvement can have negative results such as price hikes, job losses for municipal workers and exclusion of the poor from delivery of the service if not properly managed. Furthermore, if not carefully monitored, the private service operators can exploit end-users by seeking to maximise their profits at the expense of quality services.

2.8.2.5 Volume-based Rating System

The billing system used for local authority services combines refuse, electricity and water service rates. A flat rate is charged to consumers, irrespective of the amount of waste they generate. Individual charge rates for solid waste are hindered by the lack of records on waste generated by various communities in developing areas. This method of payment for solid waste services does not provide incentives to decrease waste and increase recycling (USEPA, 1990). The volume-based rating system is a method that originated in America and is also known as the pay-as-you-throw system. This system ensures that residents are charged in proportion to the amount of waste they disposed of.

The system can be implemented in two ways involving a variable can system and a bag or tag system. The variable can system requires customers to select subscription levels based on the normal number of cans of waste they need to dispose of each week. Customer bills are calculated on the subscribed service level with higher subscriptions leading to higher bills. Local authority or any other service provider offers subscriptions based on standard containers. For the tag or bag system, there is a fee for each official bag, which also includes the cost of disposal. Customers purchase these bags from the service provider and put in their waste. The more bags they put out the more they must pay. This system has been tried and has worked well in several communities in New York, Michigan, Pennsylvania and Canada (USEPA, 1990; Kelleher, 1997).

The main advantage of this system is that it is fair: households (customers) pay for what they dispose of. Those who dispose of less, pay less and vice versa. The system rewards consumers and offers direct incentives to reduce waste. It is a method that gives a customer a better idea of the actual cost of disposing of waste. The pricing of waste in this manner puts solid waste on an equal footing with water and electricity. The implementation of the volume-based rates is quicker than building new capital facilities for handling additional waste.

The disadvantage, is that the system requires manpower to implement. Secondly, the service provider cannot unilaterally decide to enforce the system but requires local political support. Law enforcement needs to be intensified to curb illegal dumping which usually arises from consumers who by-pass the system. It could be difficult to introduce the system in multi-family housing where waste is usually combined before collection (Kellenner, 1997). The volume-based system is impossible and difficult to implement where accurate waste generation data are unknown. Nonetheless, the system can be tried in well established areas where municipalities have the capacity and expertise to conduct waste generation and composition assessment. This can lead to customer satisfaction in terms of fair pricing for services and possible increased recycling.

2.9 SUMMARY

The above discussion provides an overview of the contributory factors to environmental issues associated with solid waste management. It has been noted that the extent of the problem of solid waste management varies from country to country and region to region and town to town. The variation is influenced by the degree of social development, which is advanced in developed countries and hindered in developing countries. Solutions to environmental problems lie in sustainable development, which is often difficult to accomplish in developing communities due to insufficient resources. Urban areas have attracted people on the basis of their better living conditions. Massive urbanisation has, however, created problems in the rendering of satisfactory basic services in urban areas.

The contributory factors to these problems include but are not limited to, the lack of institutions and infrastructure on which to base effective actions to address urban environmental problems. Excerbating these problems is the lack of capacity (sufficient personnel, financial resources, technical and human resources) on the part of local government. It is acknowledged that environmental problems are caused by many factors. However, solid waste management presents one of the most immediate and serious environmental problems facing local governments in urban developing communities.

The factors that influence solid waste practice are cultural, political, social, financial and environmental in nature. Most important, economic factors determine the sustainability of the programme. Socio-economic factors greatly influence the operations of a solid waste service programme. These include attitudes, level of environmental awareness, level of education of the community, wiliingness to recycle and ability to pay for the services. There are a number of strategies to deal with the problem, but the selection of a strategy has to take cognisance of the local conditions, and the waste management needs of the community. Waste generation and composition measurements are crucial in this regard. However, the absence of waste generation data in developing countries hinders the process of forward planning. Most solid waste planners, as a result, resort to thumb sucking methods for resource planning, which often lead to disastrous consequences and crisis management.

The literature has clearly shown that solutions to environmental problems caused by inadequate waste management of solid waste are not universal but rather depend on specific local conditions that prevail in the area to which the management system applies (UNESCO, 1996). This reaffirms the need to think globally and act locally. Based on this principle, this study has been designed to demonstrate through the case study in Umtata that waste management practices vary from one urban area to another in the same town due to different socio-economic conditions. The study was designed to examine and evaluate waste management attitudes and practices, including waste generation, composition and disposal of waste by households and to identify the effects of socio-economic factors on domestic waste management in order to develop an appropriate solid waste management strategy for the city of Umtata.

CHAPTER THREE

STUDY DESIGN AND METHODOLOGY

The purpose of this chapter is to explain the study design and its execution. The study was designed to capture qualitative and quantitative data for the evaluation of solid waste management practices and waste generation and composition in three residential areas with different socio-economic statuses in Umtata.

3.1 INTRODUCTION

Both qualitative and quantitative methods were employed in this study. The evaluation of waste management attitudes and waste quantities required a study design that combined qualitative and quantitative methods. The distinction between the qualitative and quantitative methods is that quantitative methods produce numerical data and qualitative methods result in information that can best be described by words. The two methods as pointed out by Dey (1993) are mutually dependent in that measurement at all levels embraces both a qualitative and a quantitative aspect. The two data sets were selected for the purpose of this study for the following reasons:

Firstly, the understanding of residents' perceptions and attitudes towards waste requires a qualitative approach. The qualitative method enables one to probe and explore people's interpretations of waste management practices and to obtain descriptions of what people observe and experience (Sapsford and Jupp, 1996). It also allows participants and/or respondents to express their opinions and the researcher to hear and incorporate such opinions/views in the research.

The qualitative method also focuses on events, interactions and other observed behaviour as well as allowing for the recording of direct quotations from participants (Casley and Kumar, 1988).

The qualitative method was therefore relevant to this study, primarily for obtaining the socio-demographic data. This enabled the collection of data including social and economic variables using a structured questionnaire.

Secondly, the quantitative method was also used because the structured survey designed for this study dealt with a large number of data. The measuring of waste required the use of quantitative methods to derive numerical values. This method was also relevant in quantifying the attitudes, beliefs and perceptions of the target population towards waste management.

3.2 STUDY DESIGN

The chosen research design was a descriptive survey method.

Background to the Study Design

Historically, the study area had neither data on solid waste management practices nor on waste generation and composition. On this basis, the study was designed to generate baseline information on solid waste management practice for the area. Micro scale studies conducted in the study area so far, had been limited to technical issues like the design of a disposal site. For instance the Hawkins, Hawkins and Osborn study in 1988 was limited to the relocation of a disposal site and a review of internal solid waste division issues like the availability of transport and staff. The issue of investigating the social aspects of solid waste practice had been largely ignored. Community perceptions about existing systems and the efficiency of the operations had not been well documented in previous research projects in the city of Umtata.

With the rapid commercial and residential developments in the city of Umtata, the need arose for an in-depth review of the solid waste management practice in the city. Solid waste management case studies in the study area showed that the system in place was falling short in addressing the solid waste needs of the community (Poswa, 1997).

The predicament facing this research initiative was the absence of data and research information on solid waste practices for the area. Due to these circumstances a descriptive survey design was found to be the most appropriate.

To support this decision cognisance was taken of findings by Edwards and Talbot (1994) who expounded on the advantages and disadvantages of the descriptive survey design. The most relevant factor for this study was that it facilitates the speedy collection of valuable descriptive data, as shown in Table 3.1 below.

Table 3.1: Advantages and Disadvantages of the Descriptive Survey Design

Advantages	**Disadvantages**
a) Provides a lot of information fairly speedily	a) Provides a large volume of information
b) Identifies relationships between data	b) Data collected may be superficial
c) Ensures confidentiality and anonymity of respondents when data are reported	c) Response rate to questionnaires may be poor and follow-up procedures are expensive and time-consuming
d) Reliability is high (questionnaires can be used with different groups and over time)	d) There is little indication of causation and of factors affecting issues under scrutiny
e) The researcher retains control over the research process	e) Gathering of information may not be what really matters to the participants under scrutiny
f) It is a valuable descriptive and exploratory design	f) Researcher bias and subjectivity in the methods adopted and interpretation of data

The descriptive survey method would in this study consider questions such as "How much"or "How many?", thus enabling the assessment of the magnitude and distribution and/or characteristics of the problem under investigation (Hammond and Gear, 1986). Through this method the following would be possible:

(a) To identify the views, knowledge, practices and attitudes of residents towards waste and waste management;
(b) To describe the socio-demographic characteristics of the study community and the living environment encompassing each area;
(c) To document the major domestic solid waste management problems in the study area as perceived by the community;
(d) To determine the quantity and the characteristics of waste generated from households and ultimately to enable the researcher to recommend appropriate strategies and practical solutions for domestic solid waste management in the study area.

The method is not without problems (see Table 3.1 above) and the effect of the associated disadvantages must be considered. However, different techniques of gathering information were considered in the design of this study.

Approach to issues being addressed

The objectives of the study presented in Chapter one were grouped into two main components (Part A and Part B as per the questionnaire design) in order to facilitate the presentation and interpretation of data as shown below.

Part A of the study addressed the first objective, which was developed to examine and evaluate attitudes and practices of households towards solid waste management in three residential areas in the city of Umtata from a socio-economic perspective. (Also consult section 3.4 for the full description of the study area). A socio-economic household (descriptive) survey was designed for the purpose of addressing this objective.

The survey involved the use of a structured questionnaire consisting of closed and open-ended questions, and it was administered by means of interviews to a random sample of the population in the study area. This exercise was carried out to assess different levels of income, population density, level of education, number of residents per household stand, type of housing stand, size of family per household stand, lifestyles and attitudes with regard to solid waste handling practices at their respective homes. (Consult Chapter four).

Part B was designed to capture data for objective two, whose aim was to determine the waste generation and composition rates of the waste stream from the three selected residential areas in the study area. The quantitative (measurement) aspects of the waste stream were addressed by weighing and sorting waste for content analysis. The analysis provided information on generation rates, density, and constituents (composition) of domestic waste. (Consult Chapter five).

3.3 STUDY POPULATION AND EXCLUSION CRITERIA

The target population for this study was households or residents residing on formal household stands or properties. The term household (s) refers to a person or group of persons, whether related or not, who normally reside in a residence or a section thereof. Respondents included residents whether they were owners or family members or tenants who resided on the property.

The rationale for the selection of households was based on a number of reasons. Household is one of the most important institutions in a society and within which the gender norms are expressed, reinforced and reflected in larger institutions of society. It is a basic unit of society where individuals both co-operate and compete for resources (World Bank, 1999).

Added to this, the World Bank describes the household as a primary place where individuals confront and reproduce societal norms, values, power and privilege. Therefore the understanding of effects of social factors on service programmes can be examined through households.

For the purpose of this study, households were deemed to be the best population group that would best reflect the nature and the effectiveness or inadequacy of a domestic solid waste programme. First, as generators of domestic waste, the lifestyle within the households was critical for evaluating the quality and quantity of waste. Second, as managers, households could provide the best evaluation of the service programmes. Their expressed views could serve as the benchmark for developing appropriate and sustainable solid waste management strategies.

The following exclusion criteria were applied:

(a) Consideration was only given to respondents who were 16 years of age or older, as these people were regarded as old enough to be familiar with the practices in their homes with regard to domestic waste.
(b) Only information gathered from respondents who resided in selected residential areas (Fortgale, Northcrest and Ngangelizwe suburbs) was accepted.
(c) All flat dwellings and businesses in the study area were excluded from the sample on the basis that they had unique properties in terms of population ratio and waste generation (Rhyner *et al.*, 1995).
(d) Monthly and seasonal variations in waste production were not considered. The basis for the disregard of variations was constraints in terms of logistics (funds, time and man-hours and other essential resources). Therefore, waste generation measurements in this study only reflect waste characteristics for a winter (dry) season.
(e) The study did not take into account the influence of the time of the week or date of the month in waste production.
(f) Only waste obtained from residences through routine collection were accepted for waste analysis.

3.4 STUDY AREA

The selection of the three residential areas for this study was primarily based on their different socio-economic status as indicated by their geographical location and dwelling characteristics. These areas included Fortgale (high income suburb), Northcrest (middle income suburb) and Ngangelizwe (low income suburb). They are located on the western, northern and eastern parts of the city of Umtata respectively. The three areas represent the historical geographic, socio-demographic distribution and housing development of the city of Umtata (Figure 3.1).

The more upmarket housing developments are centred around Fortgale on the hill area which include other newly developed suburbs on the southwestern side of the city (Umtata City Council, undated). The northern and southern parts of the city have the middle income areas where Northcrest suburb is located. In contrast, Ngangelizwe suburb to the east, comprises of low cost housing with owner-built houses, the majority of which are of traditional Xhosa style with thatched roofs. This state is gradually changing and residents are beginning to build according to western designs. Different residential areas were selected for this study because of the anticipated wide range of waste generation rates among different socio-economic groups and dwelling types (Flintoff, 1984; WRC, 1995; UNESCO, 1996).

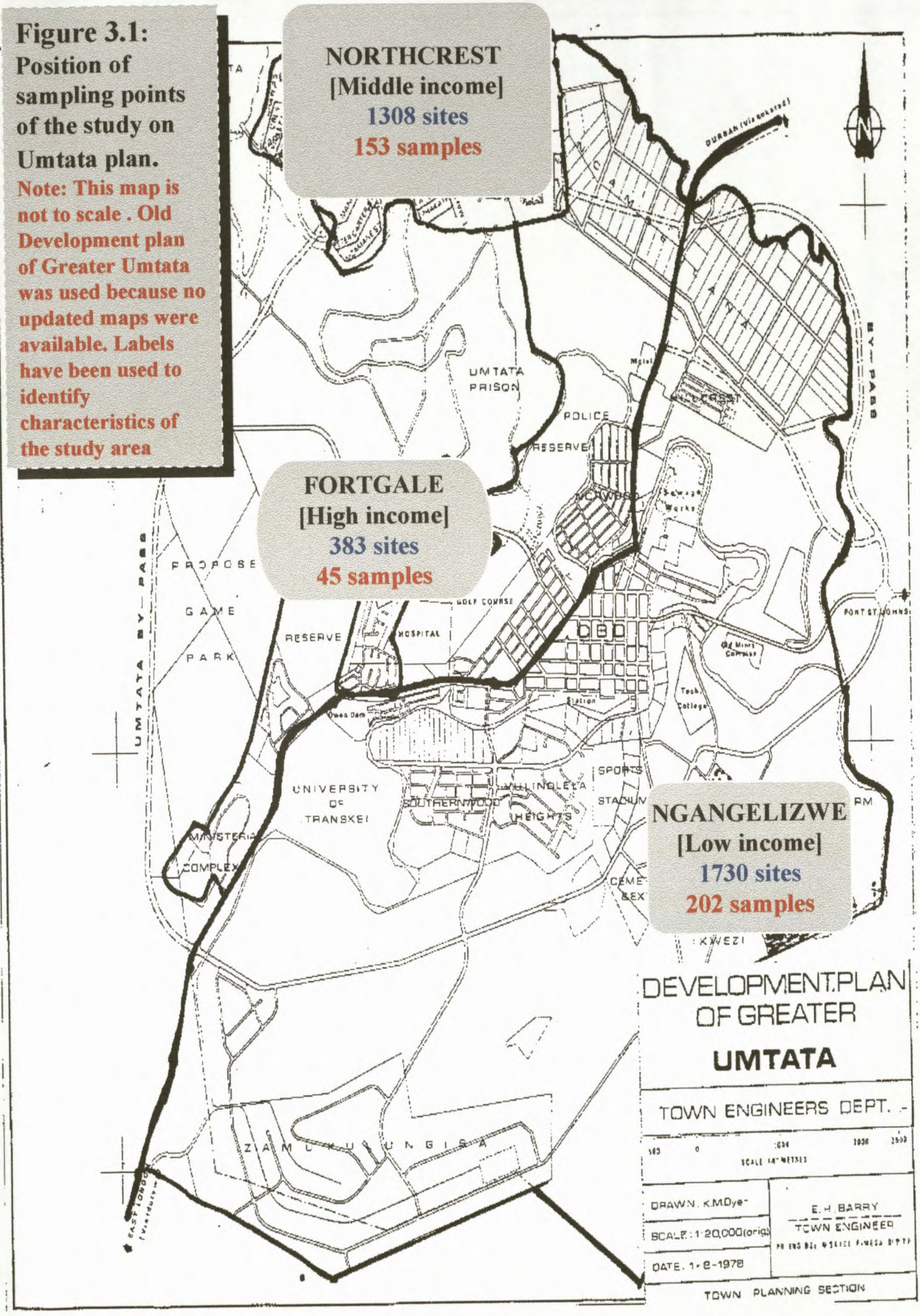
3.5 SAMPLING

Preliminary Study

A preliminary investigation was launched in the study area prior to the sampling process. The aim of the exercise was twofold. First, this step was taken to inform the relevant authorities, namely the officials in the Town Planning and Solid waste divisions of Umtata City Council (UCC) about the proposed research initiative. The second and most important step was to investigate the location and the number of housing units in each suburb or service area within the jurisdiction of the Umtata City Council.

Figure 3.1: Position of sampling points of the study on Umtata plan.

Note: This map is not to scale . Old Development plan of Greater Umtata was used because no updated maps were available. Labels have been used to identify characteristics of the study area



It was discovered that there were no current maps or updated information about the number of housing units since the development of the respective residential areas in the 1980s. The available maps were however, used to locate the areas and the old boundaries. The boundaries had not changed, with the exception of the new housing developments with the number of units unknown. The lack of updated information was attributed to the poor record keeping often encountered in most local authorities in developing communities. No aerial photographs were available. Other alternatives to obtain information about the areas under scrutiny were considered, the most feasible one being to conduct a physical count of the housing units in order to initiate a database.

The personnel of the Umtata solid waste division under the supervision and control of the researcher (who was at the time the Head of the Division) conducted a physical count of all the housing units within the city boundaries. This information served as the basis for developing a sampling frame. It was also found that the residential areas of Umtata fell into three distinct socio-economic categories: low income, middle income and high income areas. This situation resembles most developing towns in South Africa. On the grounds of this discovery the study was designed to ensure that the sample was representative.

Sampling Method

The stratified random sampling technique coupled with proportional allocation with respect to size was used to select the sample size and population groups for this study. Attempts were also made to ensure a fair distribution of samples in the different selected areas in the study area so as to obtain a sample size that would reflect both a representative sample size and the heterogeneity of the study population due to different socio-economic circumstances (Bailey, 1982).

The study area was divided into 3 strata (units which were internally homogeneous and externally heterogeneous) with regard to their geographical characteristics, living standards and assumed ability to handle waste. The most appropriate sampling technique to draw the sample was the stratified sampling technique.

Mini-samples were drawn proportionally from each stratum or subgroup using random sampling. Proportionate sampling was chosen on the basis that it offers the simplest possible data for analysis. The number of units in each stratum are shown in Table 3.2 below. The sample size was derived by preparing a complete list of households or residence addresses in each stratum to get a sampling frame from which the sample was drawn (Bailey, 1982). A table of random numbers was used to pick house numbers at random. The process was continued until the desired sample size was attained for each stratum (Fortgale - 45; Northcrest - 153 and Ngangelizwe - 202).

Table 3.2: Distribution of sample size for each stratum in the Study Area

AREA	Total No. of Housing Stands/ Units per Area	No. of Sampled Housing Stands/ Units per Area/Strata	Sample % per Area	Final Sample Size	Final sample %
Fortgale Suburb	383	383/3421= 45	11.2 %		**400/3421 = 11.7 %**
Northcrest Suburb	1308	1308/3421= 153	38.2 %	**400**	
Ngangelizwe Township	1730	1730/3421= 202	50.6 %		
TOTAL No. of Housing Units per Study Area	383+1308+1730= 3421	**45+153+202= 400**			

The total number of housing units/stands in Fortgale suburb, Northcrest suburb and Ngangelizwe Township was N = 3421 and the target sample size of the study was 400 housing units. The choice of this sample size was based on a number of factors which are described below:

(a) Primarily, consideration was given to the key factors for choosing a sample size such as available resources (cost of the survey, labour, time and materials) to obtain the proposed sample size and the number of subgroups of interest (Cochran, 1977; Lake and Harper, 1987). In view of the limited resources at the researcher's disposal, it was only feasible to sample a maximum of 400 housing units.

(b) Consideration was also given to the fact that this sample size was a proportional representation of the sample groups, which were heterogeneous in nature, a significant feature in sampling (Bailey, 1982).

(c) However, the above was done within the approved research limits. For instance Hammond and Gear's (1986) guidelines for checking adequacy of a sample recommend, *inter alia*, that a 10 % sample size for a population of 500 may be used and once the population exceeds 2000 it is not necessary to continue to increase sample size greater than a 10 % sample. Lake and Harper (1987) recommend a sample size of no fewer than 200 completed interviews and 400 to 500 for major studies.

(d) Moreover, a sample size of 400 is statistically acceptable. According to Cochran (1977), a statistically acceptable sample size should be between 336 and 400. The proportion (P) of the people at the site of study was indirectly estimated from previous studies. Researchers recommend that the proportion of people who are capable of efficiently managing waste in a responsible manner may be assumed to be equal to people who are literate or who receive a steady monthly income. Therefore, the higher the income and literacy status, the greater is the capacity to manage waste efficiently (Habitat, 1989; Mayet, 1993).

On the basis on the above, the literacy and income distribution figures of Shasha (1993) and Frost (1997) at Ngangelizwe, one of the three sites of study, were used to estimate the proportion of people who would be able to manage their waste efficiently. The *P*-value was estimated as 30 % = 0.30). The estimated proportion was given as p =30% =0.30. The level of significance, α, of the study was fixed at the 0.05 level. The margin of error, d, was fixed at the 0.15 level. Using these values the initial and final sample sizes were calculated as shown below:

Initial sample: $n_0 = \frac{Z^2_{\alpha} \hat{P}(1-\hat{P})}{d^2}$

$= \frac{1.96(0.30)(0.70)}{0.001} = \mathbf{411.6}$

Where: n_0 = initial sample

z = sample distribution

$\hat{P}$ = estimated proportion

d = margin of error fixed by the researcher

α = level of significance

Final Sample $n = \frac{n_0}{1+\frac{n_0}{N}}$

$= \frac{411.6}{1+\frac{411.6}{3421}}$

$= 411.6/1.120 = \mathbf{\textit{367.396}}$

Where n = final sample

N = total population of housing units in the study area

In the interest of statistical precision, the sample size was increased from 367 to 400. A sample size of 400 out of 3421 housing units represented a percentage of 11.7% of the total. The aim was to obtain a representative sample size in order to allow for the generalisation of the results (Bless and Higson-Smith, 1995). The detailed explanation given above justifies the sample size of 400 households as indeed being an optimal sample size.

3.6 DATA COLLECTION

The process of data collection was preceded by three events. Firstly, the Umtata City Engineer's Department was consulted for logistical support such as transport for the collection of waste samples, refuse bags, human resources (waste sorters) and to provide for incidental matters to the data collection process.

Secondly, the data collectors were recruited from the community through the political wing of the UCC (Mayors' office). This was done in consultation with the community structures. Subsequently, the researcher trained the data collectors (interviewers) in the meanings of technical terms, and in using the Xhosa translation of the English version of the questionnaire.

Thirdly, about 15 households were randomly selected from the study area to pre-test the questionnaire in order to identify flaws in its construction. Corrections were made based on the feedback given and the final questionnaire was compiled.

Thereafter, a two-stage data collection procedure was applied. This entailed a waste generation and composition assessment followed by a descriptive household survey. A questionnaire (Appendix A) was used in both cases. Detailed explanations of each stage are outlined in sub-sections 3.6.1 and 3.6.2 below.

3.6.1 Collection of waste generation and composition data

The process of capturing this type of data is referred to as waste stream assessment. The waste stream assessment was designed to determine basic aspects of the local waste stream such as quantity, composition and sources of waste. There are numerous methods using various techniques by which one can assess waste generation and composition, but a direct measurement technique was chosen for this study for the following reasons:

(a) This method is suitable for areas where there is no waste generation data already available (as was the case in the study area) on which to make estimates as required by the other methods;

(b) Analysing waste stream by manual separation and sampling waste provides the most accurate and reliable information method (USEPA, 1989). This however, requires a sufficient sample size;

(c) The main advantage is that data are unique to the specific serviced geographical area (waste shed) in which the local waste stream is generated; and

(d) Direct measurement method employs a pilot study technique, which among others provides detailed information for designing recycling and recovery programmes and promotes active participation of householders (USEPA, 1989)..

The disadvantages of the direct method are that pilot studies are time consuming and costly to perform. The capital cost can be high depending on the type and quality of information needed. Difficulties in the implementation of this technique often arise from resistance from the crews due to increased hassle, reduced freedom and from customers due to improved monitoring.

Other methods for conducting waste generation assessment considered were rejected on the following grounds:

The modelling method requires the use of existing data on waste generation to estimate a waste generation rate of the geographical area and involves the measurement of waste at the landfill site. It was not selected because of the non-availability of waste generation data and a properly operated landfill site with a weighbridge in the study area. Another method considered was the physical technique which makes use of a sample truck load or group of truck loads of waste for sampling waste at the disposal site. This method was not chosen due to the unreliable transportation system in the study area, which could have seriously affected the sampling process.

Process for collecting waste generation and composition data

A field investigation was conducted during June and July 1998 in three selected residential areas in the city of Umtata. Waste samples were collected directly from 400 randomly selected residences, an approach recommended by Rhyner *et al.*, (1995). A Municipal waste collection vehicle was specially assigned for this exercise. Samples were collected on normal waste collection days as per the Municipality's collection schedule for the respective areas within its jurisdiction. The aim was to obtain waste samples which represented one week's production as recommended by Flintoff (1984).

The waste collection vehicle crew was briefed in the procedure and a co-ordinator assigned to the vehicle. The co-ordinator was tasked with the duty of ensuring that each collected waste plastic bag was labelled with the house street number for proper classification before being loaded into the truck. Samples were collected without the knowledge of the householder that their waste was being collected for later analysis. Flintoff (1984) has stated that greater accuracy is assured when householders are not aware that their waste is investigated. The collected waste samples were then taken to the Umtata Municipality Cleansing depot for analysis. The next step was to conduct a waste generation and composition analysis using part B of the questionnaire in (Appendix A). The following measuring equipment was used to analyse the waste as recommended in the literature (Flintoff, 1984; UNESCO, 1996; Mbande, 1998):

(a) Disposable gloves used by sorters for sorting waste;
(b) A battery operated scale with a capacity of up to 150kg for weighing each bag collected;
(c) One 5m tape measure to assist in volume calculations;
(d) 85 litre refuse plastic bags for collecting sorted waste;
(e) Three hard gutter brooms for sweeping the sorting floor and some waste components into the waste bags;
(f) One 2m by 4m canvas sheet placed on a flat concrete platform for placing waste during sorting and
(g) One 10 litre bucket, used as a measuring container.

Sorting and waste analysis procedure

Waste samples were analysed for each area at the Umtata Municipal Cleansing depot under the direct supervision of the researcher and a trained technician. A maximum of 10 waste sorters was engaged and each was given a pair of disposable gloves. Part B of the questionnaire was used to record all information obtained from the analysis of the waste. The waste samples collected from the different areas were arranged around the scale and analysed separately in order to record accurately results from each area.

Special precautions were taken to ensure that samples from the different areas were not mixed. Waste samples were analysed according to the following step-by-step method:

(a) A battery operated scale and a 10 litre measuring container were calibrated. The weight of the empty container was recorded. An empty plastic bag similar to domestic waste bags used for waste collection was laid on a flat surface and its height recorded.

(b) Waste samples were accepted according to their recorded source (street number and sample area). The researcher with the assistance of a technician weighed each bag of waste and recorded information in the corresponding columns of the pre-prepared waste composition analysis sheet (part B of the questionnaire).

(c) The full waste plastic bag was placed on the scale on top of the measuring container and weighed. The weight was recorded in kilograms in the column 'total mass (kg/family/week)' of the questionnaire. Where there was more than one bag from the same residence, all the bags were weighed to obtain a total weight.

(d) The waste bag was slightly shaken to settle the waste content and care was taken to avoid compacting the bag. The height of the bag was recorded. This was done by inserting a measuring tape into the top of the waste bag and measuring the distance between the waste content and the top part (rim) of the plastic bag opening. This was recorded in millimeters and later converted to cubic meters to obtain the occupied volume of the bag.

(e) The plastic bag was then emptied on a canvas sheet placed on a flat concrete floor in the municipal cleansing depot for sorting.

(f) Waste sorters wearing disposable gloves sorted the waste by hand into the required constituents described in part B of the questionnaire. The constituents included vegetable/organic/putrescibles/; paper/cardboard; glass; metals; plastics; bones; ash/dust/soil/; and textiles/cloth. Sorters picked up and put each constituent into a plastic bag. Each bag was weighed and the weight recorded in the corresponding column of the questionnaire.

(g) All the waste constituents were mixed as soon as the weighing exercise was completed. The mixed waste was collected into a waste container for storage ($5m^3$) skip and transferred to the disposal site for final disposal.

The actual volume of the waste generated from each household per week was derived using the graph in Figure 3.2 constructed by Mbande (1998) for the calibration of domestic waste bag. This involved subtraction of the measured height (from the top layer of the waste content for each sample to the rim of the bag) from the total measured height of the bag (900mm) and superimposing the difference from the graph. The graph of volume calibration (litres) versus averaged height from the base of 85 litre domestic waste bags used (with a height of 900mm) is shown in Figure 3.2 below.

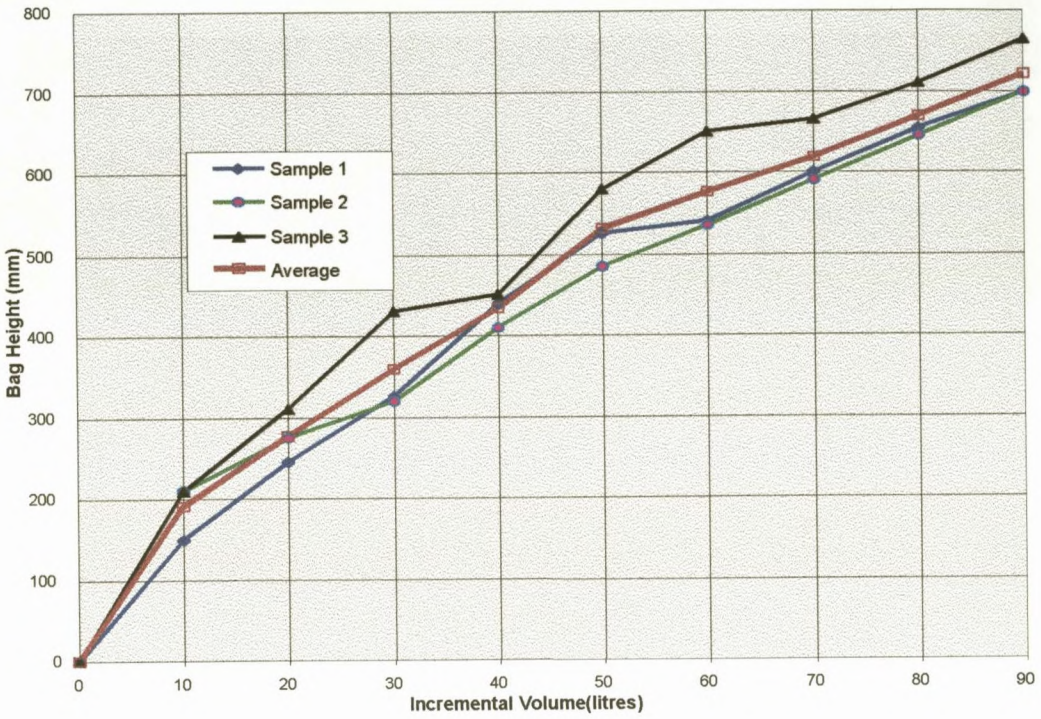


Figure 3.2: Standard domestic waste bag calibration (Adapted from Mbande, 1998)

A detailed explanation of what happens to the bag when the domestic waste is put in the calibrated 10 litre bucket and tipped into the domestic waste plastic bag is given in Table 3.3 below.

Table 3.3: Description of what happens to a standard domestic waste bag when waste is put inside it (Summarised from Mbande, 1998)

Incremental Volume (Litres)	Description of what happens
0 to 10 litres	The first 10 litre of waste occupies mainly the pleated bottom areas of the plastic bag. The waste at this level does not visibly affect the elasticity of the domestic waste bag due to the low density and weight.
0 to 20 litres	Within this range the weight of the waste starts to have a visible effect on the elasticity of the bag. This is shown by the curve that defines the response of the bag in adjusting to the pressure of the waste. The density of waste determines whether or not the plastic would tear. In this case, the bag could stand the pressure of the waste without tearing, indicating that the waste in question had a lesser density. For a more dense waste such as ash, the bag would probably start to tear at this level as the bag strength would reach its limit.
10 to 90 litres	The curving shape of the curve in Figure 3.2 (sample 3) indicates that as the waste is loaded beyond the 10 litre volume, waste starts to settle due to gravity. This action reciprocates the action by the householder who pushes waste into bags exerting limited pressure to ensure that the bag does not tear in the process. As the bag is loaded, its mouth opens and expands due to elasticity, resulting in less height between loading periods than was the case at the beginning of loading. This is explained by the curve between 10 and 90 litres.

The standard domestic waste bag at 90 litres as shown in Figure 3.2 has an average height of 722mm as compared to the total bag height of 900mm. The 722mm level was considered to represent a full bag because it is a level where no further loading was necessary as the baseline data had been established. Secondly, it was assumed that the average household would not load the bag to the 722mm level, as it would be difficult to close.

This method was used to obtain the total volume of domestic waste in bags that were analysed by measuring the height from the top of the waste to the rim of the bag and subtracting this from 900 mm to obtain the total waste height. It was then possible to estimate the volume of waste in each bag.

3.6.2 Collection of socio-demographic data

The following steps were followed to obtain the socio-demographic data:

A descriptive household survey was carried out during December 1998 (i.e. after the actual waste had been collected) by conducting personal interviews with each householder or resident in the randomly selected 400 housing units/ stands in the study area. This involved an explanation of the purpose of the study and completion of the questionnaire by the trained data collectors. Each data collector distributed a letter of explanation (Appendix B) to the respondents. The letter explained the aims of the study and solicited the respondent's participation in the study. This explanation provided the assurance that the information gathered (including the waste content survey) would remain confidential. Lastly, the letter served the purpose of ensuring consistency and uniformity amongst the data collectors in explaining the study purpose.

Part A of the questionnaire was used to interview all owners or occupants of the households that were sampled for waste analysis. Interviews were restricted to persons who were 16 years and older. In cases where properties had more housing units, all households on that property were interviewed. In a few instances, late appointments were made for respondents who were not at home during the day. Respondents had a choice of being interviewed in English or Xhosa.

The information gathered included the following:

(a) Demographic characteristics of the target households;

(b) Attitudes to waste management;

(c) Solid waste practices of the households in the study area;

(d) Sources of income for different households to show the earnings by each member or family group;

(e) Data on social status of the households; and

(f) Information on selected indicators of the quality of life such as access to solid waste management services.

The notable problems during data collection were the reluctance of some respondents to participate in the investigation especially in Fortgale (affluent suburb), and the mishandling of data collectors. For the latter, data collectors were at times not allowed in the yard and were caused to stand at the gate for the duration of the interview. Males in Northcrest and Ngangelizwe always assigned the answering of questions to the female respondents. In some cases residents of properties that had not been selected questioned their exclusion and demanded explanation.

3.7 Data Analysis

The Statistical Package for Social Scientists (SPSS) was used for data entry and analysis. All questionnaires were checked resulting in 370 correctly completed questionnaires and 30 spoilt ones on the grounds of insufficient information. A spreadsheet was prepared for recording all variables. Information was arranged and categorised according to topics and open-ended questions were grouped together for each topic.

The concern about waste removal and street cleansing was identified as the key (dependent) variable of the study. A multivariate testing of variables using the SPSS computer programme was used because it was a technique that allowed the control of the effects of correlations between variables. The relationship between all variables of the study was investigated using the Pearson chi-square test at a significance level of p-value <0.05. The criteria for selection were only variables with a large chi-square value and p-value smaller than 0.05. Discriminant function analysis was used to predict the group to which each case might belong on the basis of a set of characteristics, which the respondent held.

The demographic characteristics (section F of the questionnaire), in particular educational level, income and employment status of respondents, were used as indicators of socio-economic status. The perceived problem of waste removal and street cleansing (sections A and B of the questionnaire) was measured in two ways. Firstly, respondents were asked to rank its importance among a list of other issues such as electricity, telephones, housing, improvement of roads, development of a shopping centre and creation of jobs.

Secondly, respondents were questioned about their perception about litter and illegal dumping. To this end, they had to indicate whether they saw litter as a problem and to state reasons why people littered. Added to this, respondents were requested to state the role of residents in curbing littering and illegal dumping. Only frequencies for views on litter and role of residents are presented in this report.

Asking respondents how they stored and/or disposed of solid waste at their homes assessed the current domestic solid waste management handling practice (section C of the questionnaire). Specifically, respondents were requested to choose the method they used among a list provided for storage and disposal methods. Knowledge of respondents about recycling and their willingness to reduce waste at source was examined by first asking them to state how they disposed of the recyclable waste materials. Secondly, they were required to rank their opinions on the establishment of a recycling programme on a five-point scale. They were further requested to state whether they would support a recycling programme and if so, who should manage it. (Section D of the questionnaire).

Perception towards the current waste management service system in the study area was also investigated (section E of the questionnaire). Respondents were asked to indicate who was providing the collection service, the frequency of collection and how they felt about the system (whether they described it as good, poor, poorly managed or not sure). It was also assessed whether they paid for services and they had to give reasons for paying or not paying.

The waste generated and its characteristics were analysed according their source of origin. Because of the different socio-economic status between population groups, in particular with regard to the nature of residential areas (Mouton, 1996) the data relating to the different residential areas were analysed separately. Results in each group were compared among the three groups in terms of socio-economic development of the area in question (high, middle and low social status). Great variations were found between the different groups. The socio-economic differences were used to interpret relationships for all variables between the different groups in the study.

The use of the SPSS multivariate analysis was significant in providing descriptive statistics, cross tabulations and possible correlations or relationships, frequencies and percentages for all variables. It would have been impossible to manage the large amount of data without this computer programme. The discriminant analysis was useful in identifying which of the socio-economic data were the most useful in discriminating between members of the three different groups in the study (Sapsford and Jupp, 1996).

The results of the analyses are detailed in Chapter 4 and Chapter 5.

CHAPTER FOUR

ANALYSIS OF AND DISCUSSION ON THE DEMOGRAPHICS AND PERCEPTIONS OF HOUSEHOLDS FROM A SOCIO-ECONOMIC PERSPECTIVE WITH RESPECT TO DOMESTIC SOLID WASTE MANAGEMENT PRACTICES

4.1 INTRODUCTION

It has been documented that the quality of solid waste services in a particular area is influenced by both the specific conditions that prevail in the area and the socio-economic status of the community receiving the services (UNESCO, 1996). Mayet (1993) has provided a comprehensive description of socio-economic factors. These factors relate to the state of infrastructural development in a residential area, lifestyle and value systems, aspirations and attitudes, migratory patterns, levels of education and a willingness to recycle or reduce waste output. This includes the ability of people to pay for services based on income and willingness to pay (Sadler, 1997). Added to this, the USEPA (1992) has reported that personal and social relationships (perceptions) influence behaviour and may inspire or inhibit compliance with the set standards for service provision.

This chapter reports the main findings regarding the demographics, practices and views of households about solid waste management. An in-depth analysis and interpretation of a descriptive household survey using personal interviews of individual households to determine residents' attitudes, current solid waste management practices and socio-economic and demographic profile is presented. The analysis and interpretation of the collected data indicated important trends regarding the ways in which domestic solid waste was managed in the study area. Relationships between the variables of the study are reported, indicating frequencies and percentage distributions based on 370 successfully completed interviews. These interviews represented a 92.5% response rate, which was calculated using the Hammond *et al.*, (1986) formula as shown below.

Response rate of study = Total numbers of responders x 100
Original sample size

$$= \frac{370 \times 100}{400} = 92{,}5\%$$

where ~ total number of responders was derived by subtracting the total number of non-responders in each site of study from the original sample size

~ 'responders' refers to cases where respondents co-operated in the completion of questionnaires.

~ 'non-responders' refers to cases where questionnaires could not be completed due to insufficient information or refusal of the respondents to be interviewed

Non-responders = Fortgale (7); Northcrest (5) and Ngangelizwe (18)
= 7 + 5 + 18 = 30

Responders = 400 - 30 = 370

The total number of responders (370), is a proportional representation of the sample size for the study, where Fortgale represents 10,3%, Nortchcrest 40% and Ngangelizwe 49.7% of the final sample size respectively as discussed in Chapter three.

4.2 DEMOGRAPHIC CHARACTERISTICS OF HOUSEHOLDS

This section reports the major findings on the demographics of the population in the study area as per the questionnaire survey (Appendix A, questions 31-39). The influence of the demographic profile on solid waste practice was investigated through a comparison of different communities in the study area based on their socio-economic status.

4.2.1 Age distribution of households and its effect on solid waste practice

The age distribution of households (Appendix A, question 31) in the study area is shown in Figures 4.1 and 4.2 below. The overall age profile of respondents depicted in Figure 4.1 shows that the majority of respondents belonged into the 21-30 year age category. The rest of the residents in the households surveyed fell into 16-21, 31-40, 41-50 age categories where the lowest number 13.5% (50) was in the age group 51 + years.

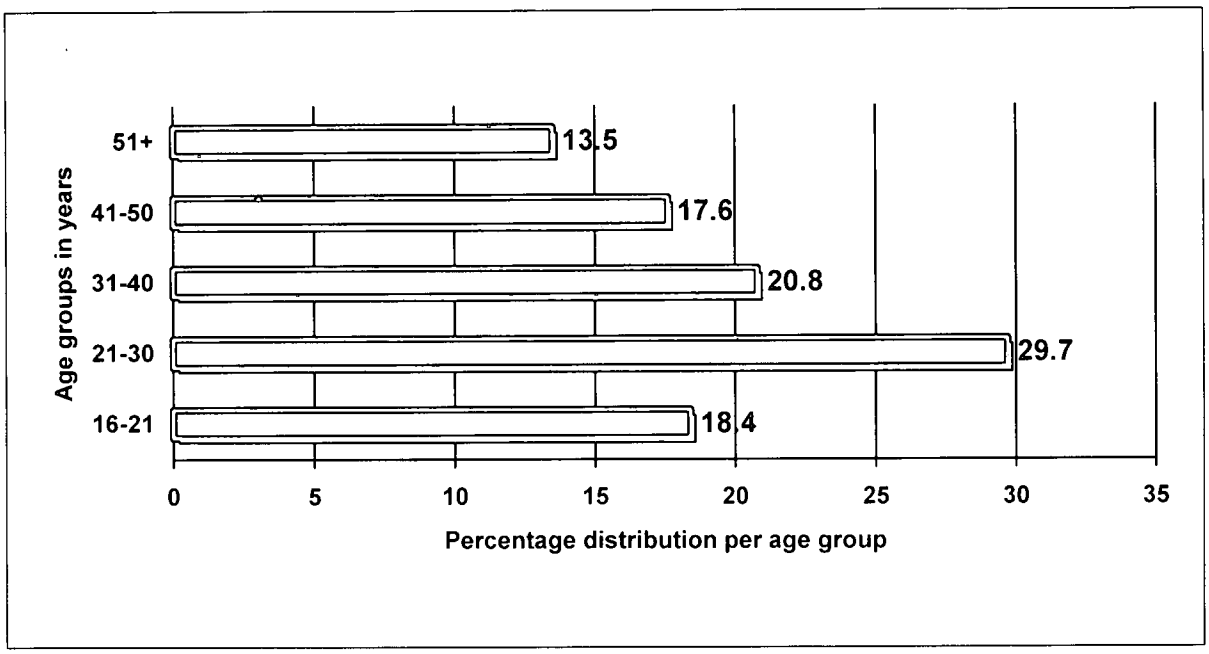
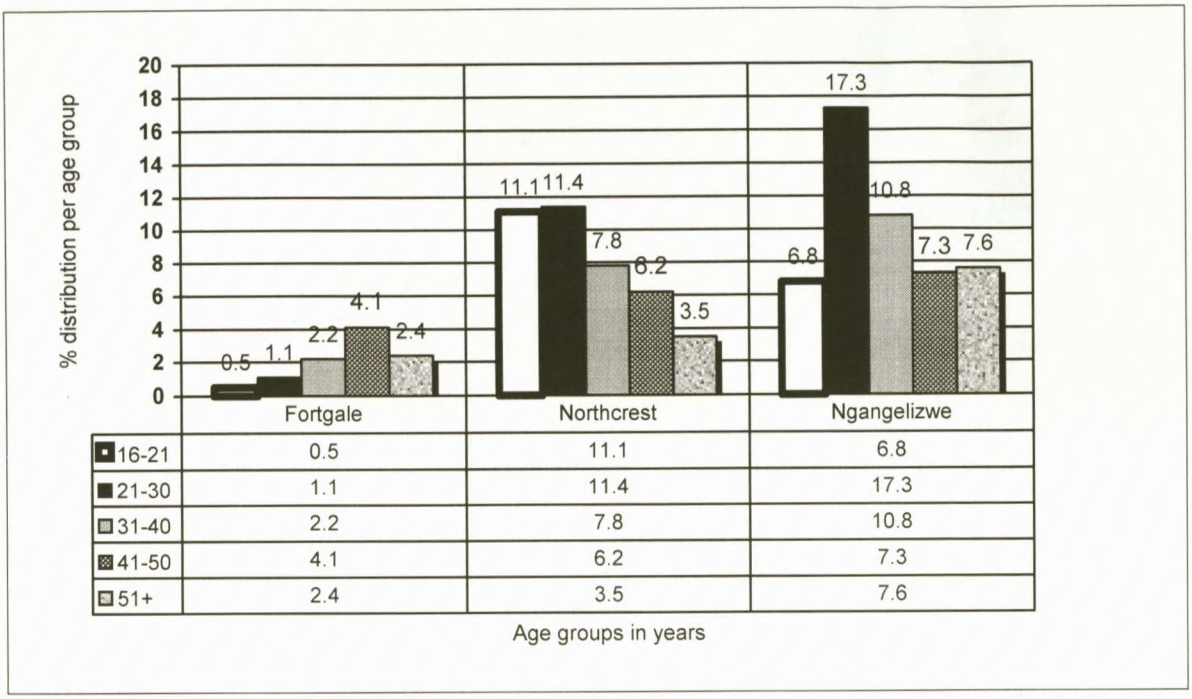


Figure 4.1: Overall age distribution of respondents from households surveyed in three residential areas with different socio-economic status in Umtata (N-370)



	Fortgale	Northcrest	Ngangelizwe
16-21	0.5	11.1	6.8
21-30	1.1	11.4	17.3
31-40	2.2	7.8	10.8
41-50	4.1	6.2	7.3
51+	2.4	3.5	7.6

Figure 4.2: Age distribution of respondents in households surveyed in December 1998 in Fortgale, Northcrest and Ngangelizwe, Umtata (N-370)

The age of respondents appears to be related to a number of waste management issues such as street cleaning and litter. Figure 4.3 below indicates that the no concern for street cleaning and litter increased disproportional with age. To this end, the study has noted that youth (less than 21 years) were less concerned about clean streets and litter. Contrary to this, there was a marginally difference between those who expressed concerned for the clean environment and those who showed no concerned as the age increases.

On the basis of these findings, it was concluded that the younger persons in the study area had less regard for the environment while the elderly people were split in two with the majority in favour of clean streets and litter free environment. The lack of interest among the young age groups was attributed to the fact that young people in most societies often have little sense of responsibility, as they assume that someone else will take care of problems such as environmental issues. The older people who showed no interest might be due their generally inactivity and thus lose interest in community issues (National Progressive Primary Health Care Network (NPPHCN), 1999).

It has been suggested that past experiences of older people living in developing communities where local governments failed to provide adequate waste collection and street cleansing services had forced people to accept the fact that they live in degraded environments. The resultant effect of such experiences is a negative interaction between people and the environment (Byrne, 1996; DEAT, 1997). Poverty, unemployment, overcrowding and lack of resources (Sapsford and Jupp, 1996) exacerbate this.

Further, the lack of participation in community development is likely to result in the loss of esteem with the resultant feeling that an individual can play a limited or no role in changing the external environment (DEAT, 1997) as discussed in Chapter two. This sense of frustration and alienation is worsened by the neglect shown by modern society towards older and more inactive citizens, and which often focuses its attentions and resources on the young (NPPHCN, 1999).

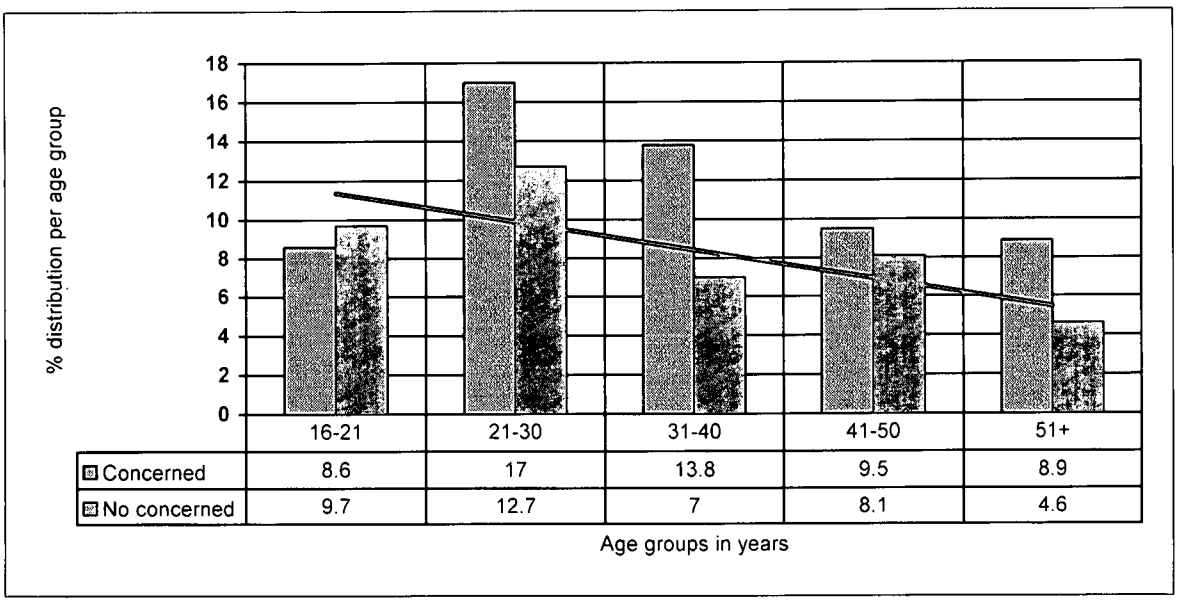


Figure 4.3: The Relationship between age of residents and their perception towards street cleaning and litter in Fortgale, Northcrest and Ngangelizwe. The trendline was fitted using Microsoft Graph curvilinear for the no concerned category (N-370).

The positive attitude towards street cleaning and litter revealed among the age groups 21-30 and 31-40 years may be explained by their recent experiences and knowledge gained at training institutions. In addition, individuals aged between 21-30 years can be regarded as being of an experiential stage at which they like to see, and be part of changes in their environments. The desire for the changes may be triggered by the self-esteem needs of an individual which are directly related to expectations for success (Robbins, 1993). On the whole, 57.8% (214) against 42,2% (156) of all respondents in the surveyed households of all age groups in the study area, showed a positive attitude towards cleaning and removal of litter.

4.2.2 Gender distribution of households and its effect on solid waste management practice

It is significant to note that 70% of the respondents were female. These findings are in accordance with responses to question 32 of the questionnaire (Appendix A). This is probably explained by the fact that the females of the households were available to be interviewed on the day and the most knowledgeable persons about waste and cleanliness in their homes. Moreover, there could simply have been more females living in the area, as suggested by Shasha (1993). The 1996 census also indicates there are more females in South Africa, except in the Gauteng Province (Statistics South Africa, 1998).

The relative distribution of men and women respondents is presented in Figure 4.4 below. A more equitable number of males (55.5%) to female (44.7%) respondents is evident in Fortgale compared to Northcrest (33.8% : 66.2%) and Ngangeizwe (20.7% : 79.3%) respectively. Whilst this might be viewed as incidental, the socio-economic connection between gender and the social status of the community was investigated further. These observations may be attributed to the influence of culture of the societies which promotes the passing of responsibilities by men to women in the homes (Scheinberg *et al.*, 1999). The extent of this practice, however, varies with socio-economic groups. Commonly, husbands and wives in homes of high socio-economic status share responsibilities (World Bank, 1999).

The second important observation is that it appears women predominantly from Ngangelizwe constituted 81% of the total unemployed respondents in the study area. The women in Northcrest and Ngangelizwe were expected by the men of the households to be responsible for answering the questionnaire. This practice might have been perpetrated by the existing norms in the society which widely regard women, due to their lower economic and social status, as responsible parties for handling domestic responsibilities, in particular those associated with cleanliness (Scheinberg *et al.*, 1999; World Bank, 1999).

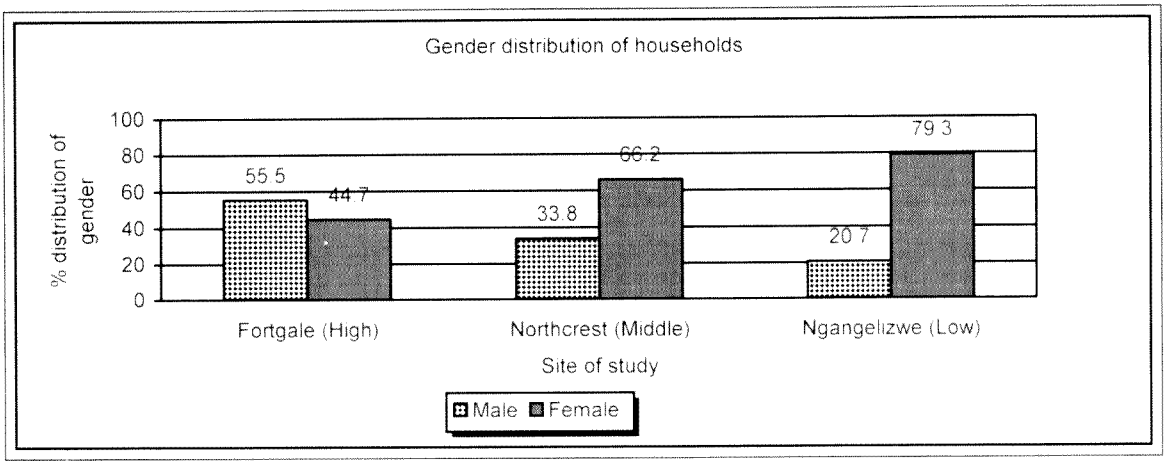


Figure 4.4: Proportional distribution of gender of households (N =370) in Umtata reflecting variations between men and women in high, middle and low socio-economic residential areas

Further, the results show that 67% (73) of the male respondents felt that proper waste removal was important whilst 54% of the female respondents indicated great concern about waste removal. When the results were viewed from a gender perspective, it was noted that females had mixed feelings about concerns for waste management with relatively small difference between those who were concerned and those who were not, compared to the clear choice of males.

Table 4.1 shows the preferences for two different waste collection methods. There are great differences of opinion between the two gender groups with regard to the preferred choice of a waste collection system. The majority of residents (predominantly women) preferred a door-to-door collection service. Men would support a drop-off recycling centre more than women would. This difference may be attributed to the cultural traditions, which govern gender relations in the households.

Women in most societies are responsible for the domestic work which includes many tasks such as child care, shopping, cooking, cleaning and the well-being of their husbands (World Bank, 1999). This affects their mobility and suggests their choice of a convenient waste disposal method. This should be taken into consideration by solid waste planners when planning a solid waste collection programme. The attitude towards illegal dumping also differed as most male respondents considered illegal dumping to be problematic. This might be because females might have been less mobile and less exposed to sites degraded by illegal dumping.

The above gender analysis has brought to light the importance of gender attitudes in the planning of waste management systems in particular domestic solid waste services. The issue of gender is often seen as an aspect that is only addressed for political reasons. It has received little or no serious attention in waste management planning. In spite of the proportionally high numbers of women workers in most municipal cleansing services and community-based collection services, decision-makers, planners and waste managers have ignored the effect of gender in the rendering of waste management services.

The effect of different perceptions of men and women in the family settings needs to be understood in order to design effective and sustainable domestic waste management service programmes. The significance of such understanding is that men and women, including boys and girls, are engaged in different waste related activities such as managing resources within the household/family; formal municipal collection services; recycling or private enterprise for different reasons.

Some participate partly because of cultural traditions and conventions, practical interest including earning income and maintaining a healthy living environment, and/or to gain recognition as a worthy community member (Scheinberg *et al.*, 1999). The designers and operators of domestic waste collection systems need to carefully consider gender issues in households in order to assure that the maximum cost-effectiveness of the programme/s in place is being realized.

Table 4.1: Perception of households to waste management related activities from a gender perspective as per a household survey conducted in December 1998 in three residential areas in Umtata

Objective	**Variables**				**Total**
	Illegal dumping				
Knowledge about waste related activities	*Male*	*Yes* 67 (18.1%)	*No* 42 (11.4%)		**109 (29.5%)**
	% within gender	61.5%	38.5%		100%
	Female	*Yes* 137 (37%)	*No* 124 (33.5%)		**261 (70.5%)**
	% within gender	52.5%	47.5%		100%
	Drop-off Centre				
Preferences for waste management services	*Male*	*Yes* 38 (10.3%)	*No* 66 (17.8%)	**N/A** 5 (1.4%)	**109 (29.5%)**
	% within gender	34.9%	60.6%	4.6%	100%
	Female	*Yes* 74 (20%)	*No* 168 (45.4%)	**N/A** 19 (5.1%)	**261(70.5%)**
	% within gender	28.4%	64.4%	7.3%	100%
	Door-to-door collection				
	Male	*Yes* 67 (18.1%)	*No* 38 (10.3%)	**N/A** 4 (1.1%)	**109 (29.5%)**
	% within gender	61.5%	34.9%	3.7%	100%
	Female	*Yes* 168 (45.4%)	*No* 79 (21.4%)	**N/A** 14 (3.8%)	**261(70.5%)**
	% within gender	64.4%	30.3%	5.4%	100%

4.2.3 Educational status of households

Figure 4.5 represents the educational qualifications of respondents in the study area as per responses to question 33 of the questionnaire (Appendix A). Education qualifications ranged from no formal education to tertiary level of education. The results reflected a variation between the levels of education with most respondents in the secondary and tertiary levels and least in the primary education category.

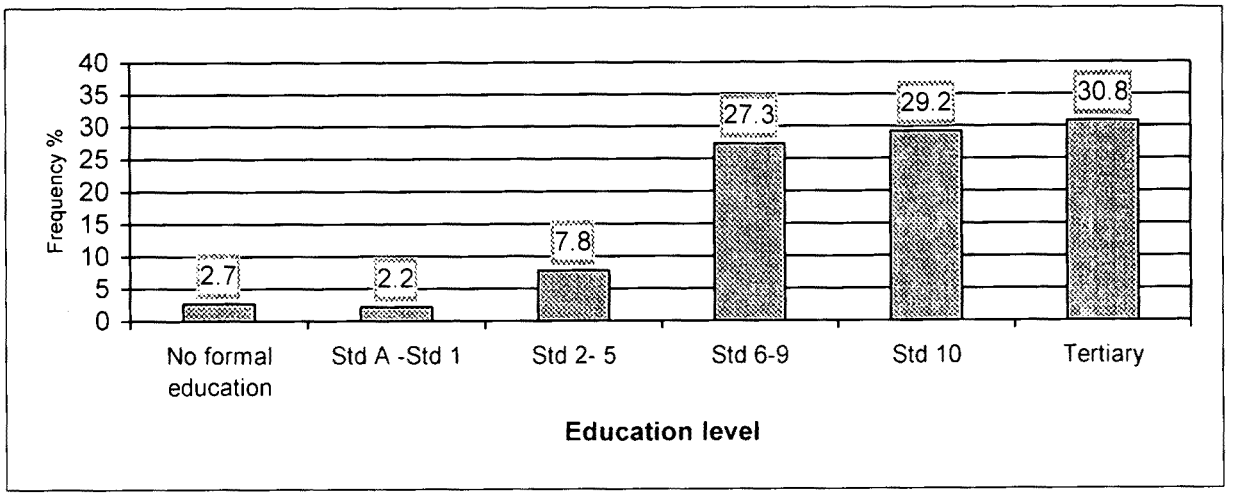


Figure 4.5: Overall distribution of education qualification of respondents in the surveyed households in Fortgale, Northcrest and Ngangelizwe (N-370)

A comparison of the educational qualifications of respondents in the three sites of study is illustrated in Figure 4.6 below. A notable trend is the higher proportion of households ranging from no education to matric (grade 12) level of education, and far fewer persons with university education in Ngangelizwe compared to the other two areas (Northcrest and Fortgale) in the study area. These results are consistent with those of Shasha (1993). The high number of households with low level education in Ngangelizwe as a low socio-economic area was attributed to the influence of external factors like unemployment and poverty. Like most developing communities which are ravaged by poverty, most families in Ngangelizwe cannot afford the high costs of education, hence the higher percentage of individuals with low education levels was found.

An unexpected finding was the relatively high percentage of respondents with tertiary education in Northcrest (middle socio-economic status suburb) compared to Fortgale (high socio-economic status suburb). This outcome was interpreted as showing that the determinant for residing in an affluent society is not necessarily education, but that wealth could be the main reason. The development trends in the society have shown that individuals from the middle class acquire higher education in order to improve their well-being and to be better positioned in their jobs, with the ultimate aim of sustaining their livelihood (Robbins, 1993).

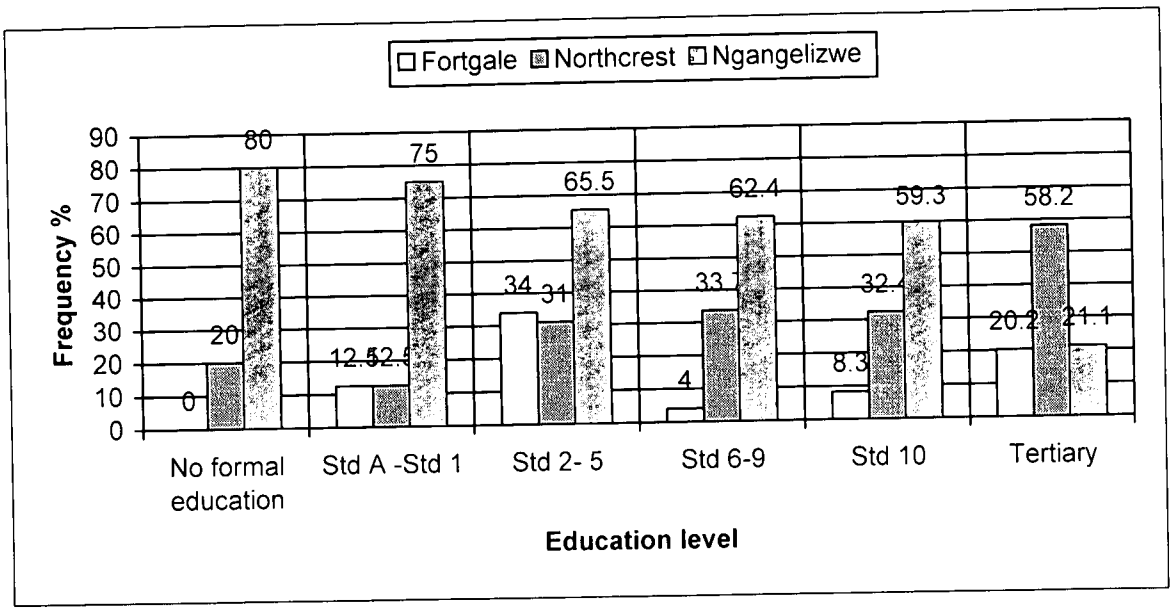


Figure 4.6: Relative distribution of educational qualifications amongst the three sites of study with different socio-economic status

It is clear from the results of this study that the overall education levels were low in areas with low socio-economic status and that a high level of inequality between different social status population groups existed. These findings are supported by those of 1995 national literacy survey in South Africa which found that 80% of Africans lacked basic literacy skills (DEAT, 1998). The recent 1996 census report revealed that only 6% of South Africans had tertiary education and 19% of those aged 20 years or more had never attended school (Statistics South Africa, 1998).

The Statistics South Africa (1998) regional educational profile of the Eastern Cape, showed that more than 20% of people aged 20 years and above have no schooling at all. About 21% have had some primary education, 9% completed primary education, 33% had secondary education, 11% were matriculants (grade 12) and 5% obtained tertiary qualifications. The findings of the current study were also found to be consistent with educational trends in developing countries, as reported below.

The analysis of education profile of the community is of paramount importance for two reasons. First, is that knowledge about educational status of the community is vital in assisting the service providers in developing strategies or programmes to enhance environmental education taking into account the low overall education levels of some sectors of the population. Second, is that level of education relates to attitudes towards solid waste service programmes.

This study found that the less educated people did not regard cleanliness as a priority issue. For instance, 51% of respondents in Ngangelizwe compared to 33.8% in Northcrest and 32% in Fortgale were having less regard for waste removal. When viewed from another angle, the same trend was observed, 68% of respondents in Fortgale, 66.2% in Northcrest, and 48.9% in Ngangelizwe were positive (had a high concern) about waste removal in their residential areas.

It was deduced from the results that, whilst other factors may contribute to negative attitudes, education is a critical factor which needs to be seriously considered in the planning of and in operating a solid waste programme. Education is significant for sustaining waste management programmes because people can only be convinced if they understand the messages they receive about improving their environments.

4.2.4 Position of respondents in the family and in the community

Scheinberg *et al.,* (1999) have reported that involvement in waste handling issues has to do with the status of the individual in his home or community where he belongs. Respondents in the surveyed households in Umtata were asked to state their status in their respective family (whether head, member, tenant and domestic assistant) in order to investigate possible links between status and role in waste handling in the homes of the respective communities (Appendix A, question 34). Their responses are shown in Figures 4.7 and 4.8 below. In Fortgale there were more respondents who were heads of families, whilst in Northcrest and Ngangelizwe a high proportion of respondents were other members of the family. This may influence the way residents have responded in the three areas.

When respondents were asked to indicate which structures or organisations including environmental groups they belonged to in their communities, results revealed that generally, the majority of respondents (with most from Fortgale and Northcrest) did not belong to any community structure within their residential areas, as shown in Figure 4.8 (page 84).

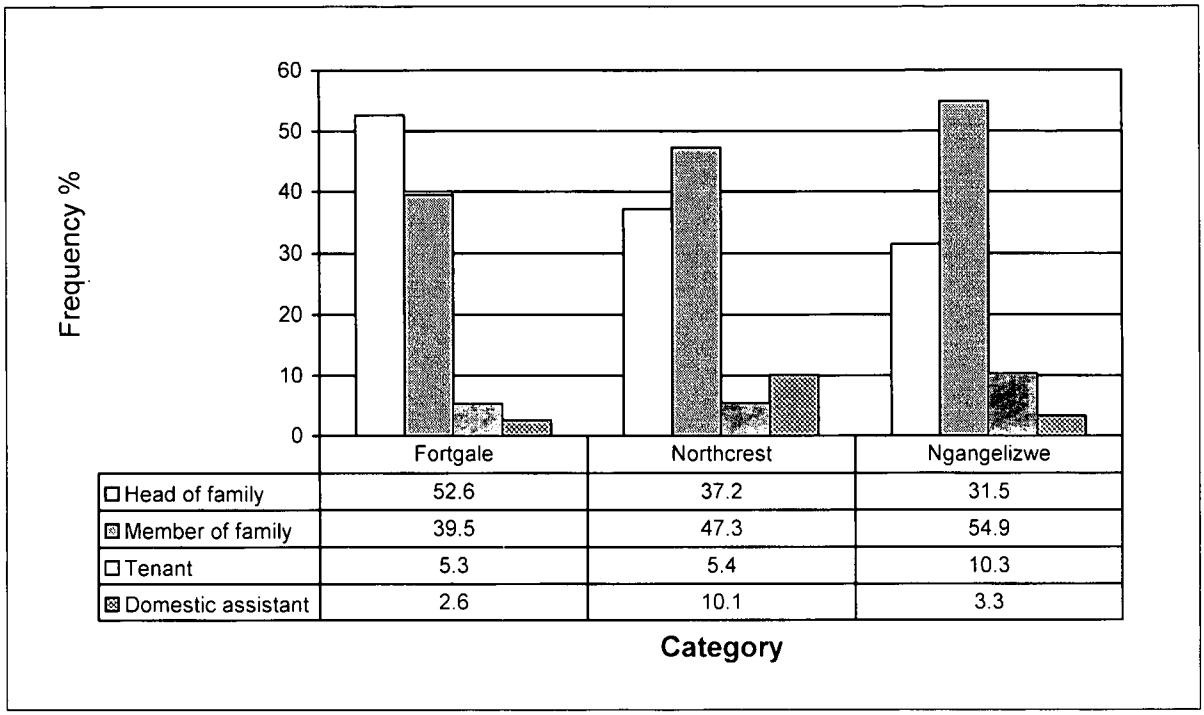


Figure 4.7: Position of respondents in their families in the surveyed households in Fortgale, Nothcrest and Ngangelizwe in Umtata during December 1998.

Ngangelizwe had three times more numbers of street committee members than in Fortgale, and double those in Northcrest. The differences in involvement in community structures or organisations were attributed to the past organisational arrangements in South Africa where a formal structure of governance in the townships was non-existent. As a result, communities mobilised themselves into informal structures such as street committees which they regarded as reliable and representative platforms to voice their concerns, and for planning and being briefed on social and service delivery issues. The identification and recognition of the existence of such community organisational arrangements are important in for example abating litter problems in residential areas (Mbande, 1998).

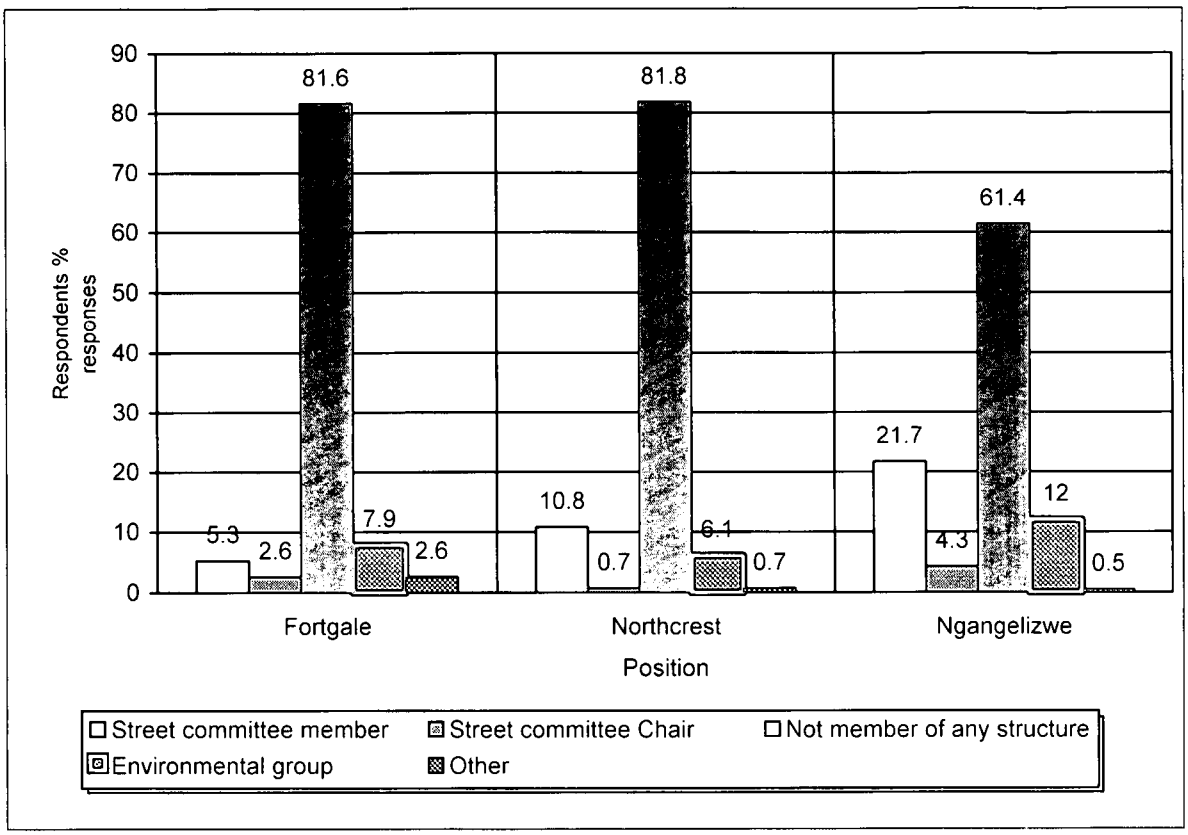


Figure 4.8: Position of households in the community per a household survey in Fortgale, Northcrest and Ngangelizwe in Umtata

The observations made in this study showed that the satisfaction of social needs relating to waste handling varied according to the social status of the population groups. Members from the low social groups preferred a more generally open and group orientated set-up. These people were more dependent on group meetings. On the other hand, residents from the middle and high social groups were more selective in their choices of belonging to groups. Hence the results of the study showed a relative increased number of respondents in Fortgale belonging to environmental groups rather than to street committees.

4.2.5 Employment and income status of households

Employment status of respondents was assessed (Appendix A, question 35). Employment status of the households receiving domestic solid waste services is an important indicator for the setting of service charges. Figure 4.9 exhibits employment of respondents in Fortgale, Northcrest and Ngangelizwe residential areas. The results reflected that the majority (30.8%) of all respondents was unemployed, followed by scholars (21.4%), professionals (17.3 %), and pensioners (10.3%). The rest of the respondents were found in other categories with the lowest percentage 0.5% of respondents doing part-time jobs.

Results showed that 50% of all unemployed respondents were from Ngangelizwe as depicted in Figure 4.9. Similarly, Shasha (1993) reported high unemployment in Ngangelizwe. Fortgale had on average a higher number of pensioners, professionals and business people. Most scholars were in Northcrest. The high unemployment rate could negatively impinge on solid waste management system in terms of ability to pay for the services. Unemployment is a good indicator to the local waste management authority to come up with appropriate community-based waste collection systems that could attract job opportunities for the local residents.

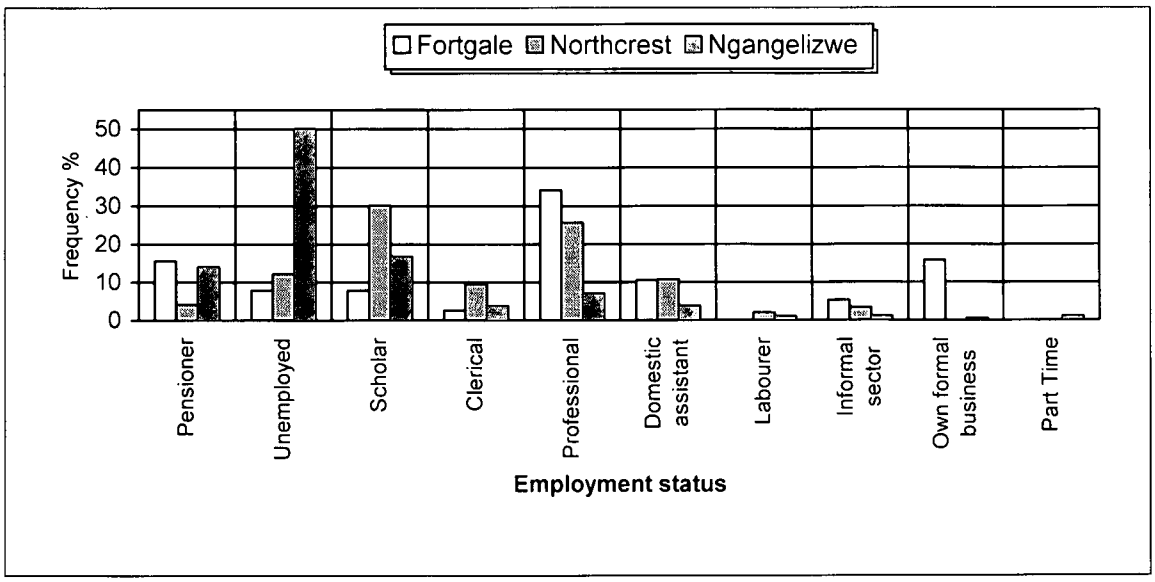
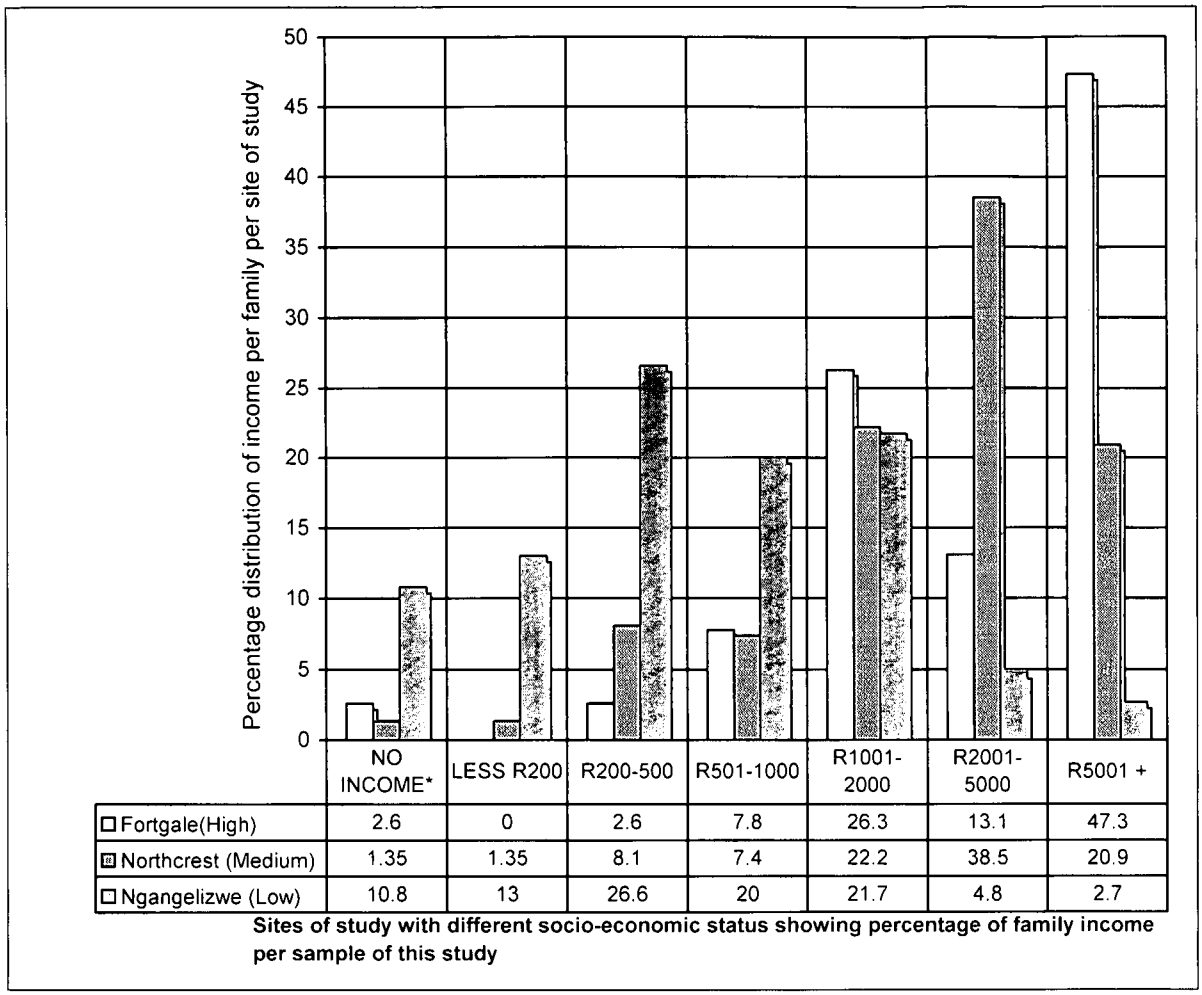


Figure 4.9: Employment distribution of respondents as per a household survey conducted in December 1998 in Fortgale, Northcrest and Ngangelizwe in Umtata (N-370)

The income status of both the respondents and households (families) was investigated as per (Appendix A, question 36). Primarily, income distribution in this study was limited to the household (family) income for two reasons. First, family income is a more accurate income-receiving unit than individual respondents income as propagated by Whiteford and McGrath, (1994). Second, this study assessed solid waste practices of households (families) therefore family income would be more appropriate in determining sources of income for different households. It is however, recognised that in interpreting data relating to family income, data could have been contaminated by people's natural reluctance to declare actual income and insufficient knowledge of respondents about actual income earned (for example scholars might not know what their parents or breadwinners earned).

The results of the individual respondents revealed that almost half (48%) of them indicated they did not earn an income. Ngangelizwe had the highest number of respondents (62.5%) with no specified source of income, against 0.5% of respondents who earned more than R5000.00. Contrary to this, Fortgale had the highest percentage of individual respondents (36.8%) who were earning more than R5000.00 per month against 10.5% of respondents who did no declare income.

Figure 4.10 shows the distribution of respondents' family income. Results indicated that the majority (26.6%) of respondents families in Ngangelizwe fell in the R200-R500 income category with a few families (21.7%) earning R1000-R2000 per month and the highest number (10.8%) of families with no income in the study area. Most families in Northcrest (38.5%) earned R2000-R5000 with only 1.35% of those with no specified source of income. Not surprisingly, in Fortgale (high income area) almost half of the respondents (47.3%) reported household incomes of more than R5000 per month.



Note: * No income refers to cases where income was not declared

Figure 4.10: Distribution of respondent's family income in Fortgale, Northcrest and Ngangelizwe in Umtata obtained by a household questionnaire survey in December 1998 (N-370).

Judging from the results of this study, there is enough evidence to suggest that there is a link between the distribution of income, unemployment, education, gender and the socio-economic status of a residential area. Such a link was attributed to the observations that the lower income households were concentrated in areas with low socio-economic status, a high rate of unemployment, poor education records and predominantly occupied by female residents.

The gap between incomes earned of black and white groups may also explain why most municipalities are still experiencing problems with regard to payment of services (Whiteford and McGrath, 1994). The resultant effect of income gap is the continued disruptions of solid waste management programmes due to non-payment for services. Therefore government, in particular local governments, should as a matter of urgency come up with alternative solutions to improve the economic state of the poverty-stricken residential areas. This requires a shift from short-lived quick solutions to lifelong solution plans that address the wealth of the communities so that they can realise improved living condition and enjoy better services. Knowledge about income distribution of households therefore serves as a fundamental indicator of inequality in society and is significant for planning sustainable waste management programmes, taking into consideration the differences in perceptions due to income disparity.

The effect of income on a number of waste management activities including the perception of respondents towards street cleansing, littering and payment of services was examined. Responses for each aspect are tabulated in Tables 4.2 and 4.3 below respectively. The results show that income does not seem to directly shape peoples' views on whether litter was a problem or not. The analysis showed that respondents who earned more reported that they were paying for services. At higher income level people seemed to be more concerned with waste issues, however, due to small percentage difference no strong conclusion with this issue could be made.

Therefore income influences how people regard street cleaning and littering. The literature documents that higher socio-economic groups highly regard environmental issues, including solid waste management (Viljoen *et al.*, 1987). Notwithstanding this premise, no conclusion of this nature could be made in this study. As mentioned in section 2.6 of Chapter Two (p24), the interrogation of the validity of this premise is beyond the scope of this study. Further study could assist in testing the validity of the observations made in the current study.

Table 4.2 Relationship between family income of respondents in Fortgale, Northcrest and Ngangelizwe in Umtata assessed in terms of attitude towards street cleansing and littering based on a household survey conducted in December 1998 (N-370)

VARIABLES				
Family income of Respondent per month	**Is street cleaning important or not?**		**Is litter a problem or not?**	
No income	Yes 14 (3.8%)	No 9 (2.4%)	Yes 11 (3.0%)	No 12 (3.2%)
Less R200	Yes 9 (2.4%)	No 17 (4.6%)	Yes 17 (4.6%)	No 9 (2.4%)
R200-R500	Yes 31(50%)	No 31 (50%)	Yes 41 (11.1%)	No 21 (5.7%)
R501-R1000	Yes 25(6.8%)	No 26 (7.0%)	Yes 39 (10.5%)	No 12 (3.2%)
R1001-R2000	Yes 48 (13%)	No 36 (9.7%)	Yes 53 (14.3%)	No 31 (8.4%)
R2001-R5000	Yes 49 (13.2%)	No 22 (5.9%)	Yes 55 (14.9%)	No 16 (4.3%)
R5000 +	Yes 38 (10.3%)	No 15 (4.1%)	Yes 39 (10.5%)	No 14 (3.8%)
Totals	Yes 214 (57.8%)	No 156 (42.2%)	Yes 255 (68.9%)	No 115 (31.1%)

Table 4.3: Responses to a household questionnaire survey in 1998 conducted in Fortgale, Northcrest and Ngangelizwe in Umtata to examine relationship between family income of respondents and perception of payment for solid waste services (N-370)

Family income of respondent per month	**Variable**	
	Are you for paying services?	
No income	Yes 10 (2.7%)	No 13 (3.5%)
Less R200	Yes 14 (3.8%)	No 12 (3.2%)
R200-R500	Yes 34 (9.2%)	No 28 (7.6%)
R501-R1000	Yes 27 (7.3%)	No 24 (6.5%)
R1001-R2000	Yes 63 (17%)	No 21 (5.7%)
R2001-R5000	Yes 62 (16.8%)	No 9 (2.4%)
R5000 +	Yes 48 (13%)	No 5 (1.4%)
Totals	Yes 258 (69.7%)	No 112 (30.3%)

An interesting discovery in the study was finding a sizeable proportion of zero income earning households reporting payment for services. This might mean that there was someone in the family who was earning some income in the form of old age pension as indicated by Whiteford and McGrath (1994). The zero income earners in 1991 census were also found to be predominantly Africans, had a female as the head of the household and were situated in rural areas. This information highlights the importance of understanding the social background of households when designing solid waste programmes in such communities.

4.2.6 Summary of key findings on demographics of households (Appendix A, questions 31-39)

This section has outlined the main demographic factors of households and their potential effect on the planning and operation of a domestic solid waste management system has been inferred. It has been noted that the demographic profile varied according to the socio-economic status of the community. It appears that for a domestic solid waste programme to succeed, it must accommodate a range of demograghic characteristics of the community to be serviced. These include age, gender, education, income, languages, and previous place of residence. By taking cognisance of the home languages of the communities they service, domestic solid waste managers will be able to use an appropriate medium of communication between the service provider and consumers.

Previous place of residence is important in curbing litter problems. The effect of people's movement between residences can be explained by Viljoen *et al.* (1987) and Bell's (1994) findings, that people from the rural areas are more likely to litter than urban residents. The latter group is however less likely to comply with litter regulations. This study found that over half (53.5%) of respondents had previously stayed in the same town, but in a different suburb. Notably, a link between the distribution of income, unemployment, education, gender and the socio-economic status of a residential household's area existed.

It was found that income of respondents did not seem to affect households' views on seeing litter as a problem and concern for street cleaning. It appeared as if women, particularly from the low social groups, played a more active role in the handling of waste management issues in the homes. This calls for the designing of gender sensitive solid waste service plans that are user friendly and convenient to the consumers. The less educated households had less regard for solid waste management issues. This situation was found in areas with low socio-economic status.

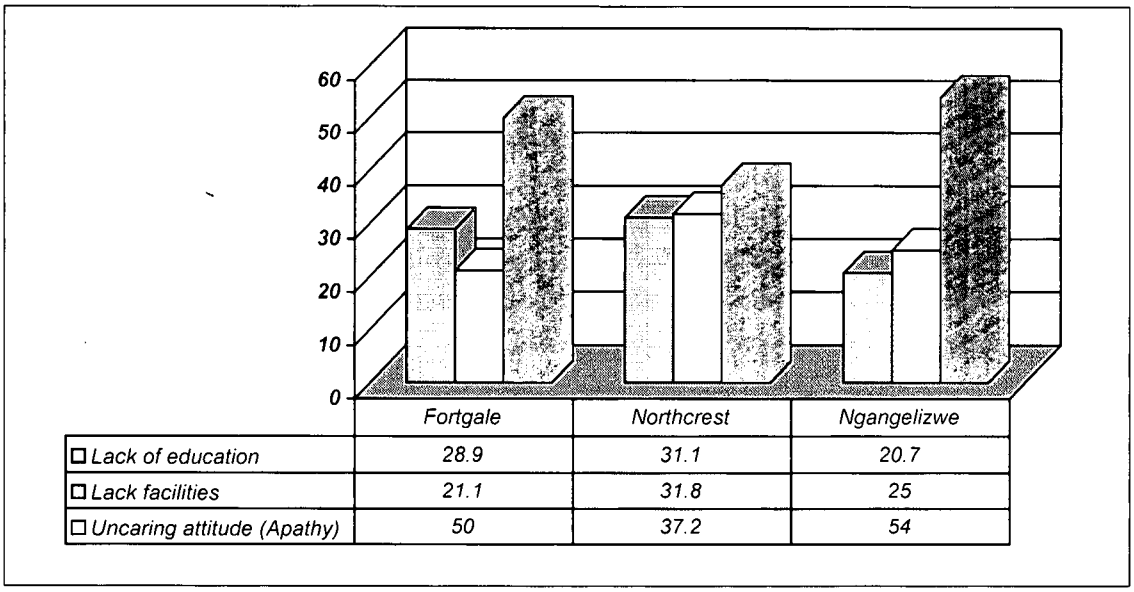
The next section provides a comparative analysis of attitudes and practices of households towards solid waste management.

4.3 A COMPARISON OF ATTITUDES, PERCEPTIONS AND PRACTICES OF HOUSEHOLDS TOWARDS KEY SOLID WASTE MANAGEMENT ISSUES

The aim of this section is to report and comment on the findings of the study on issues pertaining to street cleaning and litter control in the study area, based on an assessment of the views of residents about the hygienic state of their immediate environments. Attitudes and perceptions towards solid waste were investigated by questioning respondents about their understanding of why people litter and how they could contribute to minimising illegal dumping. The analysis of the overall responses of the sample revealed that a large proportion 68.9% (255) of respondents reported that littering was a problem, against 31.1% (115) who did not view littering as a problem. Among the reasons given for littering, all respondents rated an uncaring attitude (apathy) as the highest (47%) reason for littering. The relative distribution of the reasons for littering in the different socio-economic areas is shown in Figure 4.11 below.

Most respondents (82.2%) were of the opinion that residents were the main dumpers. About 75.7% of respondents regarded littering as an unacceptable practice while 37.3% felt that they did not litter because they paid rates. While the results clearly demonstrated that the majority of respondents reported a dislike for a littered environment, their actual behaviour was more difficult to assess.

The problem with littering is that people often report one thing and then do the opposite. For instance a littering survey conducted in Umtata in 1995 found that street vendors and transport operators were of the opinion that littering was not acceptable yet they were among the main perpetrators (Poswa, 1995).



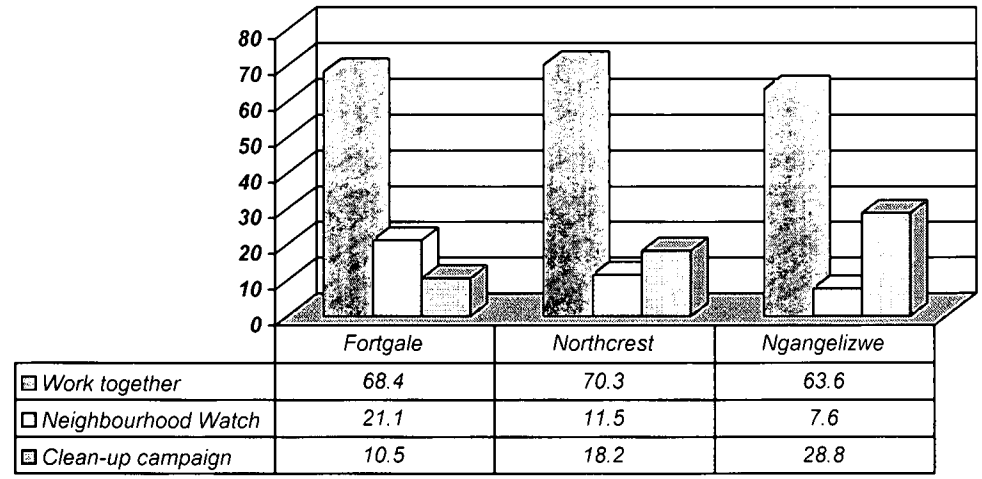
	Fortgale	Northcrest	Ngangelizwe
Lack of education	28.9	31.1	20.7
Lack facilities	21.1	31.8	25
Uncaring attitude (Apathy)	50	37.2	54

Figure 4.11: Main reasons given by respondents from Fortgale, Northcrest and Ngangelizwe as to why people litter, as obtained by a households questionnaire survey in December 1998.

Therefore, reported behaviour and attitudes towards littering should be verified by observing the actual behaviour and assessing the state of the environment in order to develop appropriate correctional measures. Solutions to littering problems were suggested during the survey. Respondents differed in opinion on how to curb littering and dumping. The responses are summarised in Figure 4.12 which shows that all respondents unanimously agreed that working together is the best feasible solution to curb littering and dumping problems.

Respondents however differed with regard to neighbourhood and clean-up campaign options. To this end, the Fortgale residents preferred the Neighbourhood Watch option, whilst a relatively high number of respondents from Northcrest and Ngangelizwe chose clean-up campaigns.

The choice of clean-up campaigns can be associated with the willingness of low social status groups to be involved and interact with other members of the community. The higher socio-economic status groups seemed to be unwilling to be involved in community activities and this could be linked to their tendency to pay someone to do the job for them. A simple illustration of this practice is the high number of domestic assistants and garden workers in areas of affluence.



	Fortgale	Northcrest	Ngangelizwe
Work together	68.4	70.3	63.6
Neighbourhood Watch	21.1	11.5	7.6
Clean-up campaign	10.5	18.2	28.8

Figure 4.12: Suggested solutions for curbing littering and dumping in residential areas obtained from Fortgale, Northcrest and Ngangelizwe by a household questionnaire survey conducted in December 1998 in Umtata (N-370)

In Australia, it has been shown that half of the people who had been observed littering within the previous five minutes reported not to have littered in the last 24 hours (Australian Beverage Industry Environment Council (BIEC), 2000). On the basis of findings on littering, it could be inferred that the denial syndrome often complicates the act of littering and dumping.

Other solutions offered include imposing of heavy fines for littering and dumping offences and refraining of residents from dumping waste in the nearby open spaces or alleys when cleaning their yards. Respondents advised that municipal workers should be trained in proper cleaning procedures and that they should stop dumping waste on street pavements when cleaning streets. Residents should be encouraged to report vehicles seen dumping to the Municipality for immediate action. Municipalities should set aside convenient waste disposal areas with containers for various waste materials. In order to probe the attitudes and perceptions towards waste in more detail, current domestic solid waste practices were examined. The focus was on the methods used for the storage and disposal of waste materials in households.

The most common methods used for storing waste at home in the study area are shown in Figure 4.13. It was found that refuse plastic bags (bin liners) were the most commonly used method. A few respondents reported that they were using refuse bins and a small number (0.3%) reported digging waste into pits in their yards. Of the 86.5% (320) respondents who used refuse plastic bags, 88% (162) were from Ngangelizwe, and 90.5% (134) and 91.2% (24) were from Northcrest and Fortgale respectively.

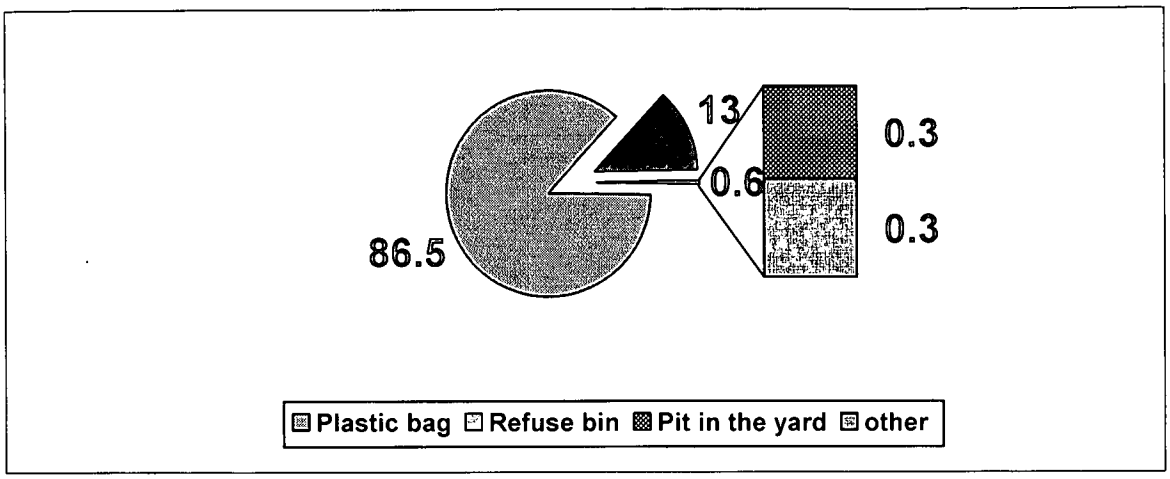


Figure 4.13: Most commonly used methods for storing waste at home in Fortgale, Northcrest and Ngangelizwe residential areas in Umtata, as per the household questionnaire survey conducted in December 1998

Respondents were asked to state methods they used to dispose of various types of waste materials. These were categorised in the survey as organic food waste, garden waste and sanitary pads and baby nappies for ease of analysis. It appeared that very little source separation of waste materials was taking place in the study area. The majority of residents (Figure 4.14) reported putting all waste materials like food (60%), garden waste (52%) and sanitary/baby nappies (61%) in the refuse bags for collection by the municipality.

The problem of mixing food waste and garden wastes with ordinary household solid waste is that organic waste (food waste) decomposes very quickly, especially during the summer season when temperatures are higher, resulting in increased vermin, in particular flies. Offensive smells are likely to result and could be exacerbated by poor waste collection frequency. This type of waste may also attract dogs when the refuse bags are put outside either for interim storage, especially when refuse bins are not used, or when placed on the street pavements for collection on the due dates. Tearing of refuse bags could lead to littering of the street.

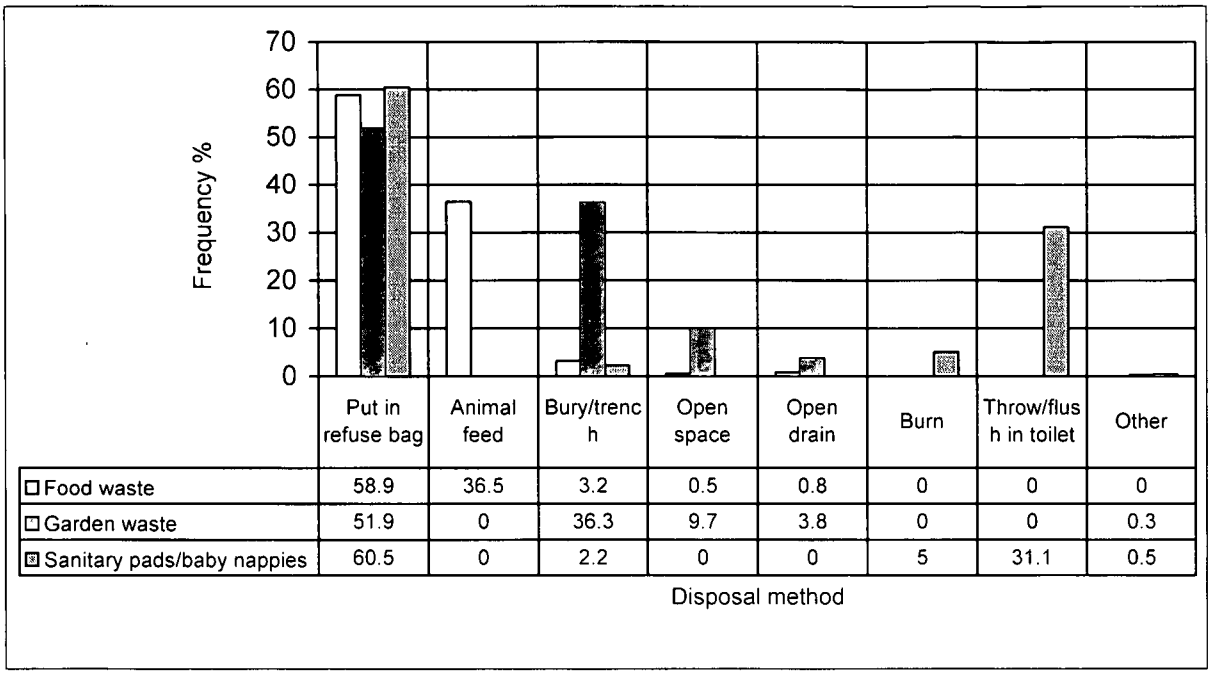


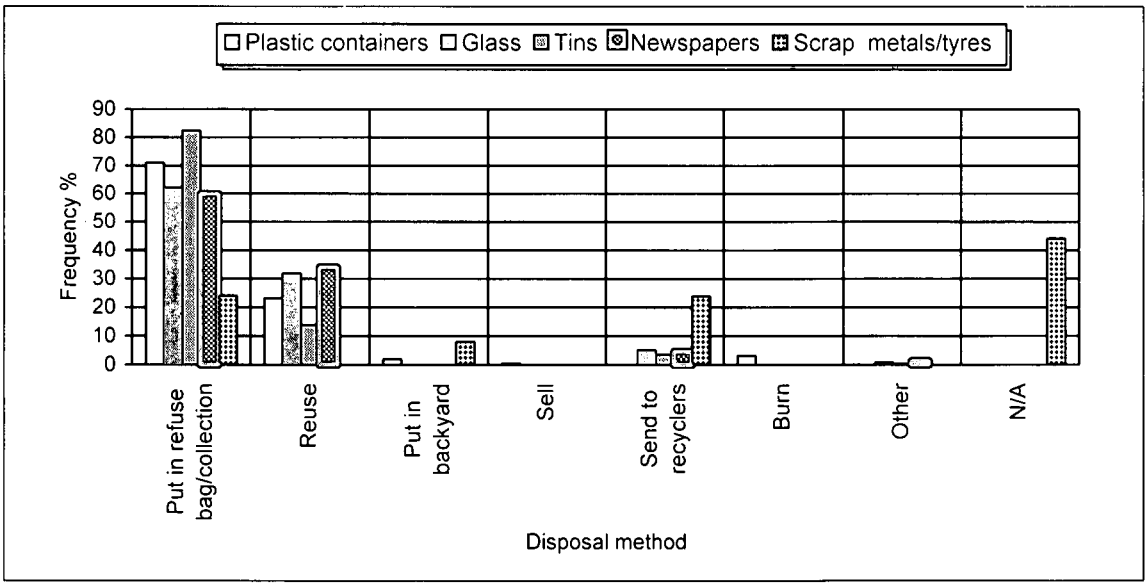
Figure 4.14: Disposal methods for organic waste (food, garden wastes) and sanitary disposables (baby nappies) in Fortgale, Northcrest and Ngangelizwe residential areas as reported in a household survey conducted in December 1998 (N-370)

The use of garden waste may be perceived as wasteful due to the volume of the waste in the bags and its non-compatibility with food waste. The combined effect of high food content and garden waste might increase the moisture content in the bags and accelerate the decomposition rate of waste pending collection, which in turn will lead to conditions as described above. The survey also revealed that other waste types for example sanitary pads are dealt with inappropriately. Over 30% of residents in the study area flushed sanitary disposables down toilet pans. This kind of practice might affect the operation of the sanitary system resulting in frequent blockages.

It was not possible to deduce whether increase in the disposal of sanitary disposables into toilet pans resulted in increased frequency of sewer blockages. It is possible that respondents did not know the causes of sewer blockages. The relevant parties to provide relevant information in this regard could be the drainage clearance personnel from the Municipality. The latter investigation was beyond the scope of this study.

Nonetheless, the disposal of waste materials in the toilet pans other than toilet tissues should be discouraged to prevent unnecessary problems. This kind of practice calls for awareness campaigns to enlighten residents about the consequences of certain behaviours and solid waste practices in the households.

The study intended to also assess the knowledge of residents about recycling in their households. A few examples of recyclable waste materials including plastic bags, glass, tins, newspapers and scrap metals were selected to determine disposal methods used in the study area. The methods of disposal served as indicators of current solid waste handling practices and the level of recycling in the homes. Figure 4.15 exhibits the disposal/recycling methods employed in households with respect to plastic containers, glass, tins, newspapers and scrap metals.



Note: N/A refers to a case where none of the mentioned disposal methods were applicable

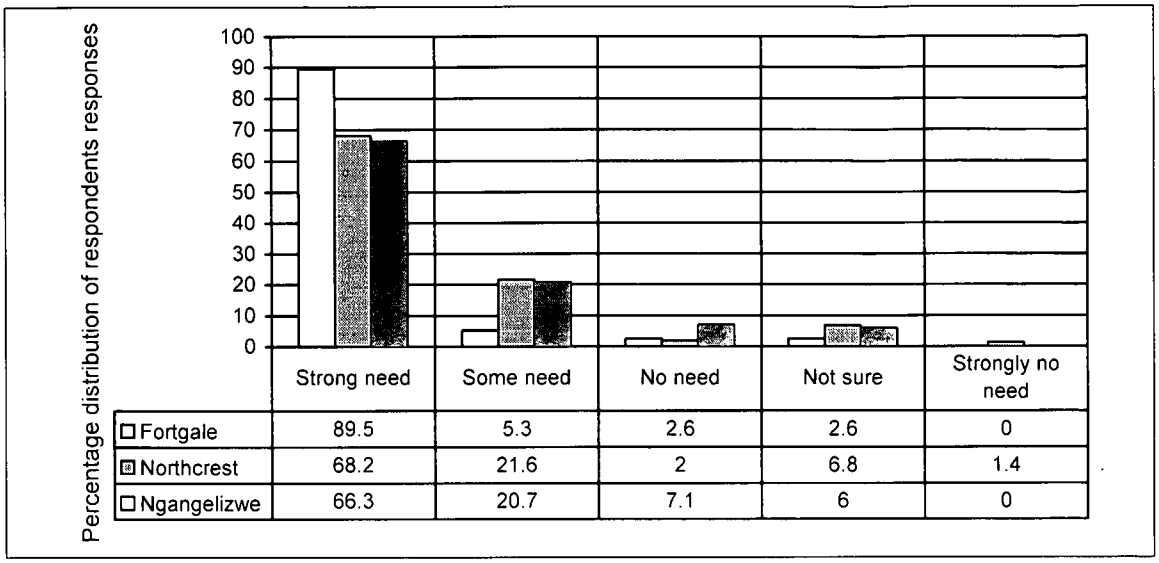
Figure 4.15: Methods reported by respondents as being used for the disposal of recyclable waste materials in Fortgale, Northcrest and Ngangelizwe residential areas as per a household survey conducted in December 1998

The results showed that the majority of residents in the study area put out almost every type of waste material including the recyclables like 71.1% plastics, 62.2% glass, 82.4% tins, 60% newspapers, 24.1% scrap metals. However, between 14% -35% of respondents reported that they were reusing plastic and glass items, tins and scrap metals where possible. It could be deduced from these results that there was little or no voluntary recycling (thus no waste minimisation) in the study area. The consequences thereof are probably an increased amount of waste generated with resultant increased costs of collection and possibly also increased littering.

This may explain why the Umtata Municipality finds it difficult to cope with the demand for waste collection when considering the continually increasing urban population (Poswa, 1997). One solution to this problem could be to make residents aware of the benefits of recycling goods such as glass, plastic and metal items which will have the added benefit of alleviating the much stretched resources of the Umtata Municipality.

Respondents were also requested to indicate how they felt about the establishment of a recycling programme as a measure for reducing waste generated. The outcome is summarised in Figure 4.16 below. The majority of respondents were positive about the establishment of a recycling programme throughout the study area with almost all the residents in favour of this representing the Fortgale community (90%).

This attitude was investigated further and revealed preferences for certain types of recycling programmes. Over half (55.3%) of the respondents most of whom were from Fortgale were in favour of a drop-off recycling centre. Northcrest and Ngangelizwe supported a door-to-door collection recycling programme. It appears that gender and socio-economic status of the community had an influence on the choice of a collection programme. The support for the door-to-door collection systems may be linked to the amount of time residents were prepared to spend on waste issues as reflected by the female respondents (section 4.2.2) and residents from the lower income communities of Northcrest and Ngangelizwe.



	Strong need	Some need	No need	Not sure	Strongly no need
Fortgale	89.5	5.3	2.6	2.6	0
Northcrest	68.2	21.6	2	6.8	1.4
Ngangelizwe	66.3	20.7	7.1	6	0

Figure 4.16: Views expressed by respondents in a household questionnaire survey conducted in Fortgale, Northcrest and Ngangelizwe residential areas in Umtata about the establishment of a recycling programme as a measure for reducing waste generated (N-370)

It was also noted that there was an association between the choice of a recycling programme and the willingness to pay for collection. For instance 60.5% of respondents from Fortgale indicated that they were not willing to pay for a door-to-door recycling programme. The support of a door-to-door option of waste collection was reflected in the willingness to pay (64%) for collection of waste materials in Ngangelizwe. However, mixed feelings were found in the case of the Northcrest respondents who indicated that they were willing to pay (47.3%) as shown in Table 4.4.

The variations in choice of types of recycling programmes could be attributed to, *inter alia*, the perception of how much a particular service would cost the individual. For example, the drop-off centre was chosen on the understanding that it would minimise the payments for collection services and hence unwillingness to pay for collection was reported. Further, it is possible that those who chose a door-to-door collection system found this method convenient and were familiar with it. It is also possible that the drop-off centre was not chosen due to a lack of knowledge about how it would function in the particular community.

Table 4.4: Responses of respondents for a preferred type of a recycling programme showing a link between preference of a waste collection system and willingness to pay for collection services as illustrated in a household survey conducted during December 1998 in Fortgale, Northcrest and Ngangelizwe residential areas in Umtata (N-370)

Preferred type of waste collection	Site of Study						Total
	Fortgale		Northcrest		Ngangelizwe		
(a) Drop-off centre	Yes	**55.3**	Yes	34.5	Yes	21.7	
	No	44.7	No	**54.7**	No	**73.9**	
	N/A	0	N/A	10.8	N/A	4.3	
		100		100		100	100%
(b) Door-to-door collection	Yes	42.1	Yes	**54.7**	Yes	**75**	
	No	**57.9**	No	36.5	No	22.3	
	N/A	0	N/A	8.8	N/A	2.7	
		100		100		100	100%
Willingness to pay for collection services linked to the choice of a type of waste collection in (a) or (b) above	Yes	39.1	Yes	**47.3**	Yes	**64.1**	
	No	**60.5**	No	43.9	No	33.7	
	N/A	0	N/A	8.8	N/A	2.2	
		100		100		100	100%
Total N	**38**		**148**		**184**		**370**

When respondents overall were asked who should be in charge of the recycling programme, 55.9% stated that the programme should be under the control of the local authority. The rest of the respondents indicated that they would prefer other parties to be in control with 24% in favour of a community structure, 12.2% opted for Non-Government Organisations (NGOs) and the least favoured party was the business sector (7%). Only one respondent (0.3%) wanted a women's group to manage the programme.

These responses indicated that the local authority as the credible regulatory and political body closest to the communities should initiate waste minimisation programmes for the communities within its jurisdiction. However, the local authority should work together with the communities in an attempt to address recycling. It could be inferred from the results that the emergence of community structures as a second choice to the local authority indicates the will of consumers for the shifting of responsibility from local government (municipality) as the sole provider and controller of services to a citizen-orientated management approach where community participation and sharing of responsibilities are promoted. This observation concurs with the suggestions of Theron (1999) that local authorities should leave waste recovery to the communities and play a monitoring role.

This is in line with the provisions of the South African National Waste Management Strategy (NWMS). The NWMS action plans for waste minimisation and recycling provide for local government departments, together with other role players, to share the duty of ensuring the allocation of responsibilities and resources for the effective management and implementation of environmental issues, including waste minimisation and recycling (DEAT and DWAF, 1999). It might be inferred that the perceived role of the private sector is not in management but might be for the funding of projects. This can further be explained by the Public Private Partnerships (PPPs) approach whereby waste collection is contracted or franchised out to the private sector (Theron, 1999).

The influence of the PPP towards community perceptions regarding waste practices cannot be ruled out, especially if the involvement of the private sector is associated with financial benefits for the participating communities and local authorities. However, the development of waste management programmes should be based on the needs of the community but, not as short-lived interventions to improve sour relationships between the service provider and service recipients. As pointed out by Theron (1999), a recycling programme should always be designed to ensure social upliftment and job creation opportunities while improving the state of the environment.

4.4 PERCEPTION OF RESPONDENTS TOWARDS SOLID WASTE MANAGEMENT SERVICE DELIVERY

The aim of this section is to examine the current views of households about the existing solid waste management service delivery in the study area. The enquiry aimed to determine the responsible party for domestic solid waste management collection services; frequency of collection; perception of residents about the municipal refuse collection service and payment or non-payment for municipal services. Relationships between these factors were investigated.

From the list provided in the questionnaire (Appendix A, question 26), respondents were asked which of the following was responsible for the waste collection in their area: municipality; private contractor/person self or other. Most respondents (91.4%) indicated that the municipality was the local authority responsible for all domestic solid waste collection and disposal services in the study area. A few (7.6%) respondents mentioned a private contractor which appeared to be a community-funded street cleansing project in Ngangelizwe. The low percentage (1.1%) self collection reported was unexplained.

When respondents were further requested to indicate the frequency of municipal domestic collection in their areas (Question 27), the survey revealed that Fortgale and Northcrest received once a week domestic waste collection services while Ngangelizwe received a twice weekly collection service.

It appeared that Ngangelizwe had received funds for social upliftment from a number of sponsors, including the National Department of Public Works (1996) and the Premier's Office of the Eastern Cape (1997). The funding was specifically given to address the solid waste management issues. Funds were spent on purchasing trucks and other implements, and hiring community members for street cleansing and waste collection in conjuction with the local authority. Due to its high population density, the collection frequency was increased from once per week to twice a week during the project period. The community project was still in operation during the execution of this study.

Respondents were also asked to express their personal opinions about the municipal collection services (Question 28). The purpose of this assessment was to determine how they felt about the current domestic solid waste collection services. Approximately half (48.9% or 181) of all respondents were of the opinion that the municipal collection programme was good. However, 28.1% (103) felt that the programme was poor and 18.6% (70) expressed concerns about its poor management while less than 5% (16) were not sure.

On the basis of these results it was evident that the current municipal solid waste service programme still enjoyed the support of most residents. However, it was noted that not all residents paid for services, although they were required to do so. The survey results depicted in Table 4.5 revealed that about 14% of surveyed households in Fortgale, 10.2% in Northcrest and 50% in Ngangelizwe were not paying for services. This phenomenon could probably be linked to the economic status of the households.

Table 4.5: The payment status for municipal services (including solid waste) in selected households in Fortgale, Northcrest and Ngangelizwe in Umtata as per questionnnaire responses of a household survey conducted in December 1998.

Site of study		**Service payment status/ Area**		**% Sample Size**
		Paying	Not paying	
Fortgale	N - 38	86.4%	13.6 %	10.3%
Northcrest	N - 148	89.8%	10.2%	40%
Ngangelizwe	N - 184	50%	50%	49.7%

Table 4.5 above shows that the majority of respondents in the study area paid municipal services against the few who did not pay. Residents from Fortgale and Northcrest tended to pay municipal services including waste management services unlike those from the lower socio-economic residential areas such as Ngangelizwe. This could probably be explained by affordability of services and the residents' perceptions about the waste services.

Further, it was found that most residents in the study area, (the majority of whom came from middle and high income socio-economic areas) felt that it was necessary to pay for services, whilst a relatively small number of residents saw no reason for paying (Table 4.6). Few residents paid for services as part of their rent. The amount of payment for services varied between Fortgale, Nothcrest and Ngangelizwe. This may be because people residing in higher income areas traditionally paid for services and would therefore be more likely to complain about environmental problems, while people from lower income areas, would tend not to register complaints and would regard other issues such as employment and housing as problems to be concerned about (Viljoen, *et al.*, 1987). The frequency of collection did not appear to influence payment for services.

Table 4.6: Reasons given by respondents for paying for services in a household survey conducted in December 1998 in Fortgale, Northcrest and Ngangelizwe residential areas, Umtata

Site of study		Reasons for Paying Services			% Sample Size
		*Service necessity	No reason	Part of rent	
Fortgale	N –38	71%	26%	3%	10.3%
Northcrest	N - 148	85%	14%	2%	40%
Ngangelizwe	N - 184	45%	45%	10%	49.7%

Note: * Service necessity refers to a situation when residents feel responsible & obliged to pay services

4.5 SUMMARY OF MAIN POINTS

This section has highlighted the perceived views of households on littering and the hygienic state of their environments. Households across the study area rated the uncaring attitudes (apathy) as the main reason why people litter. The majority of respondents expressed dislike for littering and regarded it as an unacceptable practice. They also pointed out that they themselves as residents were the main dumpers. Respondents unanimously agreed that working together was the best possible way of curbing littering and illegal dumping.

Respondents expressed different views regarding clean-up campaigns. Those from the low and middle socio-economic areas preferred to have clean-up campaigns, but the high social status respondents chose a Neighbourhood Watch System. The preference for clean-up campaigns was typical of low social groups who believe in interaction with each other, unlike residents from the more affluent society. When a need arises for the affluent members of the society to be involved in community activities, it is common practice to rather hire the services of someone to act on their behalf, like a domestic assistant or a garden worker.

The conventional bin liners (refuse plastic bags) were the popularly used storage method for solid waste in the homes. There was no source separation mechanism in place and as result, residents put out almost all waste materials in the refuse bags for collection. Respondents overwhelmingly welcomed the idea of establishing a recycling programme. However, they differed on the support of a recycling programme. Notably, the door-to-door collection was supported by the low and middle social status groups against a drop-off centre by the affluent groups.

Half of all respondents were of the opinion that the municipality solid waste collection service was good. An insignificant number expressed the opinion that the programme was adequate but poorly managed. The payment for services amongst the different sites of study varied according to the socio-economic status of the communities. A greater number of non-payers was found in the lower social status suburbs. Reasons given by those who paid for services was that this was a necessity for sustainable development.

In the next chapter the waste generation and composition patterns of the households are discussed from a socio-economic perspective. The impact of the demographic characteristics and the solid waste practices of households presented in this Chapter 4 will be examined.

CHAPTER FIVE

UMTATA DOMESTIC SOLID WASTE STREAM ASSESSMENT

5.1 INTRODUCTION

Literature has shown that estimating waste quantities and composition should be the first task in any local waste management study (Rhyner *et al.,* 1995). It has also been noted that the characteristics and composition of municipal solid waste vary from area to area due to their direct link to the societal customs and living standards of residents (UNESCO, 1996). It is for this reason that it is difficult to present precise general values on waste generation and composition rates. Instead, existing developmental, population and socio-economic trends are used to estimate waste quantities and characteristics of a waste stream in an area. Hence, various authors in the field of waste management have stressed the need for each local authority to collect data on the generation, weight and volume of wastes in its own area of operation (Flintoff, 1984; UNESCO, 1996).

Previous waste management studies conducted in Umtata had shown that there were no data on waste generation and composition for commercial and household waste in the area (Poswa, 1997; 1998). Therefore, the need for a waste generation and composition audit was evident for the purpose of this study. A solid waste generation and composition audit was conducted in Fortgale, Northcrest and Ngangelizwe by measuring wastes from randomly selected households to obtain weights (quantities) and physical characteristics (composition). This chapter presents findings regarding domestic waste generation and composition for Fortgale, Northcrest and Ngangelizwe in Umtata. The effects of the socio-economic status of the community on the generation and composition of waste were examined in order to establish how solid waste was managed in households. Reference is made to similar studies in other South African and international cases as a basis for interpretation of the results.

5.2 DOMESTIC SOLID WASTE GENERATION

The domestic waste generation data presented in this section were based on a sample size of 370 households proportionally distributed in Fortgale, Northcrest and Ngangelizwe. It is known that, generally, a significant portion (which unfortunately cannot be quantified) of domestic waste is either burnt or dumped and thus does not enter the waste stream, therefore the waste collected for assessment in this study only represented a proportion of generated waste in Fortgale, Northcrest and Ngangelizwe. A direct waste stream measuring method was used in the waste audit. Waste representing an amount generated by each family per week was picked up from each randomly selected household by a special vehicle and transported to Umtata Municipal Cleansing depot where it was analysed by measuring each waste bag using a battery operated scale to obtain weight. The content of each plastic bag was emptied onto a canvas sheet laid on a flat surface to sort it into the required constituents such as vegetables/organic, paper/cardboard, glass, metals, plastic, bones, ash/dust/soil, and textile/clothing as per Part B of the questionnaire (section 3.6.1, Chapter three).

Waste generation for each family per week was calculated for Fortgale, Northcrest and Ngangelizwe. The calculations entailed dividing the total weight of waste generated in each residential area by the number of families included in the survey (details of number of families, people, households/stands, families and waste quantities for Fortgale, Northcrest and Ngangelizwe are shown in Table 5.2). The total amount of waste generated per week in Fortgale, Northcrest and Ngangelizwe was divided by the number of people in the area per household and then divided by seven to obtain data on waste generation by each person per day per residential unit.

The results of the waste analysis in the study area (summarised in Figure 5.1 below) showed great variations of weekly family waste generation and per capita per day household generation rates for Fortgale, Northcrest and Ngangelizwe. The waste generation rate ranged from as little as 0.08kg, to as much as 0.4kg per person per day, as shown in Figure 5.1.

It was notable that Fortgale's rate was double that of Northcrest and seven times more than that of Ngangelizwe. These results reflect the influence of socio-economic status of households on waste generation. These findings concurred with those of Mayet (1993), who reported that there was a strong relationship between the amount of waste generated by a community and its demographic characteristics. He added that the highest per capita generation was found in high income level areas and the lowest per capita generation was in the low income level areas.

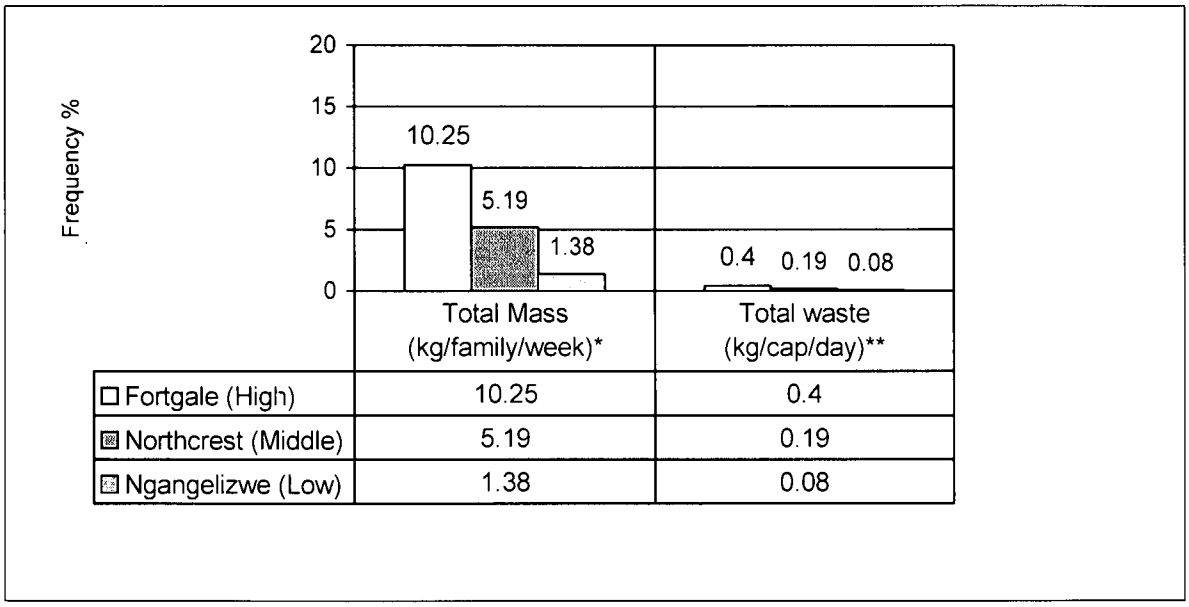


Figure 5.1: Domestic waste generation rate for Fortgale, Northcrest and Ngangelizwe residential areas in Umtata calculated based on 370 samples of a household waste generation and composition survey conducted in July 1998. *Total mass (waste in kg) per family per week) for each area was obtained by dividing the total amount of waste generated by the total number of families in the area (Detailed explanation in page 114-115).

**Per capita waste generation per day was obtained by dividing the total waste generated in the area by the number of surveyed persons per this study survey, then divided by seven (Detailed explanation in page 114-115).

Again, studies conducted in various developing communities in South Africa have shown distinct waste disposal patterns between suburbs with different socio-economic statuses (WRC, 1995). It is well documented in the literature that wealthier communities tend to be 'throw-away-societies', whilst the poor ones have less to throw away and are more inclined to reuse and refurbish articles that a wealthier community would discard (Blight and Mbande, 1994). Comparative data to illustrate common trends in waste generation are presented in Table 5.1 below.

Table 5.1: The per capita waste generation findings of this study in Fortgale, Northcrest and Ngangelizwe in Umtata were compared with similar studies in Durban, East London, and international waste generation trends to illustrate patterns of waste generation variations in developing communities due to different geographic areas and the socio-economic status of communities.

	[1]Durban	[2]East London	[3]Umtata	[4]Waste Consultant SA (1993)	[5]International trends
	Waste generation (kg/cap/day)	Waste generation (kg/cap/day)	Waste generation (kg/cap/day)	Waste generation (kg/cap/day)	Waste generation (kg/cap/day)
High	1.2 – 2	0.35	0.4	0.8	0.7 –1.8
Middle	1.2 – 1.6	0.19	0.19	0.5	0.5 – 0.9
Poor (low)	0.19 – 2	0.19	0.08	0.2	0.4 – 0.6

Source: [1]. Mayet (1993), cited by Blight and Mbande (1994) a study conducted in the urban core of Durban functional region (figures converted from tonnes per year to kg); [2.] Mbande (1999) a waste generation and composition study in Mzomhle (site and service) Mdantsane (formal) and Duncan Village (informal); [3.] Waste audit conducted for this study in Fortgale, Northcrest and Ngangelizwe (1998); [4]Lombard (1993) a waste classification table developed as a guide for calculating waste generation and [5.] UNESCO (1996) patterns of waste generation for low, middle and high income countries

Data in Table 5.1 indicate that the waste generation rate in Umtata was typical of developing communities. For example, both per capita waste generation rates in East London and Durban (South African examples) follow the same pattern as in Umtata in that they vary according to the socio-economic status of the community. The low income areas have low per capita waste generation rates in relation to the high rates in higher income areas. The same trend can be observed with regard to international waste generation rates of developing countries as depicted in column 6 of Table 5.1. The per capita waste generation variations for this study (column 4 of Table 5.1) show that the waste generation rate was unique in each residential area within the same town. This supports the argument that waste quantities can be expected to vary from one generation point to the other according to different living standards which are linked to the income levels of households.

Research has shown that the domestic per capita waste generation rate is also influenced by the number of residents per household (Pfeffer, 1992). To this end, studies conducted in the USA to assess domestic waste generation rates indicated a fall in per capita values from 1.25kg/day for two residents to 0.4 kg/day for ten residents. The increase in waste is therefore not in proportion to the increase in the number of residents. The relationship according to Pfeffer (1992) and UNESCO (1996) showed that the rate of reduction was most rapid between two and five residents, after which the rate decreased and was virtually independent of the number of residents when the number exceeded ten.

Pfeffer (1992) associated the variations of waste quantity among individual households to an economy scale in the purchase of food and beverage items. A large family will probably purchase these items in large containers while newspapers and other print items decrease significantly with increasing size of residents per unit. The cause for this trend is that only one newspaper/magazine is needed per household. This is however, culture-dependent. It appears that the same pattern is applicable in the case study in Umtata as shown by the data in Table 5.2, where the number of persons per stand was high in Ngangelizwe compared to the other two areas, but the amount of waste showed an inverse proportion.

The quantities of waste generated by weight in Fortgale, Northcrest and Ngangelizwe are given in Table 5.2 below and a more detailed breakdown of the waste quantities for each waste component (constituent) is presented in Table 5.3. The amount of waste generated from Fortgale constituted 19% by mass of the total waste generated in the study area whilst that from Northcrest constituted 43% by mass and Ngangelizwe, 38% by mass of the total waste respectively. Northcrest represented the bulk of waste generated in the study area although it had been expected that Ngangelizwe would generate more waste than Fortgale and Northcrest, considering the greater sample size and population. It is therefore argued that the variation in waste quantities between Fortgale, Northcrest and Ngangelizwe can be ascribed to the influence of socio-economic status of the community as explained above.

Table 5.2: Data reflecting waste quantities by weight, volume per week, number of families and stands (households) and total number of people in the surveyed households in Fortgale, Northcrest and Ngangelizwe residential areas in Umtata obtained through a household waste survey in July and December 1998.

Category	Fortgale	Northcrest	Ngangelizwe
Total waste (kg/week)	**533.04**	**1238.09**	**1084.43**
No. of stands	38	148	184
kg/family/week	10.25	5.194	1.38
No. of families	52	240	783
No. of people	207	910	2023
Volume/week (m^3)	0.21	0.09	0.07
Waste/person/day (kg/cap/day)	0.4	0.19	0.08

Note: Data in this Table is not standardised

It can be observed from the data presented in Table 5.3 that organic waste constituted the highest component by weight in relation to all other waste constituents measured in the study area. Specific information on waste quantities serves as an indicator for developing a cost-effective collection system in that a solid waste management authority could project waste transport needs and disposal patterns in each urban residential area. For example, when significant increases in the quantity of waste occur, additional vehicles are needed or overtime work is required (Pfeffer, 1992).

This increases the cost of operating a solid waste system. Any solid waste collection and disposal system must therefore be designed to cope with the changing quantities and composition of waste. Decisions on the choice of appropriate transport based on waste generation should however take into consideration the continually changing factors, such as the level of service; seasonal changes; changes in consumer behaviour and standard of living of the community.

Table 5.3: Domestic solid waste generated from Fortgale, Northcrest and Ngangelizwe residential areas showing exact quantities of each waste component measured in the household waste survey in Umtata in July 1998. Figures in brackets denote the sample size per area

Waste component	Fortgale (N-38)	Northcrest (N-148)	Ngangelizwe (N-184)
Veg/Organics	240.1	288.92	165.75
Paper/ cardboard	110.45	252.54	104.5
Glass	77.1	147.2	35.52
Metals	28.65	44.68	29.55
Plastics	56.44	127.05	109.96
Bones	0.05	4.9	6.70
Ash/dust	14.15	7.955	46.23
Textile/cloth	5.15	11.705	13.04
Total waste (kg/week)	**533.04**	**1238.09**	**1084.43**
Bulk density (kg/m^3)	**68**	**97**	**83**

Note: Data in this Table is not standardised

Waste generation estimates were made for Umtata based on the data presented above. Calculations were based on population figures obtained from 1996 census statistics. The 1996 census population estimates reflected surprisingly lower population figures of about 54 000 people than the expected figure of over 100 000 people. To accommodate this concern, calculations for projected waste generation for 100 000 people are also reported.

The general estimated daily, weekly and annual household waste generation rates for Fortgale, Northcrest and Ngangelizwe were calculated in kilograms and in metric tonnes as reported in Table 5.4. The area population figures from the 1996 census were multiplied by the known waste generation rate per person per day earlier reported in Table 5.2 to get a total area household waste generation in kilograms per day for Fortgale, Northcrest and Ngangelizwe. The total area household waste generation rate was then multiplied by 7 to get the total household waste generation data per week (kg/week) and further multiplied by 52 to get an annual total household waste generation per year (kg/year). This annual figure was then divided by 1000 to get a tonnage waste generated per year. The annual tonnage figure was further divided by 52 to get waste generated per week in tonnes and divided by 7 for a weekly tonnage waste generated. An average area waste generated per capita per day in kilogrammes for each area was calculated by dividing the total household waste generation in tonnes by the area population, which was then divided by 1000 to convert into kilogrammes.

Results indicated that about 12, 8, and 15 metric tonnes of waste is generated weekly in Fortgale, Northcrest and Ngangelizwe respectively. It was deemed necessary to make further calculations of waste generation estimates for the greater Umtata residential suburbs that were excluded from the survey. For ease of calculation, the additional areas were assumed to be having similar status and grouped into three categories to derive a more realistic estimate of the waste quantities. The results are shown in Table 5.5.

It appeared from the results that solid waste generation varied widely from area to area within the same town. This finding reinforces the need for periodic undertaking of waste generation measurements. Such undertakings should be based on economic and population projections and existing trends. Average estimates are not sufficient because of variations with regard to the social status of the community, and different income and lifestyle levels within a given community (UNESCO, 1996). This waste survey has shown that waste generation increases proportionally with increasing levels of income.

Table 5.4: Domestic waste generation estimates for Fortgale, Northcrest and Ngangelizwe residential areas in Umtata calculated during a household waste generation and composition survey conducted in July 1998. Calculations were based on 1996 census population figures, while area waste generation per capita per day was derived from this study.

Categories	**Fortgale** pop. per SA 1996 Census	**Northcrest** pop. per SA 1996 Census	**Ngangelizwe** pop. per SA 1996 Census	**Total**
Population	*4180	*5917	*26007	**36 104**
(a) Total household waste/day **(kg/day)**	1672	1124.23	2080.56	**4876.79**
(b) Total household waste/week **(kg/week)**	11704	7869.61	14563.92	**34137.53**
(c) Total household waste/year **(kg/year)**	608608	409219.72	757323.84	**1775151.56**
(d) Total household waste/tonnes/year **(tonnes/year)**	608.608	409.219	757.323	**1775.13**
(e) Total household waste/tonnes/week **(tonnes/week)**	11.704	7.869	14.563	**34.12**
(f) Total household waste/tonnes/day **(tonnes/day)**	1.672	1.124	2.080	**4.876**
(g) Average kg/cap/day	0.4	0.19	0.08	**0.67**

Note **Population figures have been weighted by population based on 1996 Census estimates for Fortgale, Northcrest and Ngangelizwe*

Table 5.5: Domestic solid waste generation projections for formal and informal residential areas in the Greater Umtata, including those sampled for this study calculated in July 1998. Areas assummed to be having similar socio-economic status were grouped as high income (Fortgale group), middle income (Northcrest group) and low income (Ngangelizwe group). The 1996 Census population figures were used and per capita waste generation rates for Fortgale, Northcrest and Ngangelizwe residential areas were used to calculate total waste generation rates.

Categories	**High socio-economic status areas**	**Middle socio-economic status areas**	**Low socio-economic Status areas**	***Informal residential areas**
	Fortgale, Southridge Park, Southernwood	Northcrest, Norwood, Hillcrest	Ngangelizwe, Waterfall Park, Mbuqe	Mandela Park,Chris Hani, Pola Park
Population	**8815	**10892	**28374	**5815
(a) Total household waste/day **(kg/day)**	3526	2069.48	2269.92	465.2
(b) Total household waste/week **(kg/week)**	24684	1186.36	15889.44	3256.4
(c) Total household waste/year **(kg/year)**	1283464	753290.72	826250.88	169332.8
(d) Total household waste/tonnes/year **(tonnes/year)**	1283.46	753.29	826.25	169.33
(e) Total household waste/tonnes/week **(tonnes/week)**	24.68	14.48	15.88	3.25
(f) Total household waste/tonnes/day **(tonnes/day)**	3.52	2.07	2.26	0.46
(g) Average kg/cap/day	0.4	0.19	0.08	0.08

Notes **Informal areas were at the time of this survey not receiving any municipal collection services but were part of the Greater Umtata, and their per capita waste generation was assumed to be the same as that of Ngangelizwe.*

***Population estimates obtained from 1996 Census estimates*

5.3 DOMESTIC SOLID WASTE COMPOSITION

Additional to determining waste quantities, it was essential to further determine the waste composition of waste generated in the area of study. Through waste composition analysis, the waste manager is able to identify the major constituents of the waste stream. Waste composition information is useful in illustrating the variations of waste stream from one urban centre, such as a residential area to another, from local, regional, national and international perspectives (Rhyner *et al.*, 1995). A breakdown of the waste stream from the study area is shown in Table 5.6.

Due to time, financial and human resources constraints, waste composition analysis was performed on 232 waste samples, unlike the 370 samples for waste generation reported in section 5.2 above. The waste composition sample size constituted 63% of the final sample size of the study (370). This sample consisted of 38 households from Fortgale, 97 samples from Northcrest and 97 samples from Ngangelizwe as can be seen in Table 5.6 below. The samples accounted for 10.3%, 66% and 53% of the sampled population in these areas respectively. The reduction in the sample size for waste composition in Northcrest and Ngangelizwe did not cause any significant change in the volume and density of waste generated. For instance in Northcrest the volume per week slightly changed from $0.09m^3$ to $0.08m^3$ and the density from $97kg/m^3$ to $101kg/m^3$. There was no volume change in the waste from Ngangelizwe, but a slight reduction in density from 83 kg/m^3 to 80 kg/m^3 was observed.

Table 5.6: The composition of waste from Fortgale, Northcrest and Ngangelizwe residential areas in Umtata expressed as percentages by weight (kg) for each waste category. These were measured during a household waste survey conducted in July 1998. Figures in brackets denote sample size per area.

Waste component	Fortgale (N-38)	Northcrest (N-97)	Ngangelizwe (N-97)
Veg/Organics	38%	37%	30%
Paper/ cardboard	21%	24%	22%
Glass	17%	14%	7%
Metals	6%	6%	6%
Plastics	13%	16%	22%
Bones	0%	1%	1%
Ash/dusts	2%	1%	7%
Textile/cloth	1%	1%	5%
Total waste (kg/week)	**100%**	**100%**	**100%**
Volume/week (m^3)	**0.21**	**0.08**	**0.07**
Density kg/m^3)	**68**	**101**	**80**

A detailed explanation of each waste category is given below and ranked quantitatively from the highest to the lowest percentage. Vegetables/organics/putrescibles were found to be the highest (30-38%) waste category. These waste materials consisted of perishable food left-overs, garden waste including lawn mowing clippings, yard debris. It was discovered that waste from Fortgale had relatively high proportions of garden waste arising from the mowing of yards and garden cleaning as well as animal (dog) waste. It was noted that waste from Northcrest had a lot of food, including potato and orange peels, whilst waste from Ngangelizwe had a higher amount of rotten fruits and vegetables. These findings are within the normal waste composition range of organic waste in developing countries which ranges from 20-50% of the waste stream (Cointrea (1992) in Mbande, 1999).

Paper and cardboard ranked the second highest amount (21-24%) following organic waste materials. This waste mainly consisted of newspapers, magazines and cardboard boxes.

Notable waste from Fortgale and Northcrest had a higher amount of magazines and old books. The paper content in Ngangelizwe might have been caused by the old cardboard boxes which residents used as mats and storage containers, which became waste when no longer useable.

Plastics consisting mainly of shopping plastic bags constituted 13 –22% of waste generated in the study area. The types of plastics were not classified during the analysis; however, these findings fall within the range of plastic proportions in waste stream in other developing areas in South Africa. For example, a recent waste stream analysis conducted in Ntuzuma (low density informal area) in Durban has reflected that plastic materials constituted 4-7% in the waste stream in 1998 with relatively higher proportions of 6-25% and 7-15% plastic found in Umlazi and KwaMashu Townships (McKay, 2000).

The glass waste materials which consisted of beverage empty bottles for food, beer and other household consumables ranged from 7-17% of waste generated in the study area. Ngangelizwe was found to be having the lowest percentage of glass (7%) compared to 14% in Northcrest and 17% in Fortgale. This could be attributed to the fact that people from the low social status areas do not throw away valuable things but reuse them as containers until they are no longer fit for further use. The other contributory factor to low glass content in Ngangelizwe could be the community waste cleansing projects launched in 1996, which encouraged the reuse of glass waste materials for decorating gardens thus substantially reducing its content in the waste stream.

Of the four waste categories whose amounts fell below 10%, dust content consisting of soil and dust was found to be 1–7%, followed by metals (6%) and textiles (mainly in Ngangelizwe) at 1-5% with bones having the least percentage (0-1%) of waste generated. It was noted that there was an increased amount of soil in Ngangelizwe compared to Fortgale and Northcrest. It appeared that Ngangelizwe residents were putting soil in the plastic bags when cleaning their unpaved yards.

The low percentage of metal content (aluminium cans and other scrap metals) in the study was associated with the presence of a steel recycling company which exchanged scrap metals for cash. The findings on waste composition in Fortgale, Northcrest and Ngangelizwe in Umtata were further compared to similar studies from various developing and developed communities in South Africa as reflected in Table 5.7 below.

The waste composition data for Fortgale, as can be seen in the Table 5.7, resembled those of East London regarding high proportion of organic waste matter compared to other waste constituents. The high organic matter from Fortgale (affluent society) in Umtata came from garden waste whereas the organic waste from the low social status area had more fruit and vegetable waste. It was inferred from these results that the absence of alternative means of collecting and disposing of garden waste in the study area, combined with the prohibition of burning waste in urban areas might have compelled residents to use the available municipal kerbside waste collection methods.

The high organic content in the domestic waste stream in Umtata, was found to be in line with the composition of waste generated in some other developing residential areas in South Africa. In this regard, Reddy's study (1992) in the Durban area found that the domestic waste from Phoenix (low income area) consisted of mainly organic waste (fresh vegetables) (WRC, 1995). Similarly, Mayet (1993) has also pointed out a high proportion of garden waste in some Pietermaritzburg high income areas (WRC (1995).

Table 5.7: Waste composition for Fortgale and Ngangelizwe in Umtata are compared with other waste composition studies from developed and developing communities in the East Rand Region (Gauteng Province) in South Africa to show the effect of socio-economic status on waste composition.

Waste component	**Umtata Fortgale (affluent area)**	**Umtata Ngangelizwe (low status area)**	**[1]East London formal areas**	**[2]SA developed communities (East Rand)**	**[3]SA developing communities (East Rand)**
Veg/Organics	**38%**	30%	**38%**	32%	4.6%
Paper/ cardboard	21%	22%	32%	37%	3.4%
Glass	17%	7%	6%	4%	2%
Metals	6%	6%	6%	6%	1.6%
Plastics	13%	22%	13%	17%	2.4%
Bones	0%	1%	No data	No data	No data
Ash/dust	2%	7%	1%	0	**82%**
Textile/cloth	1%	5%	5%	No data	No data
Other	No data	No data	No data	6%	2.4%
Total*	**100%**	**100%**	**100%**	**100%**	**100%**

Notes: ** Figures rounded off to nearest decimal*

Source: *[1]Mbande (1999), [2.3]WRC (1995), data obtained from developed and developing areas (East Rand) in Gauteng.*

The waste composition variations can be explained as a function of geography and social development of the area concerned (Bilitewski *et al.*, 1996). General observations indicated that the major constituents in the study area were paper and organic matter. This was found to be true for other areas in South Africa as shown in Table 5.7 above. It appeared that the findings of the current study concurred with the observations of Mbande (1999), that is, that a correlation exists between the ash/soil content and paper content.

Accordingly, the higher the ash content, the lower the paper and plastic content and vice versa. Results of this study showed a surprisingly high plastic content in Ngangelizwe (the low status suburb) in the study area. This was associated with the use of shopping bags which have a short lifespan and limited reuse. Secondly, this pointed out the lack of community projects, which would use the plastic bags for creative art works such as floor mats, hats and the like.

Contrary to the findings of this study with regard to the absence of ash, data from the East Rand (column 6 of Table 5.7) showed a higher ash content arising from the use of coal as an energy source in the Gauteng region than in other provinces. This can be explained as an influence of geography. Based on the current study findings and other research works, there seemed to be consensus about the fact that the composition of waste within a given urban area varies significantly with socio-economic status of households. This has to do with income, lifestyle and the development pattern and consumer awareness of recycling issues.

Each local authority is therefore encouraged to carry out periodic analyses of waste composition of its waste stream. This would serve as a valuable tool for monitoring the effect of a solid waste plan and the need for waste reduction measures. Accurate data on quantity and composition are required to develop individual waste management plans. To this end, Bilitewski *et al.* (1996) have recommended half-yearly studies. Data on annual averages, specific waste per capita quantities (kg/person/year) and waste composition should only be used during the first stages of planning.

5.4 DOMESTIC SOLID WASTE DENSITY

Waste density refers to the physical characteristics of waste. It relates to the mass or weight of a material to the volume it occupies (kg/m^3) (Rhyner *et al.*, 1995; UNESCO, 1996). According to Rhyner *et al.*, (1995), the volume of each component is found by dividing the weight by the density of the component. The total volume is calculated by summing the volumes of the individual components.

Knowledge of density of waste is of particular importance in the transportation and disposal of wastes in landfills. A reduction in volume is achieved with compaction vehicles/equipment during collection, transportation and disposal of wastes. The compacted waste reduces hauling costs because trucks are size limited rather than weight limited. The composition and the degree of shape alteration determine the density of any waste stream (Pfeffer,1992). As the proportion of glass, ceramics, ashes, grit and metals increases so will the density.

The density of waste was found to be 68 kg/m^3 in Fortgale, 97-101 kg/m^3 in Northcrest and 80-83 kg/m^3 in Ngangelizwe as shown in Tables 5.3 and 5.6 above. Table 5.8 compares the domestic waste density of Fortgale, Northcrest and Ngangelizwe with that of Mzomhle, Mdantsane (formal and informal areas) and normal international trends in the density of domestic waste (UNESCO, 1996). It was observed that the density of waste from Ngangelizwe was unexpectedly lower than is the normal case with low income areas.

The low density of waste in Ngangelizwe as a low income area might have been caused by the lower ash/soil content compared to paper and plastics, coupled with the sampling period. The waste survey for this study was conducted in winter which is a dry season resulting in dry waste which is less dense due to low moisture content. It is assumed that a waste density for a summer month might have been higher. It is also possible that more frequent waste removal (twice-a-week) in Ngangelizwe compared to other suburbs might have influenced the volumes of waste collected considering the low socio-economic development of the area. These results should be understood in the context of lifestyle of households in the different areas of the study. Residents in Ngangelizwe are relatively poorer than those from the other two areas. Therefore, an increase in the frequency coupled with the high number of working people would be likely to produce less volumes of wastes which, in turn, would affect the density. It has been reported that collection frequency affects the amount of waste collected (Heeramun, 1995)

It is highly possible that residents greatly rely on convenience goods which do not enter the waste stream. The high percentage (22%) of plastic bags in Ngangelizwe might indicate the type of foodstuffs they used. Further, it was found that about 40% of food waste in Ngangelizwe was used for animal feeding, as was reported in Chapter 4 section 4.3. This could reduce the density of waste proportionally to the size of waste accepted for analysis. Another possible contributory factor to the low density waste would be the general observation made that the communal skips were found to be overflowing with garden waste. This indicated that a significant amount of waste was not collected by the kerbside collection methods but rather by the communal facilities, which were not considered in this assessment. Also, Ngangelizwe has an open gutter drain system whose efficient operation has been made difficult by frequent blockages caused by food waste and the like. The unruly residents might be dumping waste instead of disposing of it by normal, acceptable means. These are all possibilities, which need to be further investigated by a follow-up study on waste stream assessment.

Trends in solid waste management indicate that density of waste is as high as 600kg/m^3 in developing countries compared to 150kg/m^3 for the developed countries (USA and Europe), (UNESCO, 1996). The differences are largely caused by differences in the level of economic development between developed and developing countries. As a result, the developed countries have high proportions of paper and packaging in the waste stream which results in easily compacted low density waste. Secondly, solid wastes from the developing countries reflect a relatively high proportion of organic matter, moisture and lower levels of recycling. Wastes in these areas are dense and therefore the use of compaction vehicles is not cost-effective.

Another important factor to consider in waste characteristics is the impact of container size. Studies in Germany found that the container size had an influence on the quantity and composition of waste. Bilitewski *et al.*, (1996) have reported that a smaller container size induces consumers to utilize the available volume more carefully. Limited container size encourages recycling and a bigger container offers space for additional waste. As a result, bigger containers tend to promote a throw-away mentality in consumers

Table 5.8: Comparison of findings on density of domestic solid waste for Fortgale, Northcrest and Ngangelizwe in Umtata with that of Mzomhle and Mdantsane in East London to illustrate density patterns between low, middle and high income residential areas.

	[1]East London	[2]Umtata	[3]SA Waste Consultant's classification (1993)	[4]International trends
	Density (kg/m^3)	Density (kg/m^3)	Density (kg/m^3)	Density (kg/m^3)
High	195	68	144	100-170
Middle	109	97-101	200	170-330
Poor (low)	87-144	80-83	330	250-500

Source: [1]Mbande (1998; 1999) a waste generation and composition study in Mzomhle (site and service) Mdantsane (formal) and Mdantsane shacks (informal); [2]Density of waste for this study obtained calculted in Fortgale, Northcrest and Ngangelizwe, Umtata; [3]Lombard (1993) a waste classification table developed as a guide for calculating waste generation and [4]UNESCO (1996) patterns of waste generation for low, middle and high income countries

Moreover, the increase in container size has led to an attitude that the already-paid-for container volume should be fully utilized. For example, a supply of a container size of more than 70 litre resulted in a 60% increase of yard waste. On the other hand, if the container size supplied to consumers is too small, household waste and yard waste is disposed of via bulky waste collection. This increases the collection and transportation costs of bulky waste, thus making it cheaper to supply consumers with larger containers. The relationship between a container size and an increase in waste quantities is determined by the socio-economic environment, development patterns and consumer awareness of waste and recycling issues (Bilitewski *et al.*, 1996).

Based on these findings, it has been concluded that decreasing waste density is accompanied by an average increase in volume. The reasons for this are that waste can be compacted more easily in small containers, and large items such as cardboard boxes and bulky waste can be accommodated only when torn-up or broken down. This leads to better utilization of the available container volume.

5.5 SUMMARY OF FINDINGS WITH RESPECT TO DOMESTIC SOLID WASTE GENERATION, COMPOSITION AND DENSITY

This study found that waste generation rates varied greatly between the different sites of study with the lowest per capita waste generation rate of 0.08kg/person/day in Ngangelizwe and as much as 0.4kg/person/day for Fortgale. The findings concurred with other waste generation assessment findings, in that the amount of waste generated by the community is generally increasing with increase in income. The higher income areas generate more waste, which is a result of different lifestyles, consumption and disposal patterns in the community (UNESCO, 1996). The study found that the general domestic waste generation rate estimate for the formal and informal residential in the greater Umtata was 0.7 kg/capita/day, which translates to 37.8 tonnes/day for a total population size of about 54 000 and 70 tonnes/day for approximately 100 000 people.

The knowledge of daily waste generation estimate is significant in determining payload (amount of waste that can be hauled in relation to the size of the truck). The waste composition analysis in Fortgale, Northcrest and Ngangelizwe showed a high proportion of organic/putrescible wastes, and this trend was found to be the same for a number of developing areas in South Africa. Surprisingly, however, waste density was found to be lower in Ngangelizwe than would normally be found in lower income areas. This was attributed to a higher frequency of waste collection and lower content of ash and dust components in that area.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

This study addressed two vital issues for proper planning and for the successful implementation of domestic solid waste management programmes. First, the study identified key demographic factors of residents and evaluated the effect of these on domestic waste management through attitudes, perceptions and solid waste disposal practices. Secondly, the study assessed waste generation and composition patterns of domestic waste in three formal residential areas with different socio-economic status (Fortgale, Northcrest and Ngangelizwe), and investigated the effect of socio-economic factors on domestic waste management. The ultimate aim was to contribute to the development of a solid waste strategy for Umtata.

The study revealed that an understanding of the perceptions and attitudes of residents as well as of socio-demographic aspects, is significant in gaining a better idea of how residents perceive solid waste management. Moreover, it was found that different lifestyles relate to domestic solid waste management planning and service delivery. The demographic factors, in particular income, age, education and gender of households appeared to be the important factors influencing domestic solid waste practices. It was also determined that the nature of waste generation and composition is typical of the generators and is correlated with the community's social status in that domestic waste, unlike commercial waste, gives a true character of the generators. Moreover, a number of important lessons for solid waste planners as well as new challenges in the development of effective solid waste strategies in the field of solid waste management in South Africa were highlighted. These points are elaborated below.

6.1 SIGNIFICANCE OF DEMOGRAPHIC CHARACTERISTICS OF HOUSEHOLDS IN SOLID WASTE MANAGEMENT PLANNING

The relationships between demographics of households and their perceptions to waste management practice were examined in detail in Chapter four. It became clear that the recipe for planning and effectively operating a domestic solid waste plan is in knowing and understanding the demographic characteristics of the service recipient community. It appeared that a link between the average age of households and attitudes to solid waste existed. Notably, the younger and the older members of the community in the study area tended to care less for the environment. Responses of residents showed that the interest of households to have regularly cleaned streets and waste removal, increased relatively with age. The young households showed little interest in the cleanliness of streets, but this interest gradually increased with an increase in age. The lack of interest in caring for the environment could be attributed to two factors:

- Firstly, young people naturally act irresponsibly at times and pay attention to other issues, assuming that someone else will take care of the environment. The danger of this behavioural pattern is having an uncaring (apathetic) future generation with regard to the environment. An increased lack of interest in the environment has serious consequences for nation building. This is significant in South Africa as it is a nation that is undergoing transition from an era of Apartheid (where most communities lived in degraded environments and had unequal access to solid waste service) to an era of democracy where equitable access to services is promoted.

  The major challenge for solid waste planners in this regard is to encourage residents to co-operate in developing their areas to improve the quality of life. Responsible solid waste authorities should convince communities to realise their potential and to reap the benefits from respecting and caring for their surroundings. There are however no quick solutions.

Solid waste planners need to incorporate educational programmes in their plans to change personal attitudes and practices of residents towards developing pride and ownership for their environments. Interest in the environment can be promoted through capacity building and information dissemination. This can encourage individuals to re-examine their actions which will lead to a change in behaviour towards the environment.

- Secondly, the lack of interest is associated with the tendency of modern society to focus on youth and discriminate against the elderly. Consequently, the older people feel frustrated and lose interest in community issues (including the environment). It is for this reason that local solid waste authorities have to continually review their service programmes in order to adapt them to the local needs and to ensure that they cater for all community members. Forums where communities can be empowered to contribute to decisions that affect their environment and solid waste service delivery need to be created.

This study also noted that knowledge about the educational status of the community is important in assisting solid waste service providers in developing strategies or programmes to enhance environmental education, taking into account the low overall education levels of some sectors of the population. Education influences attitudes to service programmes. To this end, this study found that the less educated people did not regard cleanliness as a priority. Knowledge about levels of education will facilitate selection of the right medium of communication and will ensure that the correct message is received and understood by the target population group. The South African government acknowledged that educational gaps exist in our society, and has made education an integral part of the National Waste Management Strategy.

Gender of households is another key demographic factor for the success of a domestic solid waste programme. Research according to Scheinberg *et al.,* (1998) has shown that across many cultures, women handle waste in their homes although the richer women delegate this task to servants. In general, women are not paid to handle waste, while men only do so when they are paid. This trend holds true for clean-ups and community volunteer projects.

The World Bank (1999) has pointed out that women, especially the poor, seem to swallow their pride and do demeaning jobs in the street to bring home food. Women as the larger proportion of society worldwide are often the most vulnerable population groups to poorly designed solid waste collection systems. Experience has, for example, shown that in some urban developing communities in South Africa large communal skips placed at strategic positions by local authorities were too high for children to reach the sides and perhaps too far for some women to walk to. This has resulted in the dumping of waste next to the skips (Blight and Mbande, 1994).

Gender is important for planning collection points in that women normally prefer convenient points which will not cause them to leave their homes to deliver waste to a neighbourhood collection point. This study found great differences between men and women in terms of the choice of type of waste collection service system. Women supported a door-to-door waste collection system unlike men who favoured a drop-off centre. Where there is a conflict of a collection schedule (especially for recycling) with home activities (relating to gender), residents often put out waste at the wrong times. This is often regarded as a lack of cooperation without an in-depth investigation of family settings in the area. It is therefore important that solid waste planners take into account the specific needs of women to ensure that they have equitable and affordable access to facilities and services. Added to this is the need to design user friendly waste collection systems that are accessible to all users.

The study also revealed that there is a link between the distribution of income, unemployment, education, gender and the socio-economic status of a residential area. Trends revealed by the study indicated that the lower income households were concentrated in areas with low socio-economic status. These also happened to have a high rate of unemployment, poor education and were predominantly occupied by female residents. Income disparity among different socio-economic communities in the study area was noted. The effect of the income gap was believed to be related to the continued disruptions of solid waste management programmes due to non-payment of services. This not only undermines efforts to ensure equity in service provision but deprives many individuals of the opportunity to enjoy better waste management services.

The persistence of communities in non-payment for service seems to be associated with income disparity among communities in South Africa, as noted by Whiteford and McGrath (1994).

6.2 IMPORTANT LESSONS LEARNT

This study highlighted the need for the continual evaluation of current domestic service programmes in order to pinpoint areas needing attention and to look for alternative solutions. Such evaluation provides vital information on how waste is currently being managed in the community. Armed with this information, the decision maker is able to define problems in solid waste management and set objectives for solving them (USEPA, 1989). Programmes are evaluated to see what has been achieved and to measure progress in accordance with the objectives of the programme. Evaluation assists managers to improve monitoring for better management by identifying strengths and weaknesses of the programme in order to see if effort was effective. This exercise can also be done to collect information in order to assist planning and managing the programme activities better in line with the needs of people at community level. Sharing experience with the aim of preventing others from making similar mistakes or to encourage them to use similar methods is another advantage of evaluating programmes as propagated by Feuerstein (1986).

An assessment of residents' attitudes to the domestic solid waste programme revealed that most residents reported that the current solid waste programme was good but poorly managed and needed to be improved. This emphasised the need for examining perceptions of recipients of the service on an ongoing basis. This should be done knowing that the unique nature of environments and conditions in different areas of operations result in problems that require local solutions. Hence, responsible managers should always conduct local audits of their service systems in order to identify shortcomings and develop appropriate interventions.

Another lesson learnt is that there is a need to design user friendly and consumer orientated solid waste service programmes. User friendly relates to convenience of the service programme to the users. The basic service needs and choice of designs are important as pointed out in paragraph 4 section 6.1 (c) above. Additionally, the involvement of affected communities is vital for setting priorities. Some communities for example, may prioritise the amount of time it takes the municipality to answer a query, while others might prioritise the cleanliness of an area.

Public involvement ensures a dialogue or a two-way communication that involves both getting information out to the public and retrieving information about issues and concerns from the public. Attempts should therefore be made to ensure the involvement of all stakeholders in the early stages of the planning process in order to encourage public input and acceptance of the solid waste management plans.

The study also revealed the unique pattern of waste generation and composition rates related to various areas. The waste stream analysis presented in Chapter five showed that there are no typical solid waste characteristics for all areas. Waste differs from one community to the other. It was estimated that the daily household waste generated in the study area was between 0.08kg and 0.4kg per capita per day. It is argued that this variation primarily depends on socio-economic status. It was noted that lifestyle choices determined the community's disposal patterns as varying lifestyles were found to have a direct influence on waste disposal. Godbey *et al.,* (1998) explains that the increasing domestic waste generation is associated with the increase of working women as this results in dual income households. Consequently, the limited time family members spend at home prompts them to purchase convenience goods which, in turn create more waste per capita than the more heavily packed goods. This can be explained as a consequence of inevitable social change.

The unpredictable nature of waste generation and composition rates poses major problems in solid waste planning. This can largely be attributed to their direct association with the changing lifestyle of householders. The major factors influencing waste generation and composition rates include overall population growth, income, size of household, geographic factors, seasonal variations and lifestyle factors such as the use of convenience products. Information on current waste generation and composition rates can be used to calculate future waste generation estimates and assist planners in devising effective policy strategies to target certain waste materials for source reduction efforts. Flintoff (1984) has recommended that every country must evolve an indigenous technology based on the quantity and character of wastes generated and the level of social and economic development.

All the above findings further challenge solid waste planners and decision makers. They send a clear message that solid waste services should be managed in the context of local conditions in accordance with consumer needs. This requires a paradigm shift from the traditional approaches, which have proved to be inappropriate, to the development of effective solid waste strategies and effective action plans. The following section briefly describes some key challenges facing local solid waste management practioners, planners and decision makers.

6.3 MAJOR CHALLENGES FOR SOLID WASTE MANAGEMENT PRACTICE

It was highlighted in Chapter one and in the literature review (Chapter two) that solid waste management practice in the past had focussed on technical issues and ignored the social dimensions of the communities. A summary of some of the important issues to be dealt with in redressing this situation are briefly outlined below. The application of measures in this study will vary from one local authority to the other depending on the local conditions. However, the issues raised are generic in nature particularly in most small developing municipalities in South Africa. It is therefore strongly advised that waste managers and decision-makers contextualise the suggestions to their local situations. The model presented in section 6.3.2 below will greatly assist in expediting the process of change and initiating innovative measures for the provision of domestic solid waste services.

6.3.1 Changing mindset

The issue of changing mindset is the most difficult task facing solid waste service delivery. The South African government has expressed its intention to introduce an integrated waste management approach as a shift from end-of-pipe solution to pollution prevention (DEAT, 2000). This requires a change of approach from the traditional management style where costly law enforcement measures were used to citizen-orientated management approaches that promote consumer participation and prioritisation of service delivery as pointed out in section 2.4 of Chapter two. The key stakeholders to deal with include municipal/government authorities (including politicians), consumers and the media.

- Firstly, solid waste delivery service can be improved by reorientation of municipal/government authorities from reliance on costly remedial measures to proactive approaches that involve proper planning. The attitude of rating solid waste management services as a relatively low priority in relation to other municipal services needs to change. Responsible municipal and government authorities need to be convinced that solid waste management is an essential service, which is as important as water and sewerage services. The image of an urban environment is not only judged by the structural appearance but by its cleanliness (litter-free environment). Further, solid waste management is dynamic due to its link to technology. To operate efficiently, it requires resources such as transport (a major expensive budget item), and skilled manpower (which must be trained). The low priority given to this service is manifested by the ever low budgets, unskilled managers/supervisors and a lack of autonomous status to operate freely (small section in the municipal organisation). The commonly held belief that solid waste collectors need no training on the basis that the qualification of being a collector is willingness to work under unsanitary conditions, needs to change.

Workers are the engine of any service programme. To this end, drivers and waste collectors are entrusted with expensive equipment which must be safeguarded. Their training would also assist them to handle consumers in a correct manner, thus minimising complaints. It appears that the high cost incurred by most municipal solid waste authorities is directly linked to the lack of forward planning to optimise solid waste services. Considerable savings and improvement in the level of service, as pointed out by UNESCO (1996) could be gained by optimising the operation of solid waste collection systems. Political support is equally important in this regard for deciding on priorities.

Additional to the above, municipal solid waste authorities need to change from a unilateral decision making style to a citizen–orientated management approach. This calls for the reduction of the amount of bureaucratic delays where officials have enormous powers and make unquestionable decisions (which often compromise the quality of services). An open door approach where there is interaction between service providers, workers and service recipients is essential. The greatest challenge is the restructuring of local service delivery to provide equitable services in a fair and balanced manner based on democratic principles to a formerly divided society with development patterns that differ from one area to the other and one province to another.

- Secondly, the current consumer mindset, which is characterised by uncaring attitude (apathy) to the environment and general lack of support for service providers, has to be dealt with in order to provide acceptable services. There are basically two issues to consider when dealing with the consumer mindset. Firstly, the municipalities as the main contact for local citizens who are the consumers of municipal services need to build good relationships with all communities they serve. This requires entering into a consultative process with the active participation of the wider community to debate service related issues.

The White Paper (1998) on local government has suggested that constant feedback from service-users and making of apologies where promised services have not been delivered be made to the service recipients. Coupled with this, is a sympathetic positive response to complaints received. When consumers are enlightened they will cooperate. Consumers need to be educated about simple disposal practices like flattening cardboard boxes to minimise space in the collection truck, frequency, source reduction and the like. This can boost their interest and co-operation.

An intensive educational programme needs to be developed to enlighten consumers about the payment for services. The culture of non-payment is so deeply rooted in some members of the community that it will take time to change their way of thinking. Consumers need to be informed why they have to pay and why certain methods are preferred to others. This is a long process that solid waste management authorities have to be engaged in to improve the quality of services. This study found that the payment for services varied within different socio-economic areas. Residents from the middle and high income suburbs tend to pay for municipal services including waste management services, unlike those from the low socio-economic residential areas. This has to do with their perceptions about the municipal services. The non-payment for services is a sensitive issue that should be handled with local politicians, otherwise conflict might arise and service delivery may be seriously impaired.

- Thirdly, the media is also an important stakeholder that needs to be dealt with. A committed media is needed to inform the public about good and bad practices. Bad publicity for environmental offences has worked well in other developing countries. Media support, both print and electronic (community radio stations), is crucial to report on environmental degrading practices. Information dissemination is impeded by the lack of media involvement in solid waste issues. Fortunately most local authorities have a public relations office or a political wing which could assist in this regard.

6.3.2 Establishment of a participatory planning mechanism

Additional to the above-mentioned measures for changing mindsets, solid waste management authorities have to develop mechanisms to ensure citizen participation in policy initiation, decision-making and implementation. The main aim of this mechanism is to develop an appropriate integrated planning arrangement. Through this interactive process, the public on the one hand becomes educated about the economic and logistical realities of managing municipal solid waste. The solid waste planners on the other hand gain better understanding of public concerns. Attempts should therefore be made to ensure the involvement of all stakeholders in the early stages of the planning process in order to encourage public input and acceptance of the solid waste management plans.

Citizen participation in service delivery originated from the Rio de Janeiro United Nations Conference on Environment and Development in 1992. This conference mandated local authorities to develop sustainable development plans for their cities. Accordingly, local authorities are required to acquire the information needed for formulating the best strategies through consultation and consensus building, and to learn from citizens and from local, civic, community, business and industrial organisations. This requires holistic investigation of alternative solutions that rest on sound planning, and principles of management for sustainable development.

Partnership with civil society is important in the light of the limited resources which include funds and management capacity to deliver services at the pace of the ever increasing and changing consumer demands. This highlights the fact that most municipalities in developing areas, including Umtata, do not have the capacity to deliver all the required municipal services.

Figure 6.1 on page 139 depicts an interactive process between the service provider and other stakeholders. This diagram also highlights some issues that need to form part of the deliberations about solid waste management. It shows a multi-stakeholder process in the planning of solid waste management plans.

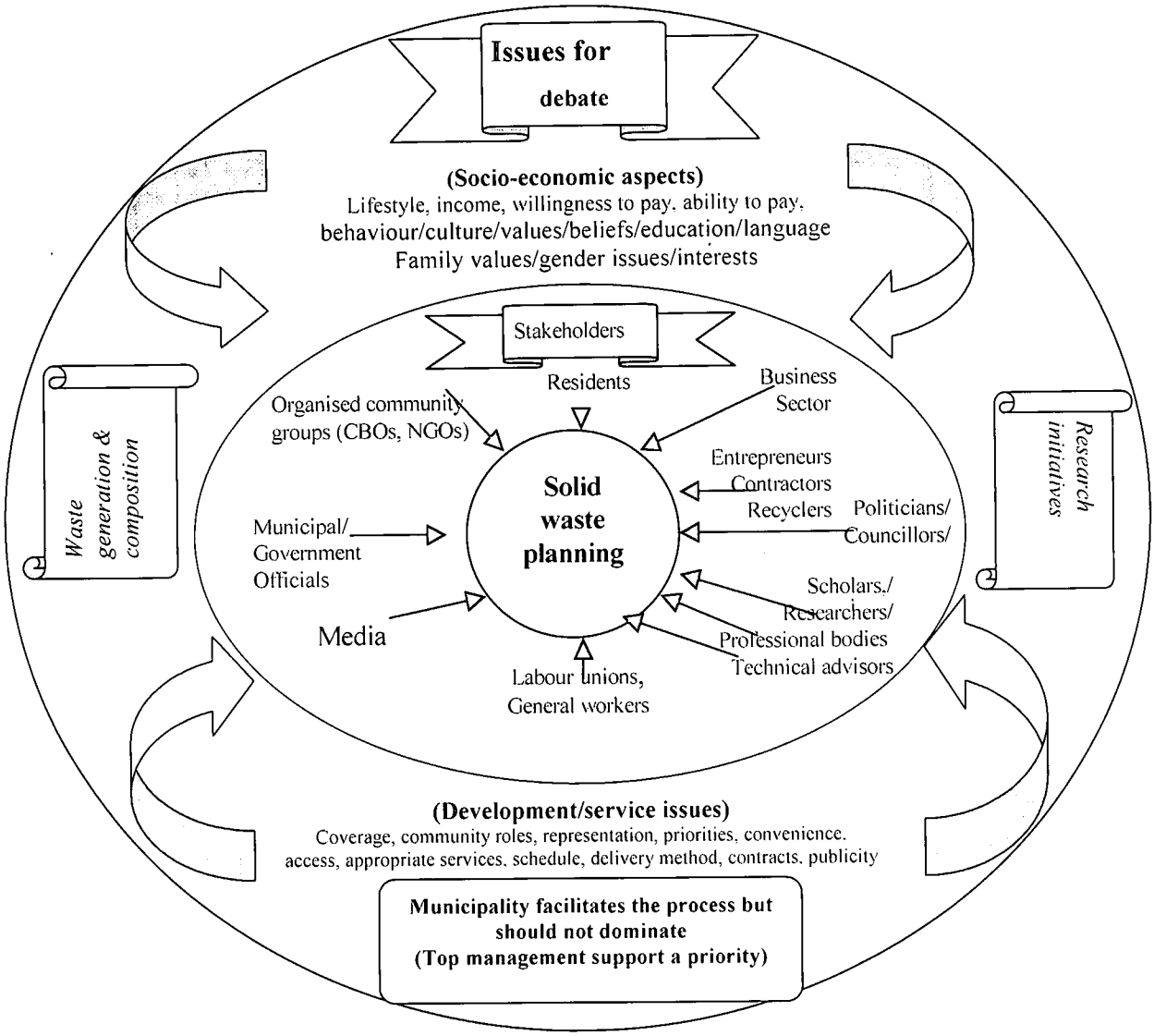


Figure 6.1 A diagrammatic illustration of an interactive process in solid waste management planning, showing some key role players and issues of debate (model designed based on the findings of this study to assist solid waste planners to seek practical solutions to local solid waste problems and facilitates forward planning). Explanation of key issues of this model is given on page 140-141).

This model is based on the principles of local governance, which promote transparency and a participatory process. It is essential for mobilizing popular support from the political, business, and community sectors. Each local stakeholder should be committed to the issues within their specific context. This will ensure the creation of a representative, effective policy framework. The local authority as a regulatory authority is tasked with the duty of ensuring representation of each stakeholder on issues that specifically affect them. The level of participation will have to be backed up with education of members on their expected roles. When people are part of the decision making process, they will be aware of issues and constraints facing the service provider. Ultimately, the shared knowledge will result in effective power sharing. The local authority will be sensitised regarding community issues and most probably, there will be fewer disruptions of services when consumers are satisfied.

The key issues to note in the diagram are the following:

Level one (Centre):

The solid waste planning process is at the heart of the solid waste management operation. his should be introduced as the cornerstone for successful development of the process for solid waste practice, knowing that programmes have failed due to the lack of proper planning.

Level two (middle layer):

Key stakeholders need to be identified and included in the planning process. Top management provides logistical support and direction when a need arises, officials are in the forefront of preparing plans and giving professional guidance in consultation with specialists based on the vision, mission and objectives of the municipality. Residents, as consumers, play an important role in informing the municipality of their priorities, interests and problem areas while community-based organisations (CBOs) and non-governmental organisations (NGOs) represent different civic society interests in general. The latter groups are important for conducting research initiatives with relevant bodies. The business sector could assist with funding as well as educating their employees on relevant solid waste issues.

Information dissemination can be done through the media and other existing communication means. Solid waste workers as the engine of the service delivery can provide vital information on operation issues and their labour relations interest will be secured by the presence of labour union representatives.

Level three (outer layer):

The key issues for debate have been highlighted. Included is research which provides new knowledge and status quo reports. Local research should be encouraged and be part of the process. Joint initiatives involving civics, workers, training institutions and schools can assist in this process.

6.4 CONCLUDING COMMENTS

Based on the above deliberations, it has been demonstrated in no uncertain terms that solutions to local problems can indeed be found by examining local conditions. This reaffirms the principle of thinking globally but acting locally. Co-operative effort is needed to convince the service recipients that their active participation in the service planning through to implementation will bring long-lasting benefit. Consumer participation in decisions on service provision is essential in order to build a mutual trust between the service providers and the service recipients. The designers of solid waste management programmes need to produce profiles of their respective communities in order to gain knowledge of the local conditions and develop appropriate interventions that would meet the needs of the service community. Merely copying plans designed for elsewhere, could lead to disastrous and unhealthy situations and a rejection of such plans by the same communities that they were meant to serve.

The following factors have been found to be the main limitations of the study:

(a) Firstly, the sampling procedure was complicated by the absence of current information on the number of service units in the study area. While every attempt was made to obtain a representative sample size, the exclusion of residents in the flats and waste from businesses in the selected study areas might have affected the amount of waste accepted for analysis. Future assessment studies should include all waste generators in the selected study areas in order to have a better picture of the waste stream.

(b) Secondly, it would have been better if the waste generation and composition analyses were performed for different seasons to allow better comparison of variations in waste generation rates. The unexpectedly low density and waste generation in Ngangelizwe might have been caused by the fact that waste collection for sampling was done once whereas the area receives a twice weekly waste removal service. It is thus recommended that a follow-up study be done to address these concerns.

Notwithstanding the above limitations, it is believed that this study provides vital information on the current solid waste practices of households in Umtata and patterns of domestic waste generation and composition. The findings will undoubtedly, greatly assist solid waste planners to seek practical solutions to the current situation, and the model presented in Figure 6.1 section 6.3.2 should facilitate forward planning. Finally, it is strongly recommended that Umtata municipality and other similar service providers seriously consider the option of sponsoring students to conduct research on the solid waste status and waste generation and composition rates for all areas within their jurisdiction. This cost-effective method could provide both an adequate training of personnel and improve a database on solid waste practice for sound planning.

REFERENCES

Alderden, J. 1990. *Volume-Based Rates, Dream or Nightmare? Recycling Today*. Nov. [On-line]. Available from: http://www.epa.gov/payt/tools4.htm. (Accessed 14 May 1998).

Australian Beverage Industry Environment council (BIEC) (2000). Understanding Littering Behaviour in New South Wales. *Wamer Bulletin*. (pp4-6) No 70 January. Pp20. ISSN 1362- 654X.

Bailey, K.D. (1982). *Methods of Social Research*. 2nd ed. New York: The Free Press. 408p. ISBN 0-02-901280-5

Bell, P.A. Fischer, J.D. Baum, A an greene,T.E (1990). Environmental Psychology. USA: Ted Buchhol. ISBN 0-03-022809—3 637p

Bilitewski, B. Hardtle, G and Marek, K. (1996). *Waste Management*. Berlin: Springer. 499p. ISBN 3-540-59210-5.

Black, B.G. (1990). *Public Participation in Waste Management*. Paper read at the 10th Biennial Congress, International Conference on Waste Management in the Nineties. Tenth Congress: Institute of Waste Management of Southern Africa. Port Elizabeth, 16-18 Oct. 1990 pp258-265. 404p.

Bless, C. and Higson-Smith, C. (1995). *Social Research Methods: An African Perspective*. 2nd ed. Cape Town: Juta and Co, Ltd. 164p. ISBN 0 7021 3432 5.

Blight, G.E. and Mbande, C.M. (1994) *Problems of Waste Management in Developing Areas*. Paper read in the First Conference on Environmental management Technology and Development held on 7 –8 March 1994 pp33.1-33.8.

Bureau of Industry Economics (BIE), (1994). *Plastics Recycling: Economic Issues and Implications: Research Report 61*. Canberra: Austraria Government Publishing Service. 111p. ISBN 0644 3528 8

Byrne, R. (1996). Quality waste management system is key to success. *Tidytimes*: Summer No. 8. Pp14. 1996.

Cassley, D.J. and Kumar, K. (1988). *The Collection Analysis, and Use of Monitoring and Evaluation* Data. London: The Johns Hopkins University Press. 174p. ISBN 0-8018-3670-7

Chaturvedi, B. (1999). Public –Private Enterprise: Waste Management in India. *Warmer Bulletin*. (pp4-6) No 66 May. ISSN 1362- 654X.

Chipkin, I. (Undated). *A Developmental Role for Local Government*. [On-line]. Available from: http://www.local.gov.za/DCD/polydocs/whitepaper/cl2ivor.html. Accessed 8 April 2000.

Christopher, P. Green, K.E and Williams, D.G. (1998). Organic planning: A New Approach to Public Participation in Local Governance. *Social Science Journal*. Vol. 35 Issues 4. ISSN 0362-3319

Cochran, W.G. (1977). *Sampling Techniques: Estimation of Sample Size*. New York: John Wiley and Sons. pp73-83. ISBN 0-471-16240-X. 417p.

Danish Cooperation for Environment and Development (DANCED), (1996). *Draft Project Document: Strategies and Action Plans for Integrated Waste Management in South Africa*. March 1996.

Department of Environmental Affairs and Tourism (DEAT), (1996). *Towards a New Environmental Policy for South Africa.* Discussion Document for inputs into the drafting of a Green Paper. April 1996. Pretoria: Government Printer. 102p.

Department of Environmental Affairs and Tourism (DEAT), (1997). *White Paper on Environmental Management Policy for South Africa*. Government Gazette No. 18164. Notice No. 1096 of 1997. Pretoria: Government Printer. 96p.

Department of Environmental Affairs and Tourism (DEAT), (1998). *White Paper on Environmental Management Policy for South Africa*. Government Gazette No. 18894. Notice 749 of 1998. Pretoria: Government Printer. 96p.

Department of Environmental Affairs and Tourism (DEAT), (1998a). *Draft White Paper on Integrated Pollution and Waste Management for South Africa: A Policy on Pollution Prevention, Waste minimisation, Impact Control and Remediation.* Government Gazette No. 19161. Notice No.1686 of 1998. Pretoria: Government Printer.

Department of Environmental Affairs and Tourism. (DEAT), (2000). *White Paper on Integrated Pollution and Waste Management*. A Policy on Pollution Prevention, Waste Minimisation, impact Management and Remediation. March 2000. Pretoria: Government Printer. No. 20978 [On-line]. Available from http://www.environment.gov.za. Accessed 15 September 2000.

Department of Environmental Affairs and Tourism and Department of Water Affairs and Forestry (DEAT and DWAF). (1997). Discussion Document, *Towards a White Paper on Integrated Pollution Control and Waste Management*. May 1997. Pretoria: Government Printer. 77p.

Department of Environmental Affairs and Tourism (DEAT) and Department of Water Affairs and Forestry (DWAF) (1999). *National Waste management Strategies and Action plans South Africa: Action Plan for General Waste collection Version C.* PMG 132

Department of Constitutional Development DCD, (1997). *Green Paper on Local government*. [On-line]. Available from http://www.polity.org.za/govdocs/green_paper/localgp.htm . (Accessed 21 March 2000).

Department of Constitutional Development DCD, (1999). *White Paper on Local government. Section A*. Published March 1998. [On-line]. Available from http://www.polity.org.za/govdocs/whitepaper/localgov/wp1.htm. (Accessed 18 March 2000).

Department of Constitutional Development DCD, (1999a). *A Citizens Guide to Municipal Service Partnerships*. Pretoria: Department of Constitutional Development.

Dey, I. (1993). Qualitative Data Analysis: What is Qualitative Data? London: Routledge. pp9-29. ISBN O-415-05851-1. 285p.

Diederich Jr, M. (1995). Can Municipalities Mange their Own Solid Waste? *Environment* Vol. 37 Issue 4 p3. ISSN 0013-9157

Edwards, A and Talbot, R. (1994: 36). *Hard-pressed Researcher: A research handbook for the caring Professions: Designing a study.* Pp28-51. England: Addison Wesley Longman Limited. ISBN 0 582 09993 5. 193p

Encyclopaedia Britannica (Undated). *Solid Waste Management.* [On-line] Available from: http://www.britannica.com. Accessed 25 April 2000).

Fishbein, B.K. and Gelb, C. (1992). *Making Less Garbage: A Planning Guide for Communities*. USA: INFORM, Inc. p179. ISBN 0-918780-58-6

Flintoff, F. (1984). *Management of Solid Wastes in Developing Countries*. World Health Organization. 231p. ISBN 92 9022 101 1

Feuerstein, M. (1986). *Partners in Evaluation: Evaluaating Development and community Programmes with Participants*. Hong Kong: MacMicmillan. ISBN 0-333-42261-9 p196.

Frost, B.A. (1997). *An investigation into Developments in Ngangelizwe Slum and SquatterSettlement: A Projection of Efforts to Meet Infrastractural Needs of Population Increase*. Paper read at Southern African Sociological Association Convention. Unitra, Umtata, 6-10 July 1997.

Fuggle, R.F. and Rabie, M.A. (1992). (eds). *Environmental Management in South Africa: Solid Waste*. Cape Town: Juta & Co, Ltd. (pp493-522) ISBN 0 7021 2847 3. 823p.

Gies, G. (1996). The State of Garbage in Canada. *Biocycle*. Vol. 37 Issue 2 Feb ISSN 0276-5055

Gilbert, R. Stevenson, D, Girardet, H and Stren, R. (1996). *Making Cities Work: The Role of Local Authorities in the Urban Environment.* London: Earthscan Publications Ltd. 203p. ISBN 1 85383 354 1.

Godbey, G. Reid, L and Robinson, J. (1998). No Time to Waste: An Exploration on Time Use, Attitudes Toward Time and the Generation of Municipal Solid Waste. *Social Research* Vol. 65 Issue 1, 40p Spring 98. ISSN 0037-783X.

Glasson, M. (1992). The Health Officer in the Waste Management. *Community Health in Southern Africa,* 7 (2) p9-10 May/June.

Hammond, M. and Gear, J. (1986). *Measuring Community Health.* Workbook 1. Cape Town: Oxford University Press. 460p. ISBN 0 19570413 4.

Hardoy, E.J. Miltin, D. and Satterthwaite. (1992). *Environmental Problems in Third World Cities*. London: Earthscan Publications Limited. 304p. ISBN 1 85383 146 8.

Hawkins, Hawkins and Osborn, (1988). *Solid Waste Collection and Disposal in Umtata. Transkei.*

Heeramun, K.K. (1995). *Solid Waste Management in Mauritius; Alternative to Sanitary Landfill.* A paper selected for Readers for Participants in the UNEP/UNESCO Postgraduate Training Course in Environmental Management, held at the Dresden University of Technology and for scholars in Africa, Asia and Latin America. Germany: Dresden University of Technology and the Institute for Scientific Co-operation. pp80-127. Vol. 2. 214p. ISSN 0947-2487.

Henderson, J.P. and Chang, T.J. (Undated). *Solid Waste Management in China.* [On-line]. Available from: http://www.interchange.ubc.ca/johnph/swana.html. Accessed 25 April 2000.

Ismael, N. Bayat, S. and Meyer, I. (1997). *Local government management.* Johannesburg: International Thomson Publishing (Southern Africa) (Pty) Ltd. 186p. ISBN 1 86864 070 1

Institute of Municipal Engineering of Southern Africa (*Imiesa)*, (1993). Refuse Disposal Strategies. p27

Keep South Africa Beautiful. (1996). Reasons given why people Litter (1996 Survey). *Tidytimes*: Summer No. 8. pp16. 1996.

Kelleher, M. (1997). Pay As You Throw. *Warmer Bulletin*, pp14-16. No 55, July ISSN 1362-654X

Kneale, L (1998). *Waste aware: Education for waste minimisation.* Paper read at WASTECON'98, a Fourteen Congress of the Institute of Waste Management. New Perspectives in Waste Management. Gauteng, (pp123-130), Kempton Park, Civic Centre, 12-15 October 1998, 740p.

Lake, C.C. and Harper, PC.(1987). *Public Opinion: Sampling.* Washington: Island Press. pp67-94. ISBN 0-33280-32-7. p123

Lapid, D. (1999). Solid waste Management Privatisation in the Philippines and its effect on Micro- and Small Enterprises. *Warmer Bulletin*, pp21-23. No 67, July, ISSN 1362-654X

Lombard, R. (1996). The Challenge of Holistic Waste Management in South Africa. *Resource*, 3 (3): pp20 - 23 Aug.

Lombard, R. (1997). The Challenge of Holistic Waste Management in South Africa: Part 2. *Resource*, 4 (3) pp12-15. Feb.

Lombard, R. (2000). Resource Recovery in South Africa. Resource, 2 (2) pp18-22. May.

Mabin, A. (Undated). *Imaginative Responses to Human Settlement Trends*. [On-line]. Available from http://local.gov.za/DCD/policdocs/whitepaper/cl2alan.html. Accessed 8 April 2000.

Marowski, G.D., Lazzarus, M. & Tardiff, C.J., & Travers, B. eds. (1992). *Environmental Viewpoints, Volume 1*. London: Gale Research Inc. 544p. ISBN 0-8103-8844-8.

Mantel, C.L. 1975. *Solid Wastes: Origin, Collection, Processing and Disposal*. New York: John Willey and Sons. 1127p. ISBN 04-471-56777-9.

Mayet, M.A.G. (1993). *Domestic Waste Generation in Urban Core of the Durban Functional Region*. MSc Dissertation, University of Natal, Durban. p189.

Mbande, C. (1998). *Community Based Solid Waste Management*. MSC thesis, University of Witwatersrand, Johannesburg. p185

Mbande, C. (1999). *Appropriate Approach in easuring waste Generation, Composition and Density in Developing Areas*. Paper in preparation for submission in a journal.

McKay, C. (2000). Personal Communication to T.T. Poswa, 13 July 2000. SKC Engineers: Breakdown of Composition of Waste from the Waste Stream Analysis Report 1998: Durban Metro Area.

Miller G.T. Jr. (1998). *Living in the Environment. 10ed.* Califonia: Wadsworth Publishing Company. ISBN 0-534-51912-1. 761p. [Linked to http:// www.thomson.com/wadsworth.html]

Mouton, J. (1996). *Understanding Social Research*. pp240-242. Pretoria: van Schaik Publishers. ISBN 0 627 02163 8. 272p.

Municipal Demarcation Board (2000). *Demarcated Boundaries*. [On-line]. Available from www.demarcation.org.za

Narayan, D. Prennushi, G. Cecchini and Walton, M. (1999). *Poverty trends and Voices of the Poor*. A joint project of the World Bank's Poverty Reduction and Economic Management and Human Development Networks and Development Economics. December. [On-line]. Available from: http://www.worldbank.org.research

National Progressive Primary Health Care Network (NPPHCN), (1999). *To take Out: Healthy Living for the Elderly: Discrimination and Abuse – respect for the Aged.* Groote Schuur: *Networker:* Newsletter of the National Progressive Primary Health Care Network. Edition 30 – Sept.

Nguta, C.M. (1996). *The Status of Waste Management in Kenya.* Paper read at WASTECON, International Congress of the Institute of Waste Management. pp352 372. Holiday Inn Crown Plaza, Durban, 17 - 20 Sept. 1996. 609p.

Palmer Development Group (1999). *Masakhane Case Studies: Winning Communities.* [On-line]. Available from: http://local.gov.za/DCD/dcdlibrary/masakhane/ma2index.html. Accessed 15 March 2000.

Palmer, I. (Undated). *Local Government: Its Role in Service Delivery.* Paper prepared as an input to the process of preparing a white paper on Local government for South Africa. [On-line]. Available from http://local.gov.za/DCD/policdocs/whitepaper/cl2ian.html. Accessed 8 April 2000.

Pfeffer, J.T. (1992). *Solid Waste Management Engineering. Sources and Characteristics of Urban Solid Wastes.* pp47-70. New Jersey: Prentice Hall. 307p. ISBN 0-13-824905-9.

Poswa, T.T. (1995). *A study into the Contributory Factors of Littering in the City of Umtata with reference to Solid Waste.* B Tech Research Report, Natal Technikon, Durban.

Poswa, T.T. (1997). Curbing Umtata's Littering Problem. *Resource*, 4 (3): pp9 - 10 Feb.

Poswa, T.T. (1997a). Eastern Cape Clean and Green Monthly Report: Prepared for Keep South Africa Beautiful.

Poswa, T.T. (1998). *Umtata Solid Waste Management Services. Evaluation of current Solid Waste Practice and Proposed Waste Management Strategy.* A report prepared for the city Engineer's Department, City of Umtata. Feb.

Robbins, S.P. (1993). *Organizational Behavior: Foundations of Individual Behavior.* pp107. New Jersey: Prentice Hall International Editions. 751p. ISBN 0-13-63904-X.

Rhyner, C.R.,Schwartz, L.J., Wenger, R.B. and Kohrell, M.G. (1995). *Waste Management and Resource Recovery.* London: Lewis Publishers. 524p. ISBN 0-87371-572-1

Sadler, C. (1997). *Guidelines for the Provision of Township Engineering Services and Amenities in Residential Township Development*. Unpublished Discussion Document on Solid Waste Management. Rivonia: Bergman - Ingerop. 16p.

Sapsford, R. and Jupp, V. (1996). *Data Collection and Analysis*. London: SAGE Publications. ISBN 0 7619 5045 1 p360

Scarlett, L and Shaw, J.S. (1999). *Environmental Process: What Every Executive Should Know*. Perc Policy Series. Political Economy Research Center: Issues PS-15. April. 34p.

Scheinberg, A, Muller M and Tasheva EL (1999). *Gender and Waste*. Integrating gender into community waste management: Project management insights and tips from an E-mail conference, 9-13 May 1998. Sept 1999.

Schubeller, P. (1997). Conceptual Framework for Municipal Solid Waste Management in Developing Countries. *Waste Management and Research*. 15 (4): pp429 Aug.

Scottish Environmental Protection Agency (SEPA), (1999). Scotland Consults on Draft Waste Strategy. *Warmer Bulletin* No 67 ISSN 1362-654X pp10-11. July.

Shasha, W. (1993). *Community Health Workers in Ngangelizwe, Umtata: Report of Feasibility Study*. Umtata: Unitra Community Partnership Project. 19p.

Skarba, K. (1992). What a waste of money. *Lantern*, 41 (2): pp61-63 May

Statistics South Africa, (SSA) (1998). Census'96: National Results. [On-line]. Available from http://www.statssa.gov.za/census96/HTML/press/Part002.html. Accessed 15 March 2000.

Stentiford, E. (1999) Improving Waste Management in Vietnam. *Warmer Bulletin* No 67 ISSN 1362-654X pp16-18. July

Swedish Environmental Protection Agency (1997). *Getting Rid of Garbage: Swedish Waste management Strategies: Now and in the future*.

Tannerfeldt, G. (1995). *Towards an urban World*. Stockholm: Swedish Development Cooperation Agency (SIDA). ISBN 91-586-7227-3. 80p.

The Constitution of the Republic of South Africa (1996). Act 108 of 1996. ISBN 0-620-20214-9 p187.

Theron, P. (1999). A New National Waste Management Strategy for South Africa. *Urban Management*. Vol. 30 No 11/12. pp2-3. ISSN 0047-8369.

Thurgood, M. (1998). Necessity-The Mother of Invention. *Warmer Bulletin* No 59 ISSN 1362-654X pp4-5 March.

Tworeck, W.C. (1979). *K47 Solid Waste Management in South Africa: CSIR Technical Guide*. Pretoria: National Institute for Water Research and Council for Scientific and Industrial Research. 130p.

Umtata City Council, (undated). *Umtata.* Advertising brochure.

United Nations Centre for Human Settlements (Habitat), (1989). *Solid Waste Management in Low – Income Housing Projects: The Scope for Community Participation.* Unpublished paper.

United Nations Conference on Environment and development (UNCED), (1992). *Earth Summit'92*. Rio de Janeiro 1992. 240p.

United Nations Development Fund for Women (UNDFW) (1998). *Gender and Telecommunications: An Agenda for Policy*. A Documented prepared for the United Nations University for New Technologies (UNU/INTECH) and the United Nations Development Fund for Women (UNIFEM).

United Nations Educational, Scientific and Cultural Organization (UNESCO), (1996). *Management of Solid Wastes: Multimedia Post Graduate Course in Environmental Engineering*. France: UNESCO. p338

United States Environmental Protection Agency (USEPA), (1989). *Decision -Makers Guide to Solid Management: Public Education and Involvement. Volume 1*. EPA/530-SW-89 - 072, p125-130 Nov.

United States Environmental Protection Agency (USEPA), (1990). *Variable Rates in Solid Waste: Handbook for Solid Waste Officials. Vol. 1 –Executive Summary.* EPA/530-SW-90-084A 399. Sept.

United States Environmental Protection Agency (USEPA), (1992). Principles of Environmental Enforcement. EPA/300-F-93-001, July 1992.

United States Environmental Protection Agency (USEPA), (1992a). *The Consumer's Handbook for Reducing Solid Waste*. EPA/530-K-92-003, p36 Aug.

United States Environmental Protection Agency (USEPA), (1995). *Decision - Makers Guide to Solid Waste Management: Public Education and Involvement*. Volume II. 2nd ed. EPA530-R-023, pp1-13 Aug.

United States Environmental Protection Agency (USEPA), (1997). *Principles of Solid Waste Management: A Facilitated International Training Course for South Africa.* Student Manual.

Van Beukering, P. (1999). Analysing Urban Solid waste in Developing Countries: A Perspective on Bangalore. India. *Warmer Bulletin.* pp8-9 No. 67, July ISSN 1362-654X

Viljoen, V.D and Van Staden, G. (1987). *Environmental Psychology: An Introduction.* Johannesburg: Lexicon Publishers. ISBN 1 86813 024 X. 292p.

Warmer Bulletin (WB) (2000). *Waste Minimisation* p14-15). N0 70 ISSN 1362-654X.

Water Research Commission (WRC) (1995). *Evaluation of Solid Waste Practice in Developing Urban Areas of South Africa: Main Report.* July.

Water Research Commission (WRC) (1995b). *Evaluation of Solid Waste Practice in Developing Urban Areas of South Africa: Draft Guidelines for Domestic Solid Waste Collection. Report No. 21.* July.

Whiteford, A. and McGrath, M. (1994). *Distribution of Income in South Africa.* Pretoria: Human Sciences Research council. 100p. ISBN O-7969-1572-5

Wilson, D.G. (1977). *Handbook of Solid Waste Management.* New York: Van Nostrand Reinhold Company. 752p. ISBN 0442295502

World Bank (1999). *Changing Gender Relations in the Household.* [On-line]. Available from http://www.worldbank.org/research. Accessed 23 June 2000

APPENDIX: A

QUESTIONNAIRE ON EVALUATION OF SOLID WASTE MANAGEMENT PRACTICE, WASTE GENERATION AND COMPOSITION IN RESIDENTIAL AREAS WITHIN THE CITY OF UMTATA IN THE EASTERN CAPE PROVINCE, SOUTH AFRICA

FOR OFFICE USE ONLY
AREA CODE

FG		NG		NC	

PART A: SOCIO-DEMOGRAPHIC DATA

DATE : _____ **Name of the Area:** _____
Street Name: _____ **House Number:** _____

Time Interview Start: _____ **Ref No:** _____

Make an □ in the relevant box and complete the necessary information where applicable.

SECTION A: ISSUES IN GENERAL

Q 1 Indicate below the issues you, regard as the most problematic and needing urgent attention. Please rate each issue on the following 5 point scale. ***(Interviewer to show a flash card).***

Of no concern 1 | Of little concern 2 | Of some concern 3 | Of strong concern 4 | Critical 5

ISSUE	1	2	3	4	5	
1. Electricity supply						
2. Telephones						
3. Housing						
4. Waste (refuse) removal and street cleansing						
5. Improvement of roads						
6. Development of a shopping centre						
7. Creation of jobs						

SECTION B: STREET CLEANING AND LITTER CONTROL (Hygienic state of the Environment)

Q 2 Do you regard littering as a problem in this area?

Yes		1
No		2

Q 3 In your opinion why do you think people litter?

_____

_____

Q 4 In the area where you live, do you have any illegal disposal of waste?

Yes		1
No		2

Q 5 If your answer is yes, whom do you think is responsible for such dumping? **More than one answer is acceptable)**

1. My garden worker		1
2. My neighbour/residents		2
3. Municipal street cleaners		3
4. Project contract workers		4
5. A building contractor in the area		5
6. Nearby flat dwellers		6
7. Myself		7
8. Other (Specify)		8
9. N/A		9

Q 6 In your opinion, do you think illegal dumping can be stopped?

Yes		1
No		2

Q 7 Do you believe that residents could play a role in stopping illegal waste disposal in residential areas?

Yes		No

Can illegal waste disposal be stopped?

In what way could you/resident plays role?

_____

_____

_____

Q 8 Which of the following statements in your opinion are true or false in regard to littering and illegal Dumping of waste?

(a) Littering

	True		False	
1. Residents are the main cause		1	2	
2. Littering by neighbours is unacceptable		1	2	

(b) Illegal Dumping

	True		False	
1. I'm paying my rates therefore I am not responsible		1	2	
2. If we don't dump the Municipality workers won't have work		1	2	
3. It is the responsibility of residents to catch illegal dumpers and report to the Municipality		1	2	
4. It is the Municipality's duty to stop illegal dumpers		1	2	

Q 9 Indicate the degree to which you agree or disagree with the following statements. Please choose one option for each statement.

	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
1. Residents should be involved in finding solutions to litter problems	1	2	3	4	5
2. Street committees should be established to deal with cleanliness in residential areas	1	2	3	4	5
3. Community based street cleaning programmes couldmake everyone responsible for litter control	1	2	3	4	5
4.Community based street cleaning forums encourage voluntary participation of the community in cleaning streets	1	2	3	4	5
5. Every resident should have refuse bins in the yard	1	2	3	4	5
6. There is nothing wrong in burning refuse/waste	1	2	3	4	5
7. Refuse bags are useful and safe for carrying goods other than waste.	1	2	3	4	5
8. It is better to burn refuse/waste than dumping	1	2	3	4	5
9. Residents should clean the nearby open spaces	1	2	3	4	5
10. Unmanaged waste contributes to the spread of diseases	1	2	3	4	5

SECTION C: DOMESTIC SOLID WASTE HANDLING PRACTICE

Q 10 How do you store or dispose of your refuse/waste at your home?

1. In refuse plastic bags		1
2. In refuse bin/s		2
3. In a pit in the yard		3
4. Other (specify) _____		4

How do you dispose of the following waste matter? (Choose from the methods given below)

Q 11 Food waste (organic food waste items like perishable left overs)

1. Put in refuse bags/bins for collection		1
2. Use as animal feed		2
3. Bury in a trench		3
4. Throw it on the nearby open space		4
5. Throw it into open drain(s) on the street		5
6. Other (specify) _____		6

Q 12 Garden waste (trimmings, yard debris, lawn mowing clippings)

1. Put in refuse bags/bins for collection		1
2. Use a trench and to make compost		2
3. Throw it on the nearby open space		3
4. Throw it into open drain(s) on the street		4
5. Other (specify) _____		5

Q 13 Sanitary pads and disposable baby nappies

1. Put in refuse bags/bins for collection		1
2. Throw/flush in the toilet pan		2
3. Bury		3
4. Burn		4
5. Other (specify) _____		5

Q 14 When last did you have a sewer blockage? Specify:_____

_____

What was the cause of the blockage? Specify:_____

_____

SECTION D: SOLID WASTE SOURCE REDUCTION MEASURES (Willingness to Recycle)

How do you dispose of the following waste materials?

Q 15 Plastic containers

1. Throw in refuse bags/bins for collection		1
2. Reuse them until become unusable		2
3. Always burn them		3
4. Throw them in my back yard		4
5. Sell them		5
6. Other (specify)		6

_____

Q 16 Glass

1. Reuse bottles		1
2. Crush and throw in the waste bag/bin		2
3. Send to recyclers		3
4. Other (Specify)		4

_____

Q 17 Tins

1. Reuse		1
2. Throw in the waste bag/bin		2
3. Send to recyclers		3
4. Other (Specify)		4

_____

Q 18 Newspapers

1. Reuse	1
2. Throw in the waste bag/bin	2
3. Send to recyclers	3
4. Other (Specify)	4

Q 19 State how you dispose of your scrap metal including scrap cars and tyres?

(Write in)_____

_____

Q 20 Can the following items be recycled?

	Yes		No
1. Tin and steel cans	1		2
2. Aluminium cans	1		2
3. Newspapers	1		2
4. Food left-overs	1		2
5. Plastic bags	1		2

Q 21 How do you feel about establishment of a recycling programme to recycle any of the above?

1. A strong need	1
2. Some need	2
3. No need	3
4. Not sure	4
5. Strongly no need	5

Q 22 If a recycling programme could be established, would you support it?

Yes		1
No		2

If no, what are your reasons (Write in)_____

_____

Q 23 If yes, which system would you prefer?

	Yes		No	N/A
1. A drop off recycling programme		1	2	3
2. A door to door collection programme		1	2	3
3. Would you be prepared to pay for the collection programme?		1	2	3

Q 24 Indicate, what you would prefer for a Recycling Programme.

	Yes	No
1. To be supplied with special bags to pre-sort waste materials at home and place the pre-sorted waste on street pavement for collection	1	2
2. Topersonally drop of the waste recyclable material at a recycling centre	1	2
3. To be provided with incentives (money or rebates) for supporting the recycling programme	1	2
4. To volunteer in sorting waste material	1	2
5. To be appointed as an area co-ordinator of the programme	1	2

Q 25 Should a Recycling Programme be established, who do you think should plan and manage such programme?

1. Municipality	1
2. Business Sector	2
3. Non-Governmental Organization	3
4. Community Structure	4
5. Other, Please specify: _____	5

SECTION E: LEVEL OF WASTE MANAGEMENT SERVICE DELIVERY

(Willingness to pay for services)

Q 26 Who is responsible for waste management collection services in your area?

1. Municipality	1
2. Private contractor/Person	2
3. Self	3
4. Other, Please specify: _____	4

Q 27 If it is the Municipality, how often is the collection?

1. Less than a week (specify)		1
2. Once a week		2
3. Twice a week		3
4. Three times a week		4
5. Daily		5
6. Not sure		6
7. N/A		7

Please, state day of the week:_____

Q 28 In your opinion how would you describe the municipal refuse collection service?

1. Good		1
2. Poor		2
3. Adequate but poorly managed		3
4. Not sure		4

Do you have any street cleaning services in your area?

Yes		1
No		2

If yes, who provide the services? (Specify):_____

Q 29 Are you currently paying for Municipal services including waste collection services

Yes		1
No		

Give reasons for your answer: _____

Q 30 Please indicate, when do you put out your refuse bag?

	Yes	No
(a) Only when full	1	2
(b) On collection days whether full or not	1	2
(c) Are you prepared to pay for plastic bags?	1	2
(d) " " " " " " the collection service?	1	2

SECTION F: DEMOGRAPHIC PROFILE

Particulars of Respondent

Q 31 Age

1. 16-21
2. 21-30
3. 31-40
4. 41-50
5. 51 or above

Respondent		Family (eldest member)	

Q 32 Gender

Male		1
Female		2

Q 33 Education

1. No formal education
2. Sub A - Std 1
3. Std 2 - Std 5
4. Std 6 - Std 9
5. Std 10
6. Tertiary Education/diploma/degree

	1
	2
	3
	4
	5
	6

Q 34 Status/ Position of Respondent (Choose only one)

1. Head of Family
2. Member of Family
3. Tenant
4. Domestic Assistant

	1
	2
	3
	4

Position in the Community

1. Street Committee member	1
2. Street Committee Chairperson	2
3. Don't belong to any community structure	3
4. Member of Environmental group	4
5. Other, Specify	5

Q 35 Current Employment Status

1. Pensioner	1
2. Unemployed	2
3. Scholar	3
4. White Collar (e.g Clerk)	4
5. Professional (e.g Health Office)	5
6. Domestic Assistant	6
7. Labourer	7
8. Self-employed (Informal sector)	8
9.Self-employed (Own formal business)	9
10. Gardener (Part Time worker)	10
11. Other, Specify	11

Q 36 Income Status (per month)

	Respondent		Family
1. No income	1		1
2. Less than R200	2		2
3. R201- R500	3		3
4. R301-R1000	4		4
5. R1001-R2000	5		5
6. R2001-R5000	6		6
7. R5001& Above	7		7

Q 37 Accommodation (Home Density)

State the number of people staying on the property.

	During the week		At weekends
1. Number of people on the stand/property	1	1	
2. Number of people in Respondents' family	2	2	
3. Number of buildings on the stand/property	3	3	
4. Number of families on the stand/property	4	4	

Q 38 Respondents duration of Stay on the property or in the area

a. How long have you lived here?_____

b. Where did you live before?_____

Q 39 Home language

1. Xhosa	1
2. English	2
3. Sotho	3
4. Afrikaans	4
5. Zulu	5
6. Other Languages, Specify _____	6

Which language do you prefer for environmental information? _____

Name of the Interviewer:_____ **Time Interview finished:**_____

End Thank the Respondent

PART B: WASTE GENERATION AND COMPOSITION DATA

NB. This Technical information should only be entered under the supervision of the Technician and the Researcher

House Number: _____

Area: _____

Q 40

Waste Composition	Mass (kg)	Percentage
vegetable/organic/putrescibles		
Paper/ cardboard		
Glass		
Metals		
Plastics		
Bones		
Ash/dust/soil		
Textile/cloth		
Volume(cm^3)		
Total mass(kg/family/week)		
Bulk density (m^3)		
Total waste (m^3/cap/day)		

TECHNIKON NATAL

P.O. Box 953
Durban, 4000

Berea Campus:
Telephone (031) 204-2111
Facsimile (031) 22-3405

City Campus:
Telephone (031) 204-2111
Facsimile (031) 22-3405

APPENDIX: B

Covering Letter to the Respondents (Residents)

RESEARCH STUDY FOR THE EVALUATION OF SOCIAL AND ECONOMIC FACTORS FOR THE DEVELOPMENT OF A DOMESTIC SOLID WASTE MANAGEMENT SYSTEM FOR THE CITY OF UMTATA

Research on domestic waste management is being conducted in the City of Umtata under the auspices of Technikon Natal and the Institute of Waste Management for Southern Africa. The purpose of this research project is to gather information that will assist the design of a waste management strategy taking into consideration needs of the local community.

This will determine the ways in which the local residents can work together to effectively manage their waste such that, problem areas and priorities are identified so as to design relevant service programmes to ensure sustained clean environment.

Your co-operation in providing necessary information could facilitate the formulation of the domestic waste management strategy based on your needs for the improvement of the living environment and ultimately the quality of life. You are urged to spare a few minutes of your time to honestly answer all questions in the questionnaire. Please do not provide your name and all information gathered will be confidential and be used only for the purpose of this investigation.

This exercise should not take more than twenty minutes of your precious time.

Thank you for your willingness to participate in this enquiry.

Yours faithfully

T.T. Poswa (Mr)

APPENDIX: C

Instructions to Interviewers

1. Only complete part A. of the questionnaire.
2. Introduce yourself to the respondent and explain the purpose of the study as contained in the covering letter.
3. Only interview respondents who are 16 years and older.
4. Assure the respondent that he/she will remain anonymous and that information obtained will be treated confidentially and be used for research purposes only.
5. Read questions to the respondent exactly as written without discussion and complete the questionnaire.
6. Remind respondents not to respond before you have read the entire question.
7. Do not skip any questions.
8. Complete time and date in the beginning and at the end of the questionnaire.
9. Complete the control sheet after every interview.

APPENDIX: D

The overall type and quantities of domestic solid waste in Umtata by weight

Waste component	Fortgale (N-38)	Northcrest (N-148	Ngangelizwe (N-184)
Veg/Organics	240.1	288.92	165.75
Paper/ cardboard	110.45	252.54	104.5
Glass	77.1	147.2	35.52
Metals	28.65	44.68	29.55
Plastics	56.44	127.05	109.96
Bones	0.05	4.9	6.70
Ash/dusts	14.15	7.955	46.23
Textile/cloth	5.15	11.705	13.04
Total waste (kg/week)	**533.04**	**1238.09**	**1084.43**
No. of stands	38	148	184
No. of families	**52**	**240**	**783**
Families per stand	1.37	1.62	4.26
No. of people	207	910	2023
No. of persons per stand	5.45	6.15	10.99
No. of persons per family	**3.98**	**3.79**	**3**
Kg/stand/week	14	8.42	5.89
Kg/family/week	**10.25**	**5.194**	**1.38**
Volume (m^3)	7.856	12.817	13.04
Volume/week (m^3)	0.21	0.09	0.07
Waste/person/day (kg/cap/day)	**0.4**	**0.19**	**0.08**
Bulk density (kg/m^3)	**68**	**97**	**83**