

**AN INVESTIGATION INTO FACTORS THAT AFFECT THE EFFICIENT  
MANAGEMENT OF WASTES GENERATED BY FOOD OUTLETS IN PRETORIA,  
SOUTH AFRICA**

**by**

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**A dissertation submitted in fulfilment of the requirement of the Degree of Master of  
Science in Environmental Management in the Department of Environmental Sciences  
College of Agriculture and Environmental Sciences, University of South Africa**

**NOVEMBER 2009**

# DECLARATION

I hereby declare that the work presented in this study for the degree of Master of Science in Environmental Management is my original work and has not been presented either wholly or in part for any other degree.

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

Signed: \_\_\_\_\_  
Supervisor of study

## **STATEMENT**

I hereby certify that this study is entirely the result of my own independent research work conducted at the University of South Africa for my MSc study in environmental sciences. The various sources of information used in this dissertation have been clearly indicated and duly referenced in the list of references.

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

Student

## **DEDICATION**

This study is affectionately dedicated to my family members and friends for providing me with the support and encouragement I needed to complete the research work during the entire period of study. I wish to gratefully thank the Lord God for all His blessings, generosity and mercy upon me.

## ACKNOWLEDGEMENTS

I would like to thank and acknowledge the following parties for the generous support and kind assistance they provided me with during the course of my study at the University of South Africa:

- Professor O. R. Awofolu of the Department of Environmental Sciences, UNISA; my supervisor of study, for providing me with the guidance, encouragement and advice and assistance needed to complete my study. Without his help, I could not have completed my study at UNISA.
- The City of Tshwane Metropolitan Municipality (CTMM) for providing the Geographical Information Systems map of the City of Pretoria.
- The Department of Trade and Industry (DTI) for providing access to the sampling frame of food outlets conducting business in the CTMM.
- Dr. Oscar Kilpert of the DCLD (Directorate for Curriculum and Learning Development) Unit of the University of South Africa, for providing me with the necessary statistical advise (Determination of sample size of study, the design and validation of my questionnaire of study, methods of data analysis, etc) and support.
- The 332 managers, owners and operators of food outlets in the City of Tshwane who provided some of the data used in this study.
- The several research assistants who worked tirelessly in areas related to duplicating my questionnaire of study, data collection, translation, data verification, coding, editing, validation and data capturing as part of my research.

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## LIST OF ABBREVIATIONS

<b>CTMM</b>	City of Tshwane Metropolitan Municipality
<b>OR</b>	Odds Ratio
<b>RR</b>	Risk Ratio
<b>PPS</b>	Probability Proportional to Size
<b>NP-PLOT</b>	Normal Probability Plot of Residuals
<b>DEAT</b>	Department of Environmental Affairs and Tourism
<b>GJMC</b>	Gauteng Johannesburg Metropolitan Council
<b>DOH</b>	Department of Health
<b>UNDP</b>	United Nations Development Programme
<b>DTI</b>	Department of Trade and Industry
<b>EPA</b>	Environmental Protection Agency
<b>CBD</b>	Central Business District
<b>N</b>	Population size of study
<b>n</b>	Sample size of study
<b>LR</b>	Likelihood ratio
<b>ROCP</b>	Receiver Operating Characteristics Plot
<b>WHO</b>	World Health Organization
<b>P-value</b>	Probability value (Observed significance level)
<b>C. I.</b>	Confidence Interval

## **ABSTRACT**

### **AN INVESTIGATION INTO THE FACTORS THAT AFFECT THE EFFICIENT MANAGEMENT OF WASTES GENERATED BY FOOD OUTLETS IN PRETORIA, SOUTH AFRICA**

The study aimed at investigating the factors that affect the efficient management of wastes produced by food outlets in Pretoria, South Africa. This was with a view of providing empirical data and information with respect to the causative factors responsible for the visible environmental pollution by wastes and materials from food outlets. Data was gathered from a representative sample of 332 food outlets on socio-economic, demographic, environmental, sanitary and health related variables that are related to waste management and efficiency in the disposal of solid and liquid wastes. Data entry and analysis was performed using statistical procedures such as frequency tables, Pearson's chi-square tests of association and binary logistic regression analysis in the statistical package STATA version 10. Odds ratios estimated from logistic regression analysis were used for identifying key factors that affect efficiency in the proper disposal of waste. Results obtained showed that 18 % of the 332 food outlets in the study were generally inefficient in waste disposal. Based on odds ratios estimated from binary logistic regression analysis, wrong perception (a factor of 10.88), failure to provide trash cans to customers (a factor of 3.15), the operation of food outlets by non-owners or managers (a factor of 2.33), and failure to practice source reduction of waste (a factor of 2.25) are the top 4 influential factors that affect the proper management of waste at the 332 food outlets in the study.

# **CHAPTER 1: INTRODUCTION AND BACKGROUND**

## **1.1. INTRODUCTION**

The conceptual framework of the research was based on the observable environmental pollution by wastes that emanating from many food outlets in Central Business District of Pretoria, South Africa. Hence, the interest in finding out causative factors that may be responsible for poor management of wastes by food outlets operating in the City. The waste collection and disposal section of the City of Tshwane Metropolitan Municipality (CTMM) is the primary organ responsible for ensuring the collection and disposal of wastes in and around the city. Since litters are found along the road and within the vicinity of food outlets, the issue of inefficient collection and disposal and other related factors require investigation and solutions. This background information is provided to provide an insight into the direction of the research work.

In this study, food outlets are defined as formally registered, properly licensed, tax paying and regularly inspected service providers that sell readily prepared and well cooked food to the general public. The study considers only formal food outlets and excludes informal food ones such as sidewalk vendors, street vendors who sell food to the general public. All formal food outlets are duly registered and are inspected for hygiene and sanitation by the City of Tshwane. According to LEAP (2006), there were over 5, 000 food outlets operating in and around the City of Tshwane in 2006. Roughly 1, 603 of these food outlets operate within the Central Business District (CBD) of Pretoria. It is well known that food outlets produce massive volumes of solid and liquid waste (dirty water, used cooking oil, empty bottles, etc) due to the nature of their business. The management of waste from food outlets constitutes a significant aspect of the overall responsibility of the City of Tshwane. Food outlets in the City of Tshwane have the capacity to produce large volumes of trash, empty bottles, empty food packages, cigarette butts, empty food cans, dirty water, used cooking oil, left-over drinks, etc on a regular basis. Food outlets can sometimes be busy and fully occupied. The accumulation of trash is quite rapid, especially on certain week days and holidays. The management of waste from food outlets in the City of Tshwane is a

challenging process that is handled by the Waste Management Department of the Municipality. Solid waste is gathered by the responsible section of the municipality from food outlets, streets, taxi ranks, bus stations, households and business outlets on a regular basis. Residents are charged waste removal and disposal fees on a monthly basis. During holiday seasons, the volume of waste that needs to be gathered and disposed of by the CTMM reaches a maximum. From time to time, municipal workers go on strike as part of their effort to have their wages improved in line with prevailing inflation rates. Wage negotiations are known to be tedious and time consuming. In cases where disputes over wage negotiation are not resolved timeously, the volume of waste that needs to be collected and disposed reaches a maximum. At present, there are no reliable and adequate alternative measures that guarantee the collection and disposal of waste at all times in the City of Tshwane, especially in a situation mentioned above.

A comprehensive national policy on waste management was developed in the year 2006 by the South African Department of Environmental Affairs and Tourism with a view to regulate the collection and disposal of waste in all major cities of South Africa. The policy is quite broad, and covers a whole range of aspects in which the environment has to be protected. The efficient management of solid and liquid waste in major cities is one of the core priorities of the national policy. The national policy basically outlines guidelines and regulations that must be adhered to in order to protect the environment from pollution. The policy document clearly states the duties and responsibilities of national and provincial governments, municipalities, civil society and individuals in terms of their roles and expectations. The national policy on waste management has a clear articulated strategy for monitoring and evaluating efficiency in the collection, disposal and management of solid and liquid waste in all major South African municipalities. Although, the national policy is relevant, suitable and feasible; the implementation of the policy, especially with respect to disposing of waste produced by food outlets operating in Pretoria CBD has been a challenge to the CTMM. As a result, the overall efficiency in the management of waste from food outlets operating in and around the City of Tshwane has so far been less than satisfactory. There is room for improvement in terms of the efficient collection and disposal of waste. The policy document aims to deal with issues related to the integrated management of pollution and waste in all municipalities of South Africa, and has two

specific objectives. In view of the fact that food outlets are major stakeholders in the efficient management of waste, it would be strategically beneficial for the thousands of food outlets operating in and around the City of Tshwane to benefit from the policy formulated by the DEAT.

According to UNEP (1992), pollution is the introduction into the environment of any substance including radiation, heat, noise and light that has or results in direct harmful effects to humanity or the environment, or that makes the environment less fit for its intended use. It also defines the natural environment as the biosphere in which people and other organisms live. It consists of renewable and non-renewable natural resources such as air, water (fresh and marine), land and all forms of life, natural ecosystems and habitats and spatial surroundings modified or constructed by people, including urbanized areas, agricultural and rural landscapes, places of cultural significance and the qualities that contribute to their value.

Integrated pollution and waste management is a holistic and integrated process of management aimed at the prevention and minimization of pollution at the source of pollution or contamination, and a way of managing the adverse impact of pollution and waste on the environment. The process is equally dedicated in the identification and implementation of suitable and feasible remedial actions. The South African Department of Environmental Affairs and Tourism (DEAT) is interested in prevention of pollution, minimization of waste, cross-media integration and soliciting support from the various branches of government and civil society in combating the risk factors for environmental pollution. This research work is in line with the strategic priorities of the DEAT, and has the potential to assist the organization in its effort to ensure the efficient management of solid and liquid waste in the City of Tshwane. The study was conducted based on a representative sample of food outlets that operate in and around the City of Pretoria. Empirical evidence was gathered on key factors that affect the management of waste produced by food outlets in and around the City of Pretoria in a form of raw data. The data gathered as part of the study was subsequently analyzed, influential factors were identified based on robust statistical methods of data analysis, and feasible recommendations were

made with a view to improve the current level of efficiency in the management of solid waste from food outlets operating in the CTMM.

Data was collected from a random sample of 332 food outlets operating in the Central Business District (CBD) of the City of Pretoria. The 332 food outlets were selected from the four districts constituting the CTMM based on stratified random sampling and probability proportional to size (PPS) techniques. From each food outlet, information was gathered on the management of solid and liquid waste. Managers and owners of the food outlets as well as employees were asked questions related to waste disposal, cleanliness at the workplace, and their personal opinion on the proper disposal of waste. Hence, data was gathered on a large number of socio-economic, demographic, environmental and sanitary variables that are related to efficiency in the disposal of solid and liquid waste. Descriptive as well as multivariate statistical methods of data analysis were used for assessing efficiency in the proper disposal of solid and liquid waste at the food outlets in the sample.

Epidemiological measures of effect, such as odds ratios and risk ratios were estimated (point and interval estimates), and interpretations were provided for major findings. Odds ratios and risk ratios are epidemiological measures that are commonly used to compare the likelihood of failure of an irresponsible food outlet operator in disposing of waste properly in comparison with a responsible operator of food outlet who disposes of waste properly (Dawson and Trapp, 2004). The theoretical reliability of all fitted models was assessed using standard diagnostic procedures. Finally, suitable and feasible recommendations were made to the CTMM, based on findings of the study, with a view to improve efficiency in waste disposal at food outlets operating in and around the City of Pretoria.

Many food outlets are unable to manage the wastes they generate in the course of doing business. This failure of the food outlets to manage waste efficiently tends to adversely affect the environment. During civil actions i.e. when municipal workers decide not to go to work due to labour-related demands), wastes are left uncollected from the streets. Such disruption in the cycle of routine waste collection and disposal exacerbates the already desperate condition of waste collection and disposal within the CTMM.

The purpose of the study was to identify key predictors of poor waste disposal in the CBD of Pretoria, and propose feasible and suitable recommendations so that, where possible, appropriate remedial actions could be taken by the relevant authorities of the City of Tshwane Metropolitan Municipality (CTMM). Sampling was conducted based on the list of all registered and actively operational food outlets conducting business in the CBD of Pretoria. The sampling frame of food outlets operating in the City of Tshwane was obtained from the Department of Trade and Industry (DTI). The map of the City of Tshwane was obtained from the Geographical Information System Department of the CTMM. Additional information on food safety, license requirements, environmental and health-related regulations and legislation were obtained from stakeholders such as the DEAT, Statistics South Africa, the Department of Trade and Industry (DTI) and the Department of Health (DOH).

The study is descriptive and cross-sectional and in such studies, data gathering is conducted only once and there is no follow-up study or repeated assessment. As such, data gathering was conducted at each of the 332 food outlets in the sample only once as part of the study. The data gathered as part of this study was analyzed using statistical methods such as frequency tables, summary statistics, Pearson's chi-square tests of association and binary logistic regression analysis. Odds ratios obtained from binary logistic regression analysis were used as epidemiological measures of effect. Odds ratios estimated from binary logistic regression analysis were adjusted for potential confounding variables. Confounding variables distort the true nature of relationship between an exposure and outcome variable. Adjusting for confounding variables is a standard technique in which the effect of potential confounding variables is controlled in the process of quantifying the strength of association between an exposure and outcome variable of study (Hosmer and Lemeshow, 2000).

## **1.2. BACKGROUND OF STUDY**

There are some critical issues that serve as background for this study. Food outlets are generally well known for the generation of high volume of solid and liquid wastes. There is room for improvement of the current level of efficiency in the management of waste

produced by food outlets. In terms of the strategic plan formulated by the DEAT to improve efficiency in the management of waste, food outlets are a major stakeholder, and no progress can be made unless food outlets are involved in the implementation of the plan drawn by the DEAT. Each of the issues raised below is a well known and deeply ingrained problem related to food outlets. Waste from food outlets can potentially contribute to environmental pollution if it is not effectively managed.

Although the CTMM is doing its best in terms of properly disposing of solid and liquid waste, the streets of Pretoria are littered with broken bottles and garbage from food outlets. Surely, there is room for improvement, considering the fact that Tshwane is the Capital City of South Africa and the seat of the Parliament for the African Union. The municipal rates paid by residents of Tshwane should be adequately utilized for ensuring clean streets in all parts of the city. However, the situation on the streets does not reflect this expectation.

There is a significant accumulation of solid waste especially in townships such as Mamelodi and Marabastad, and at various taxi ranks in and around the City of Pretoria. There is a shortage of essential facilities such as trash cans, seats, shelters, public toilets and clean tap water at taxi ranks and public gathering arenas. Some food outlets do not have properly functioning toilets and washrooms which are essential requirements for this class of business. Some food outlets, taxi ranks and public gathering arenas are often characterized by bad smell and large accumulation of solid and liquid waste. Such places are conducive for the spread of diseases such as food poisoning and diarrhoea unless they are controlled and managed efficiently by the CTMM. Not enough is known so far on the extent to which efficiency in waste disposal can be improved in view of the fact that there is lack of empirical evidence in this area of research interest. Not enough research has been done in the CBD of Pretoria to assess and identify factors that affect efficiency in proper waste disposal. There is a shortage of studies in which factors that contribute to poor environmental sanitation and the accumulation of solid and liquid waste in the CBD of Pretoria have been quantified.

Low level of awareness on waste recycling plays a major role in compounding the issue of waste management in relation to the efficient utilization of resources such as broken bottles, empty cans, used goods, plastic bags, etc. Far from being put to economic use, broken bottles are harming pedestrians and school children in addition to polluting the environment and decreasing the beauty of the City in the eyes of visitors and residents. Ratepayers would be unhappy with the level of incompetence, inefficiency and indifference. Some inhabitants of the CBD and some visitors to these areas do not have adequate respect for environmental sanitation in view of the fact that they demonstrate total disregard for cleanliness of the streets in the city. Such people often throw away rubbish on the streets. Examples of such rubbish are beer bottles, empty cans and used food packages. Empty bottles break into harmful pieces as they are thrown onto the streets from moving taxis and private cars. This scenario clearly demonstrates the need for sustained education and an awareness programme on environmental sanitation and cleanliness. The problems can further be addressed enacting suitable municipal by-laws that are relevant to proper waste disposal and environmental sanitation. The CTMM has municipal by-laws on the collection and disposal of waste that outline the responsibility of inhabitants of Tshwane. While the by-laws are very much helpful for environmental sanitation and proper waste disposal, enforcement seemed to be the challenge.

In the absence of empirical evidence, it would be almost impossible for the CTMM authorities to take necessary remedial actions of intervention. While environmental pollution is known to be a major offense in countries such as Switzerland, Sweden, the USA, Canada, England, Germany, Japan, Singapore etc, the same cannot be said about South Africa although the Department of Environmental Affairs is mandated to ensure the proper and efficient disposal of solid and liquid waste. This study aims to generate empirical information and data for the assessment of factors that contribute to poor waste disposal in and around the City of Tshwane.

The key challenges that could be contributing to the problem of inefficient treatment and disposal of waste are as follows:

- Shortage of logistical and financial resources. This situation has resulted in illegal dumping and an apparent reluctance on the part of some disposal site owners to comply with the current waste disposal standards.
- Lack of advanced technology that is required for efficient waste management and collection by the CTMM. Limited technical and environmental expertise at the CTMM has had a negative impact on overall cleanliness.
- Poor planning in terms of allocation of resources and manpower.
- Inadequate waste treatment facilities, including medical waste, are not properly managed, and will be unable to comply with the expected standards. They are also often poorly located and create unacceptable environmental conditions for adjacent communities.
- Poor enforcement of legislation and municipal by-laws.
- Poor sorting of waste and source reduction at the food outlets.
- Shortage of trash cans available to the general public at taxi ranks and streets.
- Scavenging of food waste by homeless people
- Narrow streets and shortage of infrastructure
- Chaotic situation at taxi ranks
- Large number of street vendors selling food to people
- Shortage of sidewalks
- Shortage of rubbish bins and public toilets on the streets
- High rate of unemployment and poverty
- Large number of hawkers and vendors conducting business on streets
- Failure of drivers to respect traffic regulations
- Drunken people throwing away empty bottles and cans freely on the streets
- Disregard for proper waste disposal by visitors from outside Pretoria City.
- High influx of immigrants into Pretoria CBD in search of jobs and livelihood.
- Ineffective controls within the larger metropolitan area of CTMM.
- Dirty taxis and vehicles being washed on the streets and sidewalks

### **1.3. RATIONALE OF STUDY**

Maintaining the overall cleanliness of the City of Tshwane contributes significantly to the quality of life, environmental and personal health as well as sanitation. Communicable diseases are unable to spread in a clean city where waste is disposed of properly. In this respect, this particular study has numerous direct benefits to inhabitants and consumers living in the CTMM areas. The study is designed to identify key factors that might be responsible for poor waste management and disposal. By identifying and quantifying such risk factors and by suggesting feasible recommendations based on concrete findings of research, it will enable planners and policy makers in the CTMM to take appropriate actions that are helpful for improving efficiency in proper waste disposal in the City of Tshwane and its surroundings.

Valuable lessons from this study could be extended to other cities in South Africa and elsewhere. Empirical evidence is essential for intervention by planners and policy makers. This study is based on a highly reliable epidemiological measure of effect (the odds ratio) that quantifies the factors that are responsible for poor waste disposal associated with key predictors of poor waste disposal.

### **1.4. RESEARCH QUESTIONS AND HYPOTHESES**

The research proposal attempts to provide adequate answers to each of the following key research questions based on a representative sample and results estimated from binary logistic regression analysis:

- (1) What are the socio-economic, demographic and sanitary characteristics of operators of food outlets conducting business in the CBD of the City of Tshwane?
- (2) What is the current level of efficiency in the collection and disposal of solid and liquid waste produced by food outlets operating in the CBD of the City of Pretoria?

- (3) What key socio-economic, demographic, sanitary and health-related factors affect the efficiency in the collection and disposal of solid and liquid waste produced by food outlets operating in and around the City of Pretoria?
- (4) What are the points and interval estimates of the odds ratios (epidemiological measures of the likelihood of improper disposal of waste) of key factors that affect efficiency in waste disposal? Point estimates and 95% confidence intervals are to be estimated for each influential risk factor.
- (5) What could be done to improve efficiency in the management and disposal of waste produced by food outlets operating in and around the City of Pretoria?

### **1.5. OBJECTIVES OF STUDY**

The objective of study is to investigate and identify factors that are responsible for inefficiency in the management and disposal of wastes produced by food outlets currently operating in the CBD of Pretoria.

The study has the following specific aims and objectives:

- (1) To investigate the socio-economic, demographic and sanitary conditions of food outlets currently conducting business in the CBD of Pretoria City.
- (2) To assess the current level of efficiency in the collection and disposal of solid and liquid waste produced by food outlets operating in the CBD of Pretoria.
- (3) To identify factors responsible for the inefficient management and disposal of solid and liquid waste produced by food outlets operating in the CBD of Pretoria.

## **CHAPTER 2: REVIEW OF LITERATURE**

### **2.1 INTRODUCTION**

In order to have an insight into the factors responsible for inefficient management of wastes from food outlets, it becomes imperative to have an understanding of what has been done in the past as well as current interventions. Review of the literature shows that there are numerous waste disposal challenges in Pretoria CBD. Massive amount of waste is produced by food outlets operating in and around the CBD on a daily basis which poses collection and disposal challenges. These wastes include wrapping materials, plastic foils, paper used for packing food, carton, plastic and glass bottles, wasted food, cooking oil, vegetables, meat, cereals, beverages, water, beer, alcohol drinks, etc. The rate at which waste accumulates on the streets from food outlets is much faster than the rate at which it is collected by municipal workers responsible for waste collection and disposal. The taxi ranks are almost always full of people who eat fast foods purchased from food outlets. Such food is wrapped up by plastic and paper materials as well as plastic, paper and glass bottles containing drinks such as beverages and fruit juice. There are not enough dustbins at the taxi ranks and venues where people congregate. Even if there are a few dustbins at such locations, they are almost always full and poorly serviced. Garbage produced by passengers and people on the streets is collected only after-hours, and there is accumulation of waste at public places where large crowds gather. Some of the people at such places drink alcoholic beverages, and smoke heavily in addition to eating fast food purchased from food outlets.

The City of Tshwane is the capital of South Africa, and is quite cosmopolitan. There are numerous government offices, private companies, businesses, taxi operators, buses, shops, food outlets, street vendors, hawkers, schools, old age homes, large shopping malls, etc in the city. The city has large train stations, a zoo, public libraries, several botanical gardens, playing grounds, etc providing services to the inhabitants of the city as well as visitors. All these people have to eat, drink, use toilets, and conduct business. At places where people congregate in large numbers, there is often a shortage of dustbins and public toilets. In short, the facilities available to the general public are too few and restricted for

accommodating the large volume of solid and liquid waste produced routinely on an hourly basis.

Researchers such as Anon, (2000) have shown that partnerships between the various food outlet owners and operators and the CTMM have the potential for improving efficiency in the removal and proper disposal of solid and liquid waste. Such a partnership was tested in Khayelitsha, and was found to be highly efficient (Anon, 2000). The scheme used a community based approach in which solid waste was gathered from door to door, and members of the community were educated on the benefits of proper waste disposal and personal hygiene.

A research conducted by the Palmer Development Group in 1996 for the South African Water Research Commission (WRC) on the management and disposal of solid waste in urban areas of South Africa suggested that a comprehensive monitoring and evaluation plan for the management of solid waste, public awareness, door to door collection of waste, source segregation of non biodegradable waste, recycling of waste to useful products such as plastic mats, waste paper products, implementation of composting by vermi-compost technology, marketing the compost to the various communities and sanitary education are key to improving overall efficiency in proper waste disposal (PDG, 1996). Based on research conducted in Mexico City by Sierra-Vargas et al. (2009) the accumulation of solid and liquid waste in a large metropolitan area such as Pretoria is no less risky than heavy pollution that arises from automobiles and industries in terms of causing diseases such as asthma.

Swilling and Hutt (1999) have reported that door to door collection of solid waste several times a day as well as incentives are essential for maintaining cleanliness and environmental sanitation especially in busy streets and taxi ranks where large numbers of people congregate. According to the authors, it is helpful and wise to provide incentives to members of the community who lead by example in terms of the collection and proper disposal of waste. Federico et al. (2009) have reported that a city as large and populated as Pretoria needs a well integrated strategic environmental assessment plan that could be used

for monitoring and evaluating efficiency in proper waste removal and disposal from food outlets in order to ensure public health and environmental sanitation.

Commercial leaflets are circulated by businesses to people on the streets with a view to increase awareness about promotional material and merchandize that are on sale. Once people read the information on the leaflets, they have a tendency of dropping them on the streets if they are not interested in keeping them. Although the number of people living and doing business in Pretoria has increased sharply since 1994, the capacity of the city in terms of providing its large population with enough dustbins and public toilet facilities has not improved at the same pace of growth. A large number of people go to government offices, the banks, schools, trading places and vendors on a daily basis. The number of people doing business related trips to Pretoria has increased sharply since the first democratic elections were held in Pretoria in April 1994. As more people seek employment opportunities in Pretoria, net migration from rural to urban city centres such as Pretoria has increased sharply according to the Community Survey conducted by (SSA, 2007).

The City of Tshwane Metropolitan Municipality provides the following municipal services to its roughly 3 million residents:

- Assessment of rates application forms for rebates and grants
- Account and Service application: Household consumer
- Customer Care
- Clinic services
- Health Care: TB Care in Tshwane
- Housing
- Municipal tariffs and application fees
- Environmental Management
- Integrated Development Plan
- Municipal Courts
- Policy on restricted access to public places
- Declared weeds and invader plants

- Refuse removal
- Rietvlei water treatment plant
- Streetlight services
- Noise Management draft policy
- Traffic Control Service Delivery Tariffs and Events Management Contact Details
- Waste Management

The CTMM allows the general public to use garden refuse sites at Akasia, Dorandia, Magalieskruin, Menlo Park, Mountain View, Philip Nel Park, Watloo, Eerstrust, Centurion, Kruger Avenue, Rooihuiskraal and Claudius. The CTMM allows the general public to use dumping sites at Derdepoort, Garstkloof, Onderstepoort, Hatherley, Kwaggasrand and Valhalla. The strategic priorities of the CTMM are the following:

- Managing and developing infrastructure
- Developing the economy
- Ensuring community safety
- Building and sustaining communities
- Developing and enhancing natural resources
- Providing municipal services such as rubbish removal and waste management
- Governing well
- Enhancing its image as the capital city of South Africa (CTMM, 2008).

## **2.2 CHALLENGES RELATED TO WASTE DISPOSAL**

The CTMM has a fully fledged and independent unit dedicated for the proper management of waste and rubbish removal. The services provided by the municipality are funded by funds collected from tax and rate payers who reside within the municipality which in turn employ workers to remove rubbish and dispose of waste them properly. According to the strategic and operational plans of the CTMM, the efficient collection and disposal of waste as well as ensuring general environmental cleanliness in Pretoria CBD is a top priority. The

municipality is responsible for the provision of efficient and reliable service delivery, while inhabitants are responsible for paying for services provided to them promptly. The CTMM relies on municipal bylaws that specify the roles and responsibilities of inhabitants as well as penalties for inhabitants who fail to pay for services delivered. However, based on the 2008 annual report produced by CTMM (2008), it could be inferred that the municipality is still experiencing the following challenges in terms of waste collection and disposal:

- Lack of capacity in terms of staff and specialized vehicles required for rubbish removal and waste disposal
- Frequent wage disputes and protracted industrial strike actions by employees responsible for rubbish removal and waste disposal
- Lack of technical skills required for advanced waste processing
- Large influx of migrants from rural areas who often come in search of employment opportunities
- Lack of regard for recommended methods of waste disposal by inhabitants
- Failure of inhabitants and visitors to effectively utilize rubbish bins and waste dumping sites
- Failure of a sizeable proportion of inhabitants to pay for municipal services promptly
- An increase in road accidents, abuse of street names and power lines, damage to traffic lights, etc.
- Shortage of roads to accommodate the sharply increasing number of vehicles

- Shortage of traffic and environmental safety officers responsible for enforcing municipal bylaws related to proper waste disposal

Ensuring efficient waste removal and disposal in large metropolitan cities requires commitment from all stakeholders. Khan (2009) suggested that health education, door-to-door campaigns, legislation as well as incentives should be used for ensuring efficiency in waste collection, removal and disposal. In many developed nations of the world, ordinary citizens pay due attention to cleanliness, proper waste disposal and the efficient utilization of municipal services such as waste disposal. Key examples in this regard are Geneva, Singapore and major cities in North America. By contrast, most cities in Sub-Saharan African countries struggle to keep their cities clean and environmental-friendly. This could be due to poverty, shortage of funds for essential municipal services, lack of awareness, illiteracy, high levels of unemployment and crime, massive influx of migrants into big cities in search of jobs and livelihoods, hawkers, etc. As South Africa is the major economic powerhouse of the African continent, it is natural for people from neighbouring countries to travel to major South African cities in search of jobs and employment opportunities. The limited infrastructure of the CTMM cannot cope with large numbers of migrants who travel to the city in search of livelihood and employment opportunities. It is essential to expand basic infrastructure in order to accommodate the current influx of visitors into the CTMM.

Although waste is disposed of properly in residential suburbs where residents pay for standard municipal services, waste produced by food outlets operating in the central business district is not often disposed of properly. Rubbish accumulation in the streets is a common site, especially at taxi ranks. Hawkers and street vendors sell food, drinks, fruits and vegetables on the streets of the city, and accumulate volumes of rubbish that are often not disposed of properly. At times when there are prolonged industrial strikes by municipal workers, it is commonly seen that volumes of rubbish are left on the streets for two days or more. Some people often throw away rubbish on the streets with no fear of prosecution or reprisal by members of the community. This is done partly due to lack of awareness and complete disregard for municipal laws. Mangkoedihardjo et al. (2007) suggested that

aggressive law enforcement is key to improving efficiency in proper and responsible waste management in metropolitan areas.

Efficiency in waste disposal has always been an area of strategic interest to both developed and under-developed nations of the world including South Africa. The world's most developed nations possess the infrastructure and capacity needed for proper waste disposal, efficient waste utilization and recycling of waste. In comparison with developed nations such as Switzerland, Sweden, Canada, Japan and the USA, South Africa lag behind due to a number of factors such as poverty, high unemployment, low level of awareness and education, low level of income, massive influx of immigrants, etc. Based on a study conducted in the Vidgaon village of India, Nimbalkar et al. (2009) reported that poverty among the masses and massive influx of immigrants from rural to urban areas constitute a major challenge to city councils in terms of maintaining environmental cleanliness and proper waste removal and disposal. Rao (2009) also arrived at a similar conclusion based on a study conducted in India.

According to USEPA (2007), environmental pollution is defined as the introduction into the environment of any substance including radiation, heat, noise and light that has or results in direct harmful effects to humanity or the environment, or that makes the environment less fit for its intended use. Currently, in the United States, 32.5 percent of waste is recovered and recycled or composted, 12.5 percent is burned at combustion facilities, and the remaining 55 percent is disposed of in landfills. Efficiency in proper waste disposal has both scientific and legislative aspect in the sense that scientifically correct decisions cannot be implemented without the proper legislative tool and mandate. Efficiency in proper waste disposal is also significantly related to individual awareness, socio-economic and demographic factors as well as level of education. Based on research findings reported by WHO (2007), on the importance of proper waste disposal to primary health care, illiteracy and poor waste disposal are shown to be significant risk factors. The ability of today's generation to efficiently utilize the environment and dispose of waste contributes to the quality of life of tomorrow's generation. While the developed nations are far ahead of Sub-Saharan African countries in terms of the efficient disposal of solid and liquid waste, most of the countries in Sub-Saharan African countries including South

Africa are not doing so well (USEPA, 2007). This assessment by the Environmental Protection Agency is in agreement with findings by Özkaynaka et al. (2008) in which the impact of outdoor sources of hazardous air pollutants was quantified.

DEAT (2007) outlined the core responsibilities of municipalities such as the CTMM in terms of ensuring efficient waste disposal and utilization. The strategic White Paper produced by DEAT clearly spells out the specific responsibilities of the CTMM as well as individual stakeholders such as food outlets. The Draft White Paper is an overarching policy framework that attempts at protecting the environment and renewable and non-renewable natural resources such as air, water (fresh & marine), land and all forms of life, natural ecosystems and habitats, spatial surroundings modified or constructed by people, including urbanized areas, agricultural and rural landscapes, places of cultural significance and the qualities that contribute to their value. DEAT has also produced a collection of four strategic papers that outline its strategy on the management of waste, government policy, international conventions, agreements, treaties and protocols relating to integrated pollution and waste management and principles from the Draft White Paper on environmental management for South Africa.

The vision of DEAT is to develop, implement and maintain an integrated pollution and waste management system which contributes to sustainable development and a measurable improvement in the quality of life through harnessing the energy and commitment of all South Africans for the effective prevention, minimization and control of pollution and waste. The Draft White Paper argues that economic growth and job creation can be achieved through the efficient utilization of natural resources, proper waste disposal, and adherence to the framework on integrated pollution and waste management proposed by DEAT to protect the environment and natural resources from degradation. In view of the fact that food outlets are major sources of solid and liquid waste, they are a key stakeholder in the effort made by DEAT. Roht et al. (2005) clearly shows that operational policies and strategies used by the DEAT have been widely tested and successfully implemented in various parts of the world.

As far back as in 1992, the United Nations Conference on Environment and Development established an agenda called Agenda 21 for world action on the environment and increased international efforts towards sustainable development (UNEP, 1992). These international decisions form the broad context for pollution prevention and waste minimization in South Africa, and this Integrated Pollution and Waste Management policy is part of the South African government's efforts to meet the goals of Agenda 21. Certain international agreements, such as the Framework Convention on Climate Change dealing with greenhouse gases, and the Basel Convention, which addresses trans-boundary movements of hazardous waste, impose specific requirements on South Africa. These requirements are being addressed as part of the integrated pollution and waste management policy process by the DEAT.

Temporary and casual workers are often used for assisting in waste removal by the CTMM although the method is not reliable. According to GJMMC (2000), it is not always helpful to employ casual and temporary workers for waste collection and disposal. Major cities often employ casual workers to assist in waste disposal. Temporary staff are hired at the gate or ferried in trucks between depots according to daily requirements. The casual workers are put to work at sorting centers as the need arises. Such casual workers are not entitled to benefits such as medical aid, housing subsidy and salary increase. Their duration of employment ranges from a single day to several months. Such temporary workers are poorly paid and least motivated for doing a proper job.

The availability of a highly motivated workforce is crucial for maintaining the cleanliness of the city of Pretoria. The operational and strategic objectives of the Department of Environmental Affairs and Tourism cannot be implemented without having a highly motivated and adequately resourced workforce at the various municipalities. Job satisfaction is crucial for satisfactory performance and good service delivery on a sustainable basis. The career opportunities of most refuse workers are narrow, ranging from street cleaners to drivers or gardeners. Employees who work as waste cleaners often struggle in terms of raising children, sending them to school, buying nutritious food or affording basic necessities such as medication. As a result, they often engage in extra activities as part of their effort to earn more. In so doing, they often neglect their duties to

the CTMM. As a result, they are seen as unreliable or undedicated workers by the CTMM and the various communities who rely on their services. They are unable to improve their skills, and cannot afford to move away to other places for fear of losing the little they have. In effect, the CTMM relies on a de-motivated workforce responsible for rubbish removal and the proper disposal of waste. Experience from clean cities of the world such as Geneva shows that the efficient disposal and management of waste depends on the capacity of the CTMM to utilize a highly motivated and adequately equipped workforce.

### **2.3. REGULATIONS RELATED TO WASTE DISPOSAL**

There are regulations that are helpful for ensuring the efficient collection of rubbish and waste from the streets of Pretoria as well as the efficient disposal of waste. Inhabitants of the CBD of Pretoria are entitled to living in a clean environment in terms of Act number 108 of 1996 of the South African constitution as well as the Bill of Rights (The South African Government, 1996). The most pertinent fundamental right in the context of integrated pollution and waste management is the Environmental Right (Section 24 of the Bill of Rights) that states that “Everyone has the right to an environment that is not harmful to their health or well-being; and to have the environment protected, for the benefit of the present and future generations through reasonable legislative and other measures that (i) promote conservation; and (ii) secure ecologically sustainable development and the use of natural resources while promoting justifiable economic and social pollution and ecological degradation; (iii) promote development. This section of the Bill of Rights guarantees the people of South Africa the right to an environment not detrimental to human health or well-being, and specifically imposes a duty on the State to promulgate legislation and take other steps to ensure that the right is upheld and that, among other things, pollution and ecological degradation is prevented”.

The essence of this research work is in line with global and local areas of strategic interest. Efficiency in waste disposal has always been an area of strategic interest to both developed and under-developed nations of the world including South Africa. The world’s most developed nations possess the infrastructure and capacity needed for proper waste disposal,

efficient waste utilization and recycling of waste. In comparison to these developed countries, South Africa lags behind due to a number of factors such as poverty, high unemployment, low level of awareness and education, low level of income, massive influx of immigrants, etc.

Since the year 2000, the following municipal by-laws have been promulgated by the CTMM in order to ensure law and order, good quality of life, efficiency in the administration of the City of Tshwane and its surrounds, as well as general safety and environmental cleanliness in the City of Tshwane and its surroundings:

- Cemeteries and Crematoriums (effective from 29/02/2005)
- Child care services: Crèches and crèches-cum-nursery schools (effective from 26/05/2004)
- Control of Outdoor Advertising (effective from 1 Feb 2006)
- Credit Control (effective from 27/02/2002)
- Establishment of the Tshwane Youth Development Unit (effective from 2 August 2007)
- Fire Brigade (effective from 01/07/2005)
- Homes for the aged (effective from 26/05/2004)
- Keeping of animals, birds and poultry (effective from 26/05/2004)
- Keeping of Bees (effective from 16/03/2005)
- Operation and management of initiation schools (effective from 26/05/2004)
- Parking meters (effective from 29/02/2005)
- Property Rates (effective from 1 July 2008)
- Public Amenities (effective from 29/02/2005)
- Rules and Orders (effective from 18/09/2002)
- Sanitation by-laws (effective from 10/09/2003)
- Solid Waste (effective from 25/05/2005)
- Standard electricity supply by-laws (effective from 25/06/2003)
- Street trading (effective from 16/03/2005)
- Substance Abuse (effective from 29 May 2008)

- Tshwane Market (effective from 4 June 2008)
- Water supply by-laws produced by the CTMM (2008) (effective from 05/11/2003)

Each of the municipal by-laws listed above is currently enforced and implementation of the by-laws is a key performance monitoring indicator (CTMM, 2008). Although the objective of the municipal by-laws is to improve the quality of life in the City of Pretoria, implementation has not been totally efficient. Some of the by-laws have been contested by various parties that were adversely affected by the laws. Two key examples are the by-laws related to sanitation and street trading. Both are poorly enforced although they are highly related to the overall cleanliness of the city.

Shortly after the democratic elections held in South Africa in April 1994, the South African Government used legislation as a tool to improve waste information systems (WIS). This was done in order to improve efficiency in reducing pollution and managing waste based on modern information management techniques used in most developed nations of the world. The measure was informed by due consideration for the need to protect the environment and implement regulations related to waste management optimally. While the WIS was well articulated on paper, there were several hurdles in implementing it. Some of the major obstacles were illiteracy, lack of commitment from stakeholders, poor consultation with stakeholders, lack of technical skills, lack of infrastructure, shortage of funding and resources, etc. Some of the measures put in place called for vigorous measures in managing pollution and waste reduction, and were integrated with a range of waste management operations conducted by the various municipalities (Republic of South Africa, 2000a).

According to Heeks (2002), although the Waste Information System (WIS) had the potential to dramatically improve efficiency in waste management, it was not implemented due to lack of resources and suitable action plans of activities. In most cases, the various stakeholders were not even properly motivated by the merits and potential benefits of the WIS. As a result, the WIS has failed to realize its expected goals and objectives. Some of the stakeholders have failed to embrace the principles of WIS. In order for information

systems to be sustainable, one must understand the underlying motivations or needs of key stakeholders. The WIS must be shown to be sustainable and feasible in terms of available resources and level of skills. It should also be shown to yield practical benefits in terms of quality of life, revenues, attracting potential businesses into the CBD, creating job opportunities, etc.

While the WIS is strategically beneficial to all spheres of society within South Africa, not enough is known about the merits and technical requirements of the policy. The roles and responsibilities of the various stakeholders have not been adequately outlined in the WIS. As a result, the WIS has not been fully embraced by the various stakeholders such as local municipalities and community based non-governmental organizations dedicated for the proper management of waste in densely populated urban areas within South Africa. The national government has not played its part adequately to ensure the successful implementation of the WIS. This could explain why the WIS has not produced tangible results in terms of the reduction of pollution and waste in densely populated urban areas. The development of an efficient waste information system is more than just collecting routine data on waste; it is about facilitating the improved management of waste by providing timely, reliable information to the relevant role-players. It is a means of supporting the waste governance challenges facing South Africa. Such challenges range from strategic waste management issues at national government to basic operational challenges at local government and the various municipalities.

Heeks (2002) argues that the WIS cannot lead to the improved management of waste in the country in its present form, and that it should be re-formulated after due consultation with the relevant stakeholders. He also calls for an awareness campaign as well as the provision of adequate resources and skills training. Reliable statistical information is crucially helpful for decision making and planning. Accurate reports are based on reliable data sets gathered on key performance monitoring indicators. Accurate statistical information is crucially helpful for the allocation of scarce resources, for making informed planning and decision, for ensuring compliance with monitoring and enforcement activities, for promoting community participation, and for maintaining the infrastructure. Godfrey (2007) has reported that plans of actions carried out by the various local municipalities are poorly

integrated and coordinated mostly due to lack of reliable statistical information on waste management. The need for reliable data on waste management corresponds closely with key waste management challenges currently facing the country. The approach made by the national government must be in line with the approach made by the various local governments and municipalities. However, this has not been done adequately.

According to UNDP (2003), South Africa has one of the most advanced constitutions in the world in terms of the protection of human rights including the right to a safe and healthy environment. In addition, it has some of the most progressive environmental legislation in the world. However, there is a perception that the national government is reluctant to enforce regulations and legislations that are meant to protect the environment from abuse. Examples of such areas are failure to enforce pollution and waste-related legislation. A public perception exists that the national government is not doing enough to enforce legislation in areas related to proper waste disposal and the reduction of environmental pollution. Industrial waste is known to pollute drinking water in some areas of South Africa. The failure of the national government could be attributed to lack of awareness, lack of resources, poverty, unemployment and general lack of regard for environmental sanitation by major industrial and mining companies UNDP (2003). According to DEAT (2006), only 43.6% of the 1203 landfill sites in South Africa are known to be permitted and of those permitted, little to no information exists on their compliance with permit conditions. Of the non-permitted/unknown permit status landfill sites, in excess of 90 % are thought to be municipal landfills. The biggest culprit of non-compliance in the landfilling of waste, it would therefore appear, is government itself. The need for cooperative governance between the three spheres of government, supported by reliable, accurate waste information is therefore imperative in improving the levels of compliance with waste and pollution legislation. Increasing compliance with environmental quality and protection legislation and authorisations has been identified as a strategic objective of DEAT, and this is an objective that needs to be supported by reliable and comprehensive data and research.

There are 26 international agreements (17 conventions, 4 protocols, 3 treaties and 2 agreements) which pertain to integrated pollution and waste management. Of these 26 agreements, 19 have been acceded to or ratified by South Africa (DEAT, 2007). The

following South African legislation fully or partially covers 12 of these international agreements: Prevention and Combating of Pollution of the Sea by Oil Act (6 of 1981) and regulations; International Convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualties Act (64 of 1987); Dumping at Sea Control Act (73 of 1980); Prevention of Pollution from Ships Act (2 of 1986) and regulations; Conservation of Agricultural Resources Act (43 of 1983); Nature Conservation Ordinances of the various provinces; Antarctic Treaty Act (60 of 1996); and Nuclear Energy Act (113 of 1994).

The Draft White Paper on Environmental Management Policy for South Africa sets a number of objectives for integrated pollution and waste management which will be addressed in this Draft White Paper on Integrated Pollution and Waste Management for South Africa. These objectives are: to prevent, reduce and manage pollution of any part of the environment due to all forms of human activity, and in particular from radioactive, toxic and other hazardous substances; to set targets, minimize waste generation and pollution at source and promote a hierarchy of waste management practices, namely reduction of waste at source, re-use, recycling and safe disposal as the last resort. There is a plan to regulate and monitor waste production, enforce waste control measures, and coordinate the administration of integrated pollution and waste management through a single government department. The plan hopes to set up a comprehensive information system on chemical hazards and toxic releases in order to track the movement and disposal of hazardous materials. The plan also hopes to establish a database that could be used for the production of reliable statistical reports on the tracking, management and disposal of waste and hazardous chemicals. The objective is to provide adequate protection to humans, animals, the infrastructure and the environment, and to promote cleaner production.

This Integrated Pollution and Waste Management policy is driven by a vision of environmentally sustainable economic development. This vision promotes a clean, healthy environment, and a strong, stable economy. By preventing, minimizing, controlling and remediating pollution and waste, the environment is protected from degradation. By increasing the use of cleaner production technologies, avoiding accidental and operational releases and reducing the non-productive costs of treatment, disposal and clean-up, a more efficient and competitive economy and a healthier environment will be established.

The South African government is committed to a programme of sustainable development that will deliver basic environmental, social and economic services to all, without threatening the viability of natural, built and social systems upon which these services depend (DEAT, 2007). In view of the fact that food outlets contribute to large volumes of solid and liquid waste, it is strategically crucial to improve the overall efficiency of the more than 1, 600 food outlets that are currently operating in the CBD of Pretoria in waste management.

According to the British Government, the proper disposal of waste is a constitutional obligation that should be enforced with full vigour in order to minimize environmental pollution, minimize the outbreak of communicable diseases in the community, and to improve the overall quality of life of all citizens (UKGR, 2007). This same principle has been adopted by member nations of the European Community over the past several years since 1990. Community policy has therefore had a major influence on waste and pollution legislation in Great Britain from at least as early as 1990.

Özkaynaka, et al. (2008) have used epidemiological measures of effect such as odds ratios and risk ratios to quantify the relationship between exposure to hazardous pollutants of the environment and the quality of life of the community. The study clearly shows that proper waste disposal contributes significantly to the overall quality of life of people by minimizing environmental pollution. The efficient disposal of waste by ordinary citizens depends on socio-economic and demographic factors such as level of education, type of occupation and respect for observing municipal by-laws related to waste disposal. Eisa (2006) pointed out that the proper and efficient disposal of solid and liquid waste is an essential public service that must be accomplished using legislation and municipal bylaws as a tool. Based on a comprehensive environmental study conducted in Indonesia, Mangkoedihardjo et al. (2007) have reported that legislative assistance is essential for the efficient disposal of waste in most developing nations of the world such as Indonesia and South Africa.

## **CHAPTER 3: METHODOLOGY**

### **3.1. INTRODUCTION**

The methods and materials used in this study are suitable for fulfilling the specific objectives of the study. The primary focus of the study is to gather baseline information on the volume and type of waste generated by food outlets operating in Pretoria CBD, and the extent to which such waste is disposed of efficiently. To this end, the methods and materials used in the study make an attempt to shade light on what the current situation looks like in terms of the type and volume of waste generated by the various food outlets operating in Pretoria CBD, along with the mechanisms used for waste disposal.

Both quantitative and qualitative information was gathered from operators or managers of food outlets as well as employees working in food outlets. Quantitative information was gathered by way of administering a structured questionnaire. The questionnaire used for data collection was pre-tested prior to use. Qualitative data was gathered in order to acquire information on subjective variables of study such as job satisfaction, degree of commitment for keeping personal hygiene and proper waste disposal, personal attitude toward waste removal and disposal, respect and concern for environmental sanitation, cleanliness, and the safety and customers purchasing food on a daily basis. In this study, all respondents in the study were literate, and could read, write and communicate easily. The principal data gathering instrument used in the study was a structured questionnaire. At each food outlet selected for the study, questionnaires were administered by trained interviewers. In addition to questionnaires, personal interviews and observations made by data collectors were used for collecting information from each respondent who took part in the study.

There is no unique method of data collection that is flawless. In this study, questionnaires and personal interviews were used for data collection. Both questionnaires and interviews have strong points as well as weak points. Personal interviews are often conducted fast, and researchers are able to gather data rapidly, thereby cutting down the cost of study. More over, personal interviews enable the interviewer to elaborate on tricky or difficult questions

by giving the necessary clarification as required by the respondents. However, the provision of such assistance to respondents during interviews can introduce bias into the study inadvertently. This is because some respondents get prompted to provide answers that would be pleasing to interviewers although such answers are not necessarily true. The other weak point of interviews is that they are costly and challenging to conduct.

Questionnaires have the benefit of being the same to all respondents in the study. Questionnaires do not vary from respondent to respondent, or from interviewer to interviewer during the data collection procedure. However, questionnaires require that each respondent has a fairly good understanding of the research being conducted. Also, the response rate of questionnaire-based surveys could be as low as 75% or less.

The variables of study used in this study involve nominal variables such as gender (male, female) as well as ordinal variables such as the extent to which waste is disposed of properly at the various food outlets (excellent, very good, good, poor, very poor). Order does not matter in nominal scales, whereas order matters in ordinal scales. The list of variables of study consists of well established indicators of proper waste disposal and awareness about the benefits of proper sanitation and personal hygiene. The variables of study also include socio-economic and demographic characteristics that are directly related to the type and volume of waste generated by the various food outlets, efficiency in the collection and disposal of waste, awareness about the benefits of cleanliness, proper waste disposal, personal hygiene and overall environmental sanitation.

The methods of data gathering and analysis used in this study were predominantly quantitative due to the nature of variables of study and the research questions that needed to be answered as part of the study. The extent to which qualitative research methods of data collection and analysis were used was quite limited. The response obtained from each questionnaire of study was verified, and validation of data was performed prior to data analysis and the interpretation of results. Data entry and analysis was done in the statistical package STATA version 10 (Svend, 2007).

The sample size and statistical power of study were determined in accordance with standard sampling techniques that are recommended for descriptive, cross-sectional surveys. The choice of statistical methods of data analysis was informed by the research questions that needed to be answered, and the nature of variables of study on which data was collected. Discrete variables such as gender were analyzed by using frequency tables and bar charts. Pearson's chi-square tests of associations were used for identifying variables that were associated with each other significantly. Binary logistic regression analysis was used for exploring the relationship between a dichotomous dependent variable of study and key independent variables of study that were influential. The reliability of all fitted statistical models was rigorously assessed before results of analysis were accepted.

Due consideration was made to all relevant ethical principles. Standard ethical principles were followed in the process of data collection. All participants in the study were adequately informed about the purpose and potential benefits of the study, and took part in the study voluntarily.

### **3.2. STUDY DESIGN**

The design of the study is cross-sectional and descriptive. This is because data is collected from respondents once, without follow-up. The study is designed in such a way that key values of parameters are described based on suitable epidemiological measures of effect. The principal methods of data analysis are descriptive statistics and the estimation of odds ratios. Data was gathered from a random sample of 332 food outlets in the CBD of the City of Tshwane. Data was collected based on personal interviews and structured questionnaires. Data analysis was done using statistical methods such as frequency tables, summary statistics, Pearson's chi-square tests of association and binary logistic regression analysis. Odds ratios obtained from binary logistic regression analysis were used as epidemiological measures of effect. Odds ratios estimated from binary logistic regression analysis were adjusted for potential confounding variables.

### **3.3. STUDY SITE**

The site of the study is the Central Business District (CBD) of the City of Pretoria. Roughly 1, 603 food outlets operate within the CBD of Tshwane (LEAP, 2006). It is well known that food outlets produce massive volumes of solid and liquid waste (dirty water, used cooking oil, soft drinks, etc) due to the nature of their business. The management of waste from food outlets constitutes a significant aspect of the overall responsibility of the City of Pretoria. Food outlets have the capacity to produce large volumes of trash, empty bottles, empty food packages, cigarette butts, empty food cans, dirty water, used cooking oil, soft drinks, etc on a regular basis. They are often busy, fully occupied, and the accumulation of trash is quite rapid, especially during peak rush hours and holidays. Hence, the management of wastes in the municipality is a challenging endeavour.

### **3.4. STUDY SAMPLE SIZE**

#### **3.4.1 Sample size**

The sampling frame of this study consists of the list of all food outlets including liquor stores selling food along with liquor operating in the CBD of the City of Tshwane. The sample size of study is determined using the statistical package **nQuery Advisor version 4** based on the following estimates obtained from previous studies:

Based on a survey conducted by the research consulting company LEAP CC Pty Ltd based in Pretoria in the year 2006, the total number of food outlets operating in Pretoria CBD was equal to 1, 603. This figure included all food outlets operating within the CBD including liquor stores selling food along with liquor to customers.

The level of significance of study,  $\alpha$ , is fixed at the 5% level.

In the year 2006, according to the company, the proportion of food outlets that do not dispose of waste properly according to municipal by-laws varied from 10 % to 15 %. The power of study,  $1 - \beta$ , is equal to 77%. The power of study is a measure of how sensitive the statistical test to be used in the study is. A power of study greater than or equal to 75%

is said to be robust in cross-sectional, descriptive studies of this type (Dawson and Trapp, 2004). Using the above assumptions, the adjusted sample size of study becomes equal to 332. It is worth noting that the sample size of study amounts to 21% of all food outlets operating in the CBD of Pretoria City.

### 3.4.2 Sampling technique and data collection

Systematic random sampling (Dawson and Trapp, 2004) was used for selecting eligible food outlets within Pretoria CBD. Eligibility of participants was determined based on willingness to take part in the study voluntarily, willingness to provide accurate information and records to interviewers, and operating food outlets within Pretoria CBD.

### 3.4.3 Definition of terms

$N$  = Population size of study = 1603

$n$  = Sample size of study

$K$  = Sampling interval = Ratio of population size to sample size of study. That is,  $K = \frac{N}{n}$

$\alpha$  = Probability of Type 1 error = Probability of rejecting a true null hypothesis by mistake  
= Level of significance of statistical test

$\beta$  = Probability of Type 2 error = Probability of accepting a false null hypothesis by mistake

$1 - \beta$  = Power of study

First, a complete list of all 1, 603 food outlets operating in the CBD was prepared. This list was used as a sampling frame. Every  $k^{th}$  food outlet on the list was selected where  $K$  denotes the sampling interval.  $K$  is given by:

$$K = \frac{N}{n} = \frac{1603}{330} = 5 = \text{Sampling interval.}$$

Hence, every 5<sup>th</sup> food outlet in Pretoria CBD was selected for the study. The process of selection continued until all 332 eligible food outlets were selected. In cases where a food outlet could not take part in the study (Example: Owner or manager not available for interview, Records not available, etc), the next food outlet on the list was selected for the study. From then on, every 5<sup>th</sup> food outlet was selected as usual.

For a descriptive, cross-sectional study of this type, a sample of size  $n=332$  and a power of 77 % are suitable (Dawson and Trapp, 2004).

### **3.5 STATISTICAL METHODS OF DATA ANALYSIS**

The outcome variable of study is discrete, and has 5 possible values. The following statistical methods of data analysis were used:

- Frequency tables and bar charts for each discrete variable of study.
- Summary statistics and box and whisker plots for each continuous variable of study
- Pearson's chi-square test of association was used to evaluate the strength of association between variables.
- Binary logistic regression analysis (Hosmer and Lemeshow, 2000) was performed in order to identify key risk factors for inadequate waste disposal. Unadjusted and adjusted odds ratios shall be obtained for influential predictor variables.
- Sensitivity and specificity tests were also performed in order to assess the reliability of the fitted logistic regression model.

The statistical package STATA version 10 was used for data analysis, data entry, checking and validation (Svend, 2007).

### **3.6 QUESTIONNAIRE OF STUDY AND DATA COLLECTION**

All eligible operators of food outlets that met the criteria of inclusion were selected for the study. Data was collected for this study using structured questionnaires (Appendix 3),

personal interviews and observation at the various food outlets. Data collection was done by visiting each of the n=332 food outlets in the sample of the study. Each participant in the study gave consent for the study, and willingly participated in personal interviews. Each participant read the letter of introduction written by the supervisor of study. Interviews were conducted by the researcher at various food outlets selected for the study. Three of the 332 respondents selected for the study could not understand English well enough, and so questions had to be translated into Zulu (2 respondents) and Sotho (1 respondent).

### **Measurement of variables**

Nominal and ordinal scales were used for the measurement of variables. Variables with possible values of Yes and No were measured based on nominal scales in which order did not matter. However, variables with possible values of 1, 2, 3, 4 and 5 were measured based on ordinal scales in which categories 1 and 5 denoted the lowest and highest possible levels respectively.

## **3.7. LIST OF VARIABLES AND THEIR LEVELS**

Two types of variables were used in the study. The first is the dependent or outcome variable of study. The second is the various independent or explanatory variables of study that affect the outcome variable of study.

### **3.7.1. DEPENDENT (OUTCOME) VARIABLE OF STUDY**

The purpose of regression analysis is to investigate the relationship between a dependent or outcome variable of study and a set of independent variables of study. Values of the dependent variable of study vary as values of the independent variables vary. In this particular study, the dependent variable of study assesses the extent to which waste is disposed of properly based on a 5-point ordinal scale. Category 1 denotes the lowest score, whereas Category 5 denotes the highest score. That is, the initial score for proper waste disposal was based on the following ordinal scale varying from 1 to 5:

$$\text{Initial score} = \begin{cases} 1 & \text{if } \textit{poor} \\ 2 & \text{if } \textit{less than satisfactory} \\ 3 & \text{if } \textit{satisfactory} \\ 4 & \text{if } \textit{very good} \\ 5 & \text{if } \textit{excellent} \end{cases}$$

Table 3.7.1.1 below provides a frequency distribution for the initial score (extent of proper waste disposal) variable. The table shows that the quality of waste disposal by 41.87% of the 332 food outlets in the study is satisfactory. The quality of waste disposal by 35.54% of food outlets is very good. The quality of waste disposal by 5.12% of food outlets is excellent. The quality of waste disposal by 3.31% of the food outlets is poor. The quality of waste disposal by 14.16% of food outlets is less than satisfactory. The table shows that the quality of waste disposal by the majority of food outlets is consistent with the minimum requirements stipulated in municipal by-laws set out by the CTMM for food outlets.

Table 3.7.1.1: Initial score for proper waste disposal

Score for proper waste disposal	Frequency	Percent	Cum. Percentage
Poor	11	3.31	3.31
Less than satisfactory	47	14.16	17.47
Satisfactory	139	41.87	59.34
Very good	118	35.54	94.88
Excellent	17	5.12	100.00
Total	332	100.00	

In binary logistic regression analysis, the outcome variable of study has only 2 possible values, and not 5 possible values. Using binary logistic regression analysis greatly simplifies the interpretation of odds ratios. In order to perform binary logistic regression analysis (Hosmer and Lemeshow, 2000), a final score variable having only 2 possible values (1, 0) was computed by defining the final score variable as shown below:

### Dependent variable of study (Y)

$$Y: \text{Final score for proper waste disposal} = \begin{cases} 1 & \text{if poor or less than satisfactory} \\ 0 & \text{if satisfactory, very good or excellent} \end{cases}$$

In binary logistic regression analysis, the dependent variable of study (Y) has 2 categories only (1, 0). Category 1 maximizes the likelihood of failure (poor performance in waste disposal) whereas Category 0 denotes success (satisfactory performance in waste disposal). This is a universal notation used in binary logistic regression analysis (Dawson and Trapp, 2004).

Table 3.7.1.2: Final score for proper waste disposal

Score for proper waste disposal	Frequency	Percent	Cum. Percentage
Satisfactory, very good or excellent	274	82.53	82.53
Poor of less than satisfactory	58	17.47	100.00
Total	332	100.00	

Table 3.7.1.2 shows that 17.47% of the n=332 food outlets that took part in the study had poor performance in the proper disposal of waste at their food outlets, whereas 82.53% them had satisfactory scores in the proper disposal of waste.

The variable Y denotes the outcome variable of study. It measures the overall efficiency of each of the 332 food outlets in the study based on a dichotomous variable of study with only 2 possible values (poor efficiency in waste disposal, or satisfactory efficiency in waste disposal). Category 1 of Y denotes poor efficiency in the proper disposal of waste, whereas category 0 denotes satisfactory efficiency in the proper disposal of waste.

### 3.7.2. INDEPENDENT VARIABLES OF STUDY

Independent variables of study are factors that affect the extent to which waste is properly disposed of at the 332 food outlets that were selected for the study. At each food outlet,

data was gathered on the following variables of study. Data were gathered based on personal observation and interviews. Responses obtained during interviews were captured in questionnaires.

### **Factors/responses**

District number (1, 2, 3, 4)

Is the environment generally clean? (Yes/ No)

Number of customers

General condition of building =  $\left\{ \begin{array}{l} 1 \text{ if } \textit{poor} \\ 2 \text{ if } \textit{less than satisfactory} \\ 3 \text{ if } \textit{satisfactory} \\ 4 \text{ if } \textit{very good} \\ 5 \text{ if } \textit{excellent} \end{array} \right.$  (A 5-point ordinal scale)

Is the business premise rented? (Yes/ No)

Trash such as bottles, cans and food packing materials thrown outside the food outlet (Yes/ No)

Use of personal uniforms by employees working in the food outlet (Yes/ No)

Enough number of seats available for customers (Yes/ No)

Cleanliness of seats and tables available for customers (Yes/ No)

Availability of a toilet facility at outlet (Yes/ No)

Cleanliness of toilet facility at outlet (Yes/ No)

Availability of a hand washing facility (Yes/ No)

Availability of a clean hand drying towel or equipment (Yes/ No)

Cleanliness of hand washing facility (Yes/ No)

Availability of tissue paper for hand cleaning (Yes/ No)

Availability of a separate seating for smokers (Yes/ No)

Cleanliness of kitchen =  $\left\{ \begin{array}{l} 1 \text{ if } \textit{poor} \\ 2 \text{ if } \textit{less than satisfactory} \\ 3 \text{ if } \textit{satisfactory} \\ 4 \text{ if } \textit{very good} \\ 5 \text{ if } \textit{excellent} \end{array} \right.$  (A 5-point ordinal scale)

Personal hygiene =  $\left\{ \begin{array}{l} 1 \text{ if } \textit{poor} \\ 2 \text{ if } \textit{less than satisfactory} \\ 3 \text{ if } \textit{satisfactory} \\ 4 \text{ if } \textit{very good} \\ 5 \text{ if } \textit{excellent} \end{array} \right.$  (A 5-point ordinal scale)

(The above variable measures the personal hygiene of staff working in kitchen)

Bad smell at eating area coming from toilet or kitchen (Yes/ No)

Age of manager of food outlet in years

Race of manager (Black, White, Indian, Coloured)

Gender of manager (Male, Female)

Duration of service of manager at food outlet

Age of food outlet

Perception on the importance of efficient and proper waste disposal (1, 2, 3, 4, 5)

$$\text{Perception} = \begin{cases} 1 & \text{if } \textit{poor} \\ 2 & \text{if } \textit{less than satisfactory} \\ 3 & \text{if } \textit{satisfactory} \\ 4 & \text{if } \textit{very good} \\ 5 & \text{if } \textit{excellent} \end{cases} \quad (\text{A 5-point ordinal scale})$$

(The above variable measures the importance of efficient and proper waste disposal)

### 3.8. STATISTICAL METHODS OF DATA ANALYSIS

The dependent or outcome variable of study (Y) defined in Section 3.7.1 above can only have 2 possible values. These values are 1 and 0. Y=1 in cases where a food outlet fails to dispose of waste properly. Y=0 in cases where a food outlet disposes of waste properly. Category 1 of Y is associated with failure in proper waste disposal. Category 0 of Y is associated with success in proper waste disposal. A dependent variable Y that can only have 2 possible values (1, 0) is called dichotomous. The relationship between Y and a set of independent variables that affect the quality of waste disposal could be investigated by using the following statistical methods of data analysis:

- Frequency tables and bar charts for each discrete variable of study
- Summary statistics and box and whisker plots for each continuous variable of study
- Pearson's chi-square tests of association shall be used to test the strength of association between variables
- Binary logistic regression analysis (Hosmer and Lemeshow, 2000) shall be performed in order to identify key risk factors for inadequate waste disposal. Unadjusted and adjusted odds ratios shall be obtained for influential predictor variables.

The outcome variable Y is dichotomous, and has only 2 categories. That is,

$$Y = \begin{cases} 1 & \text{if } \textit{waste is not disposed of properly by food outlet} \\ 0 & \text{if } \textit{waste is disposed of properly by food outlet} \end{cases}$$

$X_1, X_2, \dots, X_k$  are the independent variables that affect waste disposal.

An estimated regression coefficient is denoted by  $\hat{\beta}$ . In logistic regression analysis, a regression coefficient is estimated for each explanatory variable included in the model.

**Notations used in binary logistic regression analysis:**

Y = the dependent variable of study

$X_1, X_2, \dots, X_k$  = the k independent variables of study

$p_i$  = the probability of event  $i$

$\hat{\beta}_i$  = the estimated regression coefficient of the  $i^{th}$  independent variable of study where  $i = 0, 1, \dots, k$

$\hat{\beta}_0$  = the estimated regression coefficient for the Y-intercept of the line of regression

$\text{logit}(p_i)$  = the natural logarithm of the ratio of probabilities where:

$$\text{logit}(p_i) = \ln\left(\frac{p_i}{1-p_i}\right) = \hat{\beta}_0 + \hat{\beta}_1 X_1 + \dots + \hat{\beta}_k X_k$$

Z denotes the equation of the fitted linear line of regression where:

$$Z = \hat{\beta}_0 + \hat{\beta}_1 X_1 + \dots + \hat{\beta}_k X_k$$

Using the notations introduced above, the binary logistic regression of a dichotomous outcome variable Y on a combination of k discrete and continuous independent variables  $X_1, X_2, \dots, X_k$  is defined by the following logit function:

$$\text{logit}(p_i) = \ln\left(\frac{p_i}{1-p_i}\right) = \hat{\beta}_0 + \hat{\beta}_1 X_1 + \dots + \hat{\beta}_k X_k$$

In this specific study, the probability that a food outlet fails to dispose of waste properly is denoted by  $\text{Pr}(Y = 1)$ . The probability that a food outlet disposes of waste properly is denoted by  $\text{Pr}(Y = 0)$ . For a randomly identified food outlet in this particular study, the probability that the food outlet fails to dispose of waste properly is given by the following statistical expression:

$$\text{Pr}(Y = 1) = \frac{1}{1 + \exp(-Z)} \quad \text{where:}$$

$$Z = \hat{\beta}_0 + \hat{\beta}_1 X_1 + \dots + \hat{\beta}_p X_k$$

Using the expression for the random variable Z, the probability of Y=1 (the probability that a randomly identified food outlet operator conducting business in Pretoria CBD fails to dispose of waste properly given values of the predictor variables  $X_1, X_2, \dots, X_k$  can be worked out for a randomly identified individual in the study.

### **Interpretation of odds ratios**

The odds ratio corresponding to the  $i^{th}$  explanatory variable  $X_i$  is equal to  $e^{\hat{\beta}_i} = \exp(\hat{\beta}_i)$  where  $\hat{\beta}_i$  denotes the estimated regression coefficient corresponding to  $X_i$ .

#### **Case 1:**

If  $\hat{\beta} > 0$ , then  $\exp(\hat{\beta}) > 1$ . In this case, the odds of Y=1 are increased by a factor of  $\exp(\hat{\beta})$ .

#### **Case 2:**

If  $\hat{\beta} < 0$ , then  $\exp(\hat{\beta}) < 1$ . In this case, the odds of Y=1 are decreased by a factor of  $\exp(\hat{\beta})$ .

#### **Case 3:**

If  $\hat{\beta} = 0$ , then  $\exp(\hat{\beta}) = 1$ . In this case, the odds of Y=1 remain unchanged.

Sensitivity and specificity tests were performed in order to assess the reliability of the fitted logistic regression model. The statistical package STATA version 10 was used for data analysis, data entry, checking and validation (Svend, 2007).

### **3.9. ETHICAL CONSIDERATIONS**

Full explanation was provided to each respondent in the study. Respondents were provided with the letter of introduction written by the supervisor of study before they were

interviewed. Respondents were informed about the purpose of study along with their right not to take part in the study without having to explain why. Each participant took part in the study willingly, and there were no objections. Participants of the study were informed that their responses to questions would be kept confidentially.

## **CHAPTER 4: RESULTS OF STUDY**

### **4.1. INTRODUCTION**

The results of study presented in this section were obtained by using the statistical methods of data analysis indicated in Section 3.5 above. The results are presented in a series of sub-sections in order to facilitate smooth reading and understanding. The results include results from biographical questions, Pearson's chi-square tests of association, and binary logistic regression analysis. In most cases, frequency tables are supplemented by graphical depictions in order to provide a visual summary of proportions of various attributes. In Section 4.6, results obtained from goodness-of-fit tests are presented in order to show that odds ratios estimated from binary logistic regression analysis are reliable.

Socio-demographic characteristics of respondents are presented under Section 4.2 (Results from biographical queries). In Section 4.3, a summary of variables that are significantly associated with proper waste disposal is shown. All such tests of association are conducted at the 5% level of significance. Complete details of all Pearson's chi-square tests of association conducted in Section 4.3 are shown in Appendix 1. Discussion of major findings of study is based on statistical results that are significant at the 5% level of significance.

### **4.2. RESULTS FROM BIOGRAPHICAL QUERIES**

Socio-demographic characteristics of respondents are presented in this section. Frequency tables were obtained for each discrete variable of study. The tables provide observed frequencies, percentages and cumulative percentages for various attributes based on queries that were validated in order to elicit responses from respondents. The Results in this section describe the socio-demographic characteristics of the 332 respondents in the study. Frequency tables, bar charts and pie charts are shown for variables such as age, race, gender, level of education, duration of service, ownership of food outlet, availability of waste disposal bins, toilets, seats, at food outlets, etc. The results show that 274 of the 332

food outlets in the study (82.53%) are efficient in the proper disposal of waste. Food outlets that are efficient in proper waste disposal are characterized by ownership of food outlet, availability of enough seats for customers, availability of waste disposal bins for customers, good personal hygiene of staff working at the food outlet, good perception on the importance of proper waste disposal, regular inspection of by health inspectors working for the CTMM, the availability and implementation of a waste management plan, familiarity with the South African White Paper on environmental management, the practice of sorting waste, as well as source reduction of waste.

## DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

### 4.2.1: Ages of managers of food outlets

Table 4.2.1.1 and Figure 4.2.1.1 below show that the majority (46.08%) of food outlet operators were middle aged (40 to 49 years of age). The proportion of young operators (20 to 24 years of age) is quite small (1.20%).

Table 4.2.1.1: Distribution of ages of respondents

Age of manager in years	Frequency	Percent	Cum. Percentage
Less than 20 years	2	0.60	0.60
20 to 24 years	4	1.20	1.80
25 to 29 years	32	9.64	11.44
30 to 39 years	109	32.83	44.27
40 to 49 years	153	46.08	90.36
50 years or older	32	9.64	100.00
Total	332	100.00	

The fact that 46.08% of the 332 respondents are aged between 40 and 49 years shows that almost half of the respondents are middle-aged people working in food outlets. The table shows that over 78% of the 332 respondents have ages between 30 and 49 years. This result shows that the food outlets provide livelihood to a sizeable proportion of inhabitants.

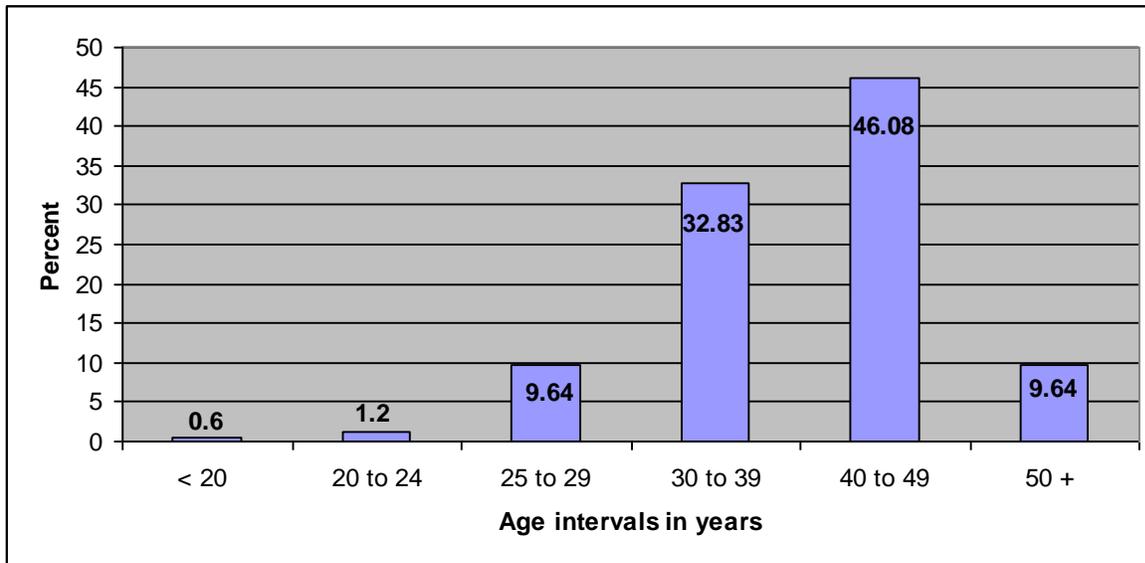


Figure 4.2.1.1: Distribution of ages of respondents

#### 4.2.2: Racial distribution of managers/operators of food outlets

Table 4.2.2.1 and Figure 4.2.2.1 below show that the majority (55.42%) of food outlet operators were white. The proportion of black operators was 22.29%. The proportion of Indian operators was 11.14%. The proportion of coloured operators was 9.64%. The table shows that more than half of all food outlets are owned or operated by whites. The proportion of white operators is more than twice the proportion of black operators. Coloured operators constitute the lowest proportion of operators. The fact that more than half of all food outlets in Pretoria CBD (55.42%) are owned or operated by whites is a reflection of the relative economic strength of whites in the food outlet business within Pretoria CBD in comparison with other racial groups. The figure shows that whites, relative to other racial groups including blacks, possess the necessary financial means and managerial skills that are required for owning and operating food outlets in the city profitably. This finding is in agreement with the racially skewed economic distribution observed in the South African food catering industry (SSA, 2007).

Table 4.2.2.1: Racial distribution of managers/operators of food outlets

Race of manager	Frequency	Percent	Cum. Percentage
African	74	22.29	22.29
Coloured	32	9.64	31.93
Indian	37	11.14	43.07
White	184	55.42	98.49
Others	5	1.51	100.00
Total	332	100.00	

By virtue of their relative financial and skills-related strength, white owners and/or operators of food outlets are better resourced and skilled than the other four racial groups in terms of operating food outlets profitably and the efficient management of waste.

Figure 4.2.2.1 below displays a graphical depiction of the figures presented in Table 4.2.2.1 above.

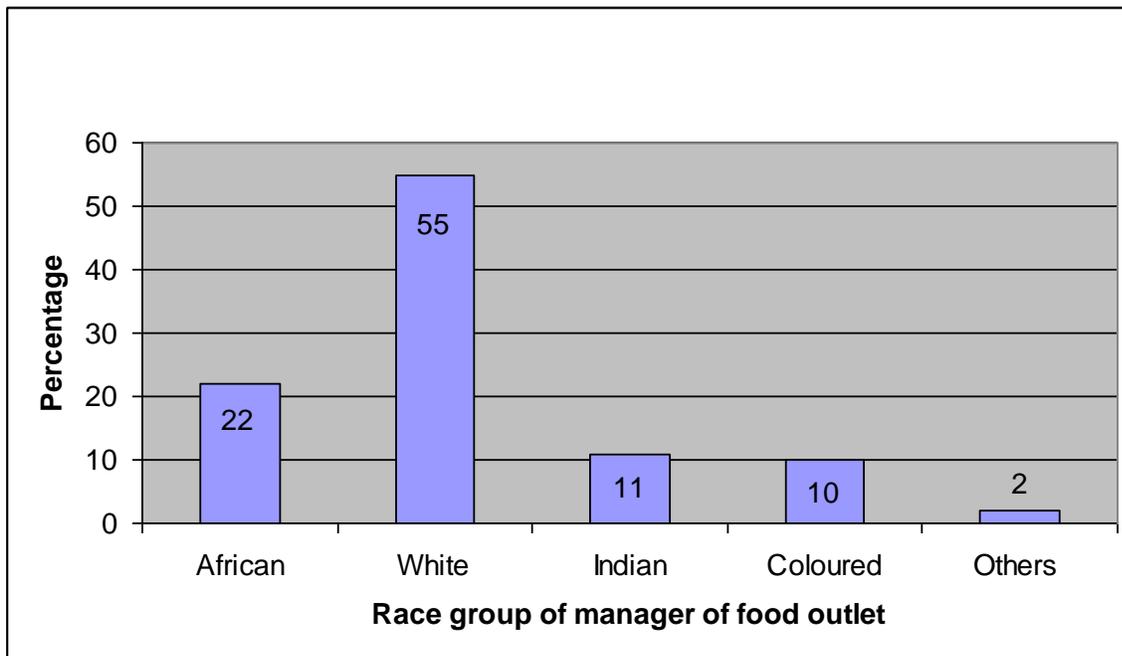


Figure 4.2.2.1: Distribution of race of respondents

### 4.2.3: Gender distribution of managers/operators of food outlets

Table 4.2.3.1 and Figure 4.2.3.1 below show that the majority (75.30 %) of food outlet operators were male. The proportion of female operators was 24.70 %.

Table 4.2.3.1: Gender distribution of managers/operators of food outlets

Race of manager	Frequency	Percent	Cum. Percentage
Female	82	24.70	24.70
Male	250	75.30	100.00
Total	332	100.00	

The figures in Table 4.2.3.1 show that the food outlet business in Pretoria CBD is a male-dominated business. Cross-tabulated results between gender and efficient management of waste show that 62.35% of male owners/operators dispose of waste efficiently (Appendix 1). The corresponding figure for female owners/operators is 20.18%. This shows that male owners/operators are relatively much more efficient than their female counterparts in terms of efficiently managing waste.

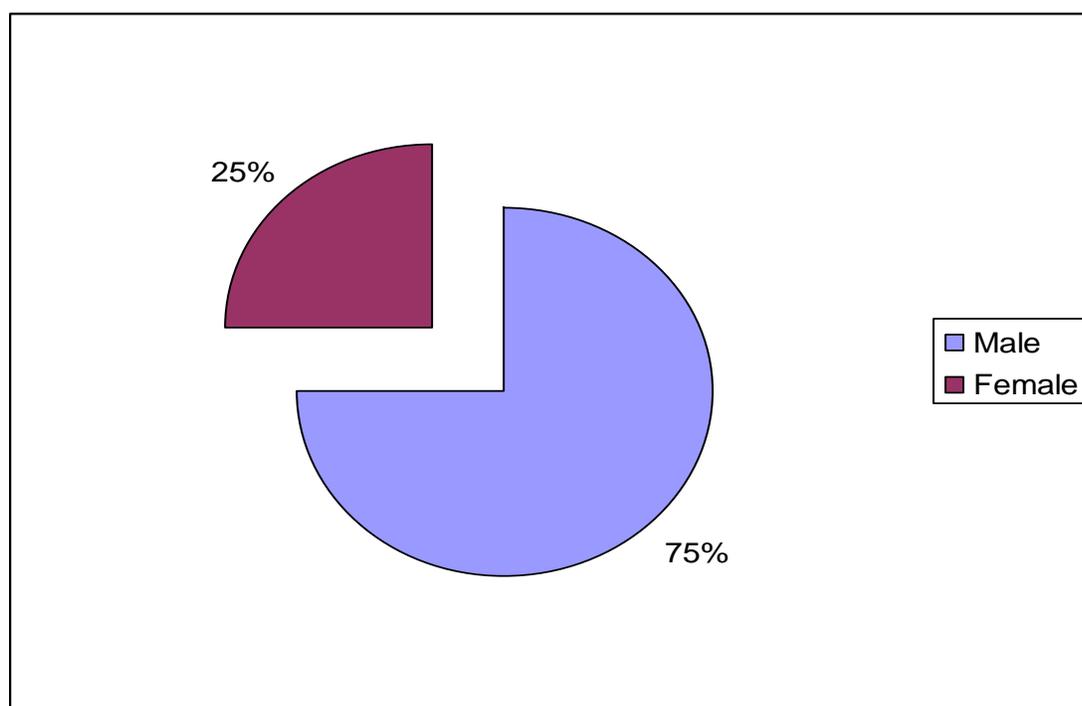


Figure 4.2.3.1: Distribution of gender of respondents

## GENERAL CHARACTERISTICS OF RESPONDENTS

### 4.2.4: Educational level of operators of sampled food outlets

Table 4.2.4.1 and Figure 4.2.4.1 below show that 43.37% of operators had diploma level education, whereas 43.37% of them had secondary level education, 9.04% had degree level education, 3.61% had primary level education, and less than 1% of them had no formal education.

Table 4.2.4.1: Level of education of respondents

Highest level of education	Frequency	Percent	Cum. Percentage
No formal education	2	0.60	0.60
Primary level	12	3.61	4.21
Secondary level	144	43.37	47.58
Diploma level	144	43.37	90.95
Degree or above	30	9.04	100.00
Total	332	100.00	

The values in Table 4.2.4.1 show that the proportion of illiterate operators is quite small at 0.60% < 1%. The proportion of operators with primary level education is also small at 3.61%. The fact that 43.37% of operators have diploma level education shows that almost half of all operators are fairly well educated. Cross-tabulated results between level of education and efficient management of waste show that 33.44% of owners/operators with secondary level education dispose of waste efficiently (Appendix 1). The corresponding figure for diploma level graduates is 37.65%. In general, the results show that there is a positive association between level of education and efficiency in waste management.

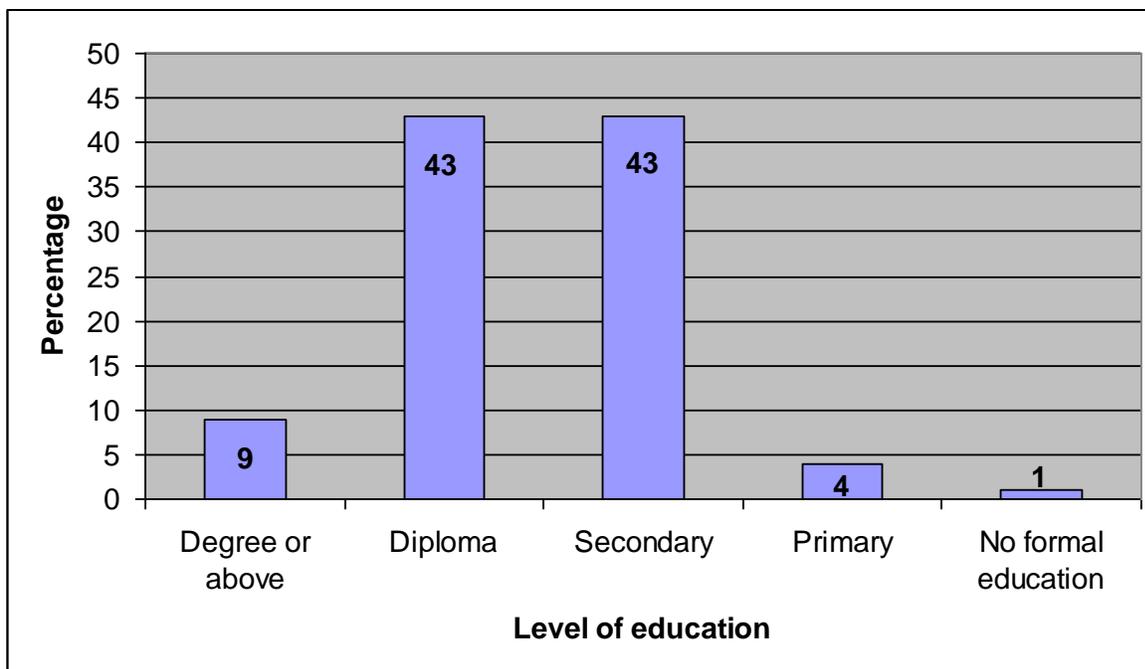


Figure 4.2.4.1: Level of education of respondents

#### 4.2.5: Number of years of operation of sampled food outlets

Results obtained from the population of respondents with respect to the period or number of years of operation of business reveal that 59.64% of food outlets have been operational for 6 years or more, whereas 28.61% of them were operational for 3 to 6 years, 5.12% were operational for 1 to 2 years, and 6.63% of them have been operational for less than a year as shown below in Table 4.2.5.1. Cross-tabulated results between duration of operation and efficient management of waste show that 69.88% of owners/operators with 3 or more years of experience dispose of waste efficiently (Appendix 1). The corresponding figure for owners/operators with less than 3 years of experience is 11.14%. There is a generally positive association between duration of service and overall efficiency in waste management.

Table 4.2.5.1: Duration of operation of sampled food outlets

Duration of operation of food outlets	Frequency	Percent	Cum. Percentage
Less than 1 year	22	6.63	6.63
1 to 2 years	17	5.12	11.75
3 to 5 years	95	28.61	40.36
6 years or more	198	59.64	100.00
Total	332	100.00	

The finding reported in the above table is graphically displayed in Figure 4.2.5.1 below.

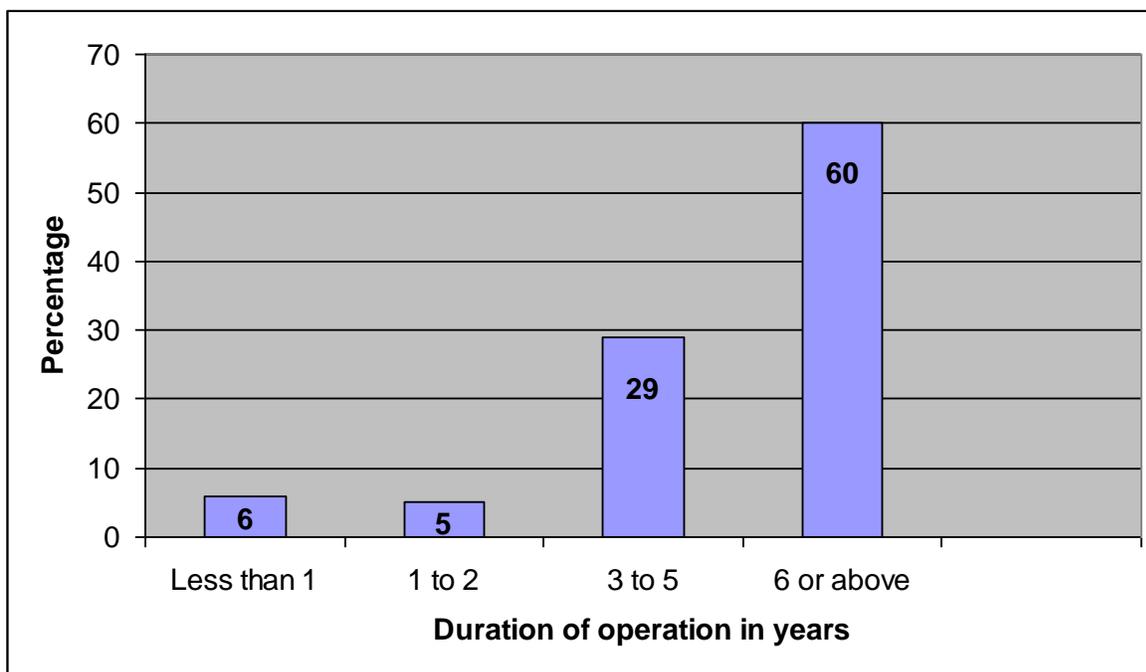


Figure 4.2.5.1: Duration of operation of food outlets

#### 4.2.6: Duration of employment of operators of sampled food outlets

The results obtained from the survey were used to summarize the duration of service of the operators in the sampled food outlets. The results show that 43.98% of operators have been in business between 3 and 5 years, while 40.96% of them were in business for 6 years or more, 13.55% were in business for 1 to 2 years, and less than 2% of them were in business for less than a year.

Table 4.2.6.1: Duration of service of managers of food outlets

Duration of service of managers in years	Frequency	Percent	Cum. Percentage
Less than 1 year	5	1.51	1.51
1 to 2 years	45	13.55	15.06
3 to 5 years	146	43.98	59.04
6 years or more	136	40.96	100.00
Total	332	100.00	

The significance of the results shown in Tables 4.2.6.1 is that more than 84% of operators have been in service for at least 3 years. Figure 4.2.6.1 gives a graphical display of the results shown in Table 4.2.6.1.

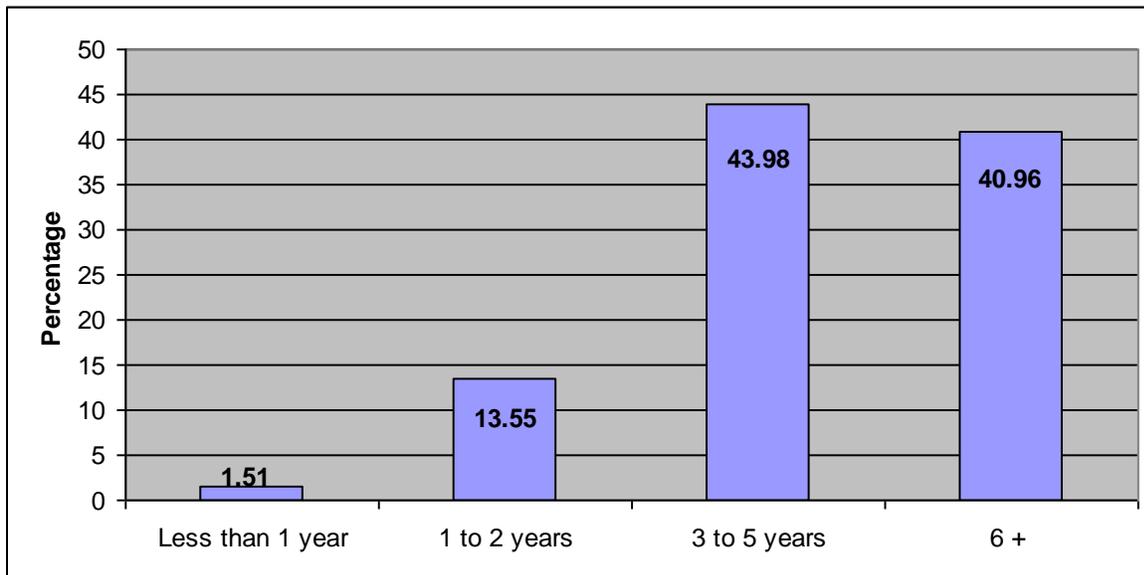


Figure 4.2.6.1: Duration of service of managers of food outlets

#### 4.2.7: Categories of food outlets

Table 4.2.7.1 and Figure 4.2.7.1 below show that 65.06% of food outlets were commercial food canteens, whereas 13.55% of them were general stores with canteens, 11.75% were liquor stores, and less than 10% of them were simple fast food outlets or eateries.

Table 4.2.7.1: Types of food outlets surveyed in the study

Category of food outlet	Frequency	Percent	Cum. Percentage
Commercial food canteen	216	65.06	65.06
Eatery (Snack)	32	9.64	74.70
General store with canteen	45	13.55	88.25
Liquor store	39	11.75	100.00
Total	332	100.00	

The values in Table 4.2.7.1 show that the demand for commercial food canteens is by far the greatest category of food outlets that are currently operating in the CBD of Pretoria. Figure 4.2.7.1 below shows a graphical summary of the figures in Table 4.2.7.1. Cross-tabulated results between types of food outlets and efficient management of waste showed that there was positive association between the degree of organization of food outlets and overall efficiency in the management of waste (Appendix 1). For example, 11.44% of general food canteens are efficient in waste management. The corresponding figure for commercial food canteens is 28.60%.

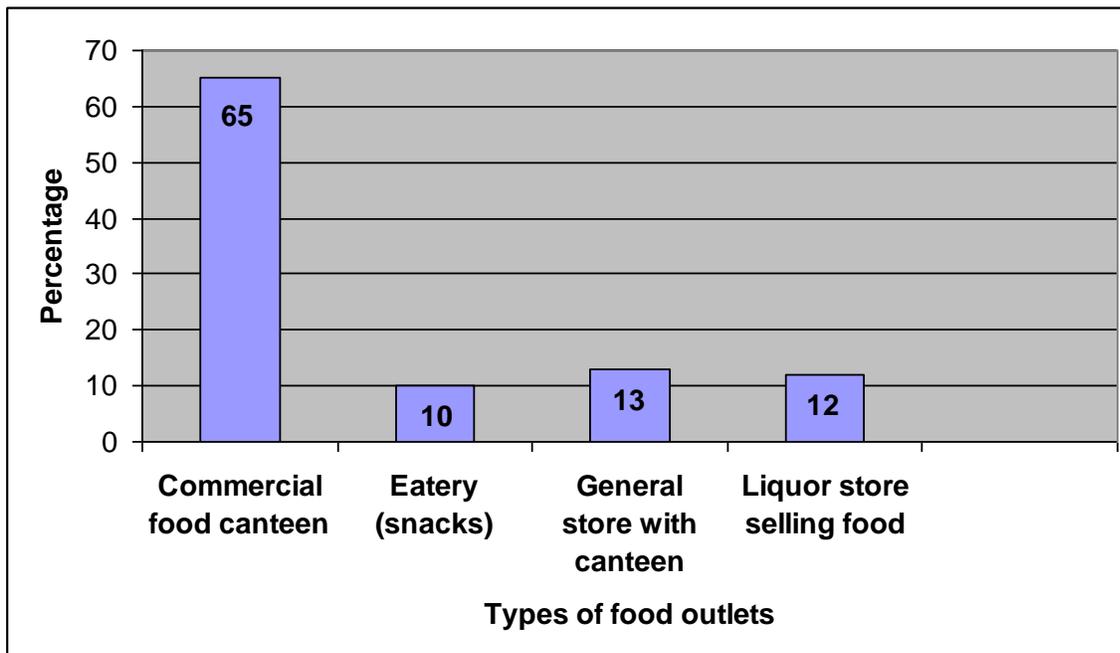


Figure 4.2.7.1: Types of food outlets surveyed in the study

#### 4.2.8: Waste disposal contractors patronized by food outlets

Table 4.2.8.1 and Figure 4.2.8.1 below show that 65.06% of service providers were private waste disposal contractors, whereas 13.55% of them were street kids and waste scavengers, 11.75% were personal waste collectors, and 9.64% of them government employees responsible for waste disposal. Cross-tabulated results between types of contractors providing waste removal service to food outlets and efficient management of waste show that privately owned service providers are much more efficient than government-owned service providers (Appendix 1). For example, 54.82% of privately owned service providers are efficient in waste management. The corresponding figure for government owned service providers is 6.62%.

**Table 4.2.8.1: Contractors providing waste disposal services to food outlets**

Contractors providing waste disposal service	Frequency	Percent	Cum. Percentage
Government waste disposal service	32	9.64	9.64
Private waste contractor	216	65.06	74.70
Self/Personal arrangement	39	11.75	86.45
Street kids and waste scavengers	45	13.55	100.00
Total	332	100.00	

Table 4.2.8.1 shows that street kids and waste scavengers account for 13.55% of all waste disposal services provided to food outlets in Pretoria CBD. This figure is quite sizeable. Figure 4.2.8.1 below gives a graphical summary of the results shown above in Figure 4.2.8.1.

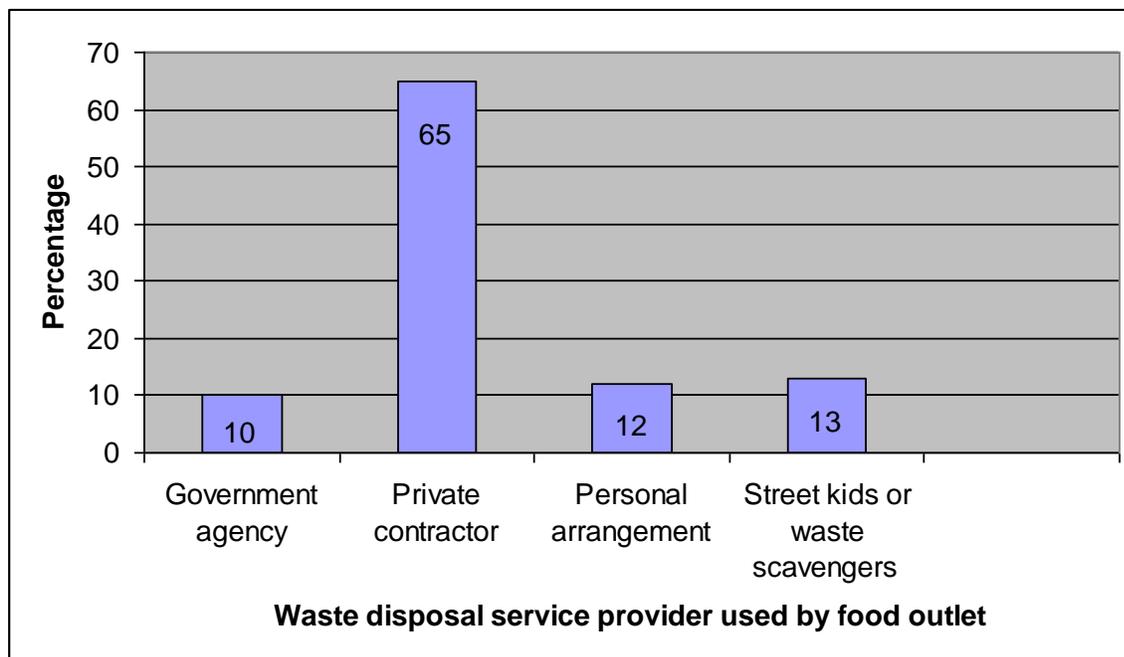


Figure 4.2.8.1: Contractors providing waste disposal services to food outlets

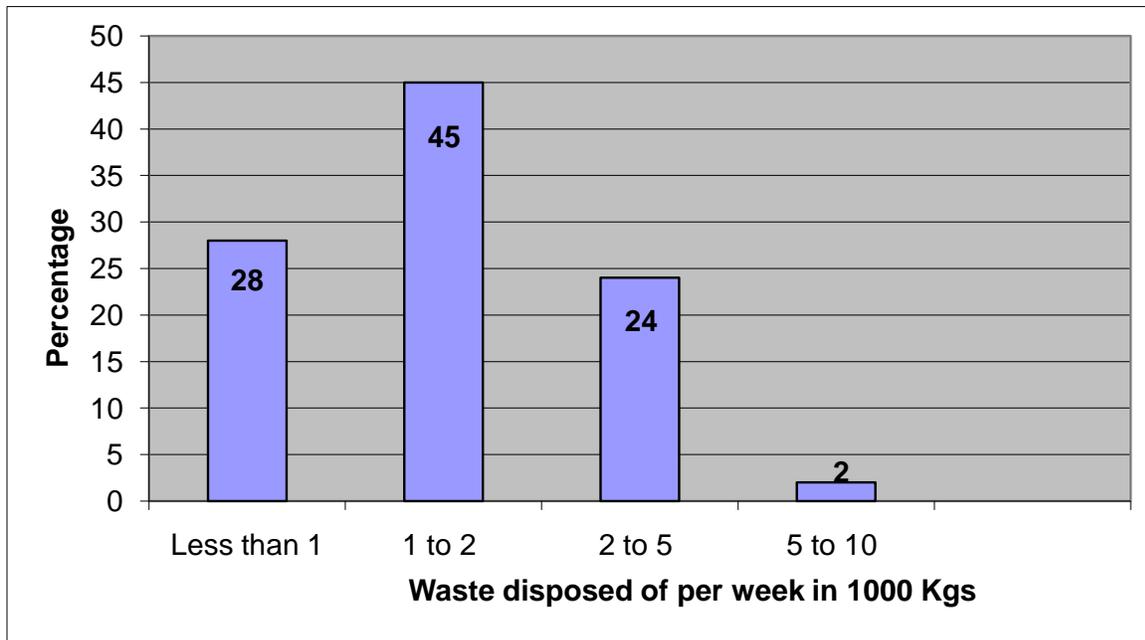
#### 4.2.9: Volume of waste generated weekly by food outlets

Table 4.2.9.1 and Figure 4.2.9.1 below show that 45.48% of food outlets produce between 1, 000 to 2, 000 kg of waste per week. Followed by this is the 28.31% of food outlets that produce less than 1, 000 kg of waste per week.

**Table 4.2.9.1: Volume of waste produced per week in kg by food outlets**

Volume of waste produced per week in Kg by food outlets	Frequency	Percent	Cum. Percentage
Less than 1, 000 Kg	94	28.31	28.31
1, 000 to 2, 000 Kg	151	45.48	73.79
2, 000 to 5, 000 Kg	80	24.10	97.89
5, 000 to 10, 000 Kg	7	2.11	100.00
Total	332	100.00	

Interestingly, 2.11% of food outlets in the sample produce waste of volume between 5, 000 to 10, 000 kg of waste per week. Figure 4.2.9.1 below provides a graphical depiction of the figures reported in Table 4.2.9.1.



**Figure 4.2.9.1: Volume of waste produced per week by food outlets**

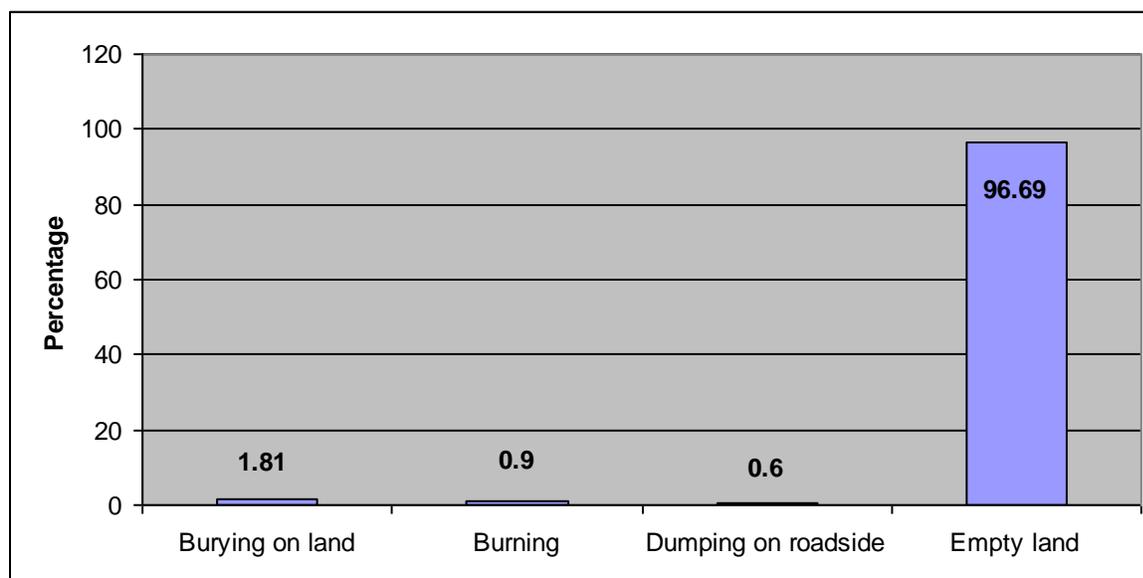
#### **4.2.10: Mode of waste disposal used by food outlets during civil action**

Results obtained under this query revealed that the majority of respondents in the sampled food outlets (96.69%) dispose of wastes on empty or vacant land during civil action. Less than 2% of food outlets dispose of their wastes by burying waste on land during civil action. The proportion of food outlets that dispose of waste by burning wastes in open veldt (0.90%) and by dumping waste on roadside (0.60%) are each less than 1%. Cross-tabulated results between methods used for waste disposal during strike actions and efficiency in waste management show that 75.61% of food outlets that normally dispose of waste efficiently resort to disposing of their waste on empty land during strike actions (Appendix 1). The large proportion indicates how much food outlets depend on the availability of regular or uninterrupted waste disposal services for ensuring efficiency in the proper management and disposal of waste. The huge dependence on waste removal agencies for ensuring cleanliness at food outlets is a typical feature of food outlets operating in all major metropolitan cities elsewhere in South Africa.

**Table 4.2.10.1: Waste disposal method used during civil action by food outlets**

Method used for waste disposal	Frequency	Percent	Cum. Percentage
Burying on land	6	1.81	1.81
Burning in open veldt	3	0.90	2.71
Dumping on roadside	2	0.60	3.31
Disposal on empty land	321	96.69	100.00
Total	332	100.00	

Figure 4.2.10.1 shows a graphical depiction of the figures presented above in Table 4.2.10.1. The figure shows that almost 97% of all food outlets dump wastes on empty land during civil actions by waste collectors. The result shows that the proportion of food outlets that dispose of waste by utilizing the other 3 preferable methods is quite insignificant.



**Figure 4.2.10.1: Waste disposal method used during civil action by food outlets**

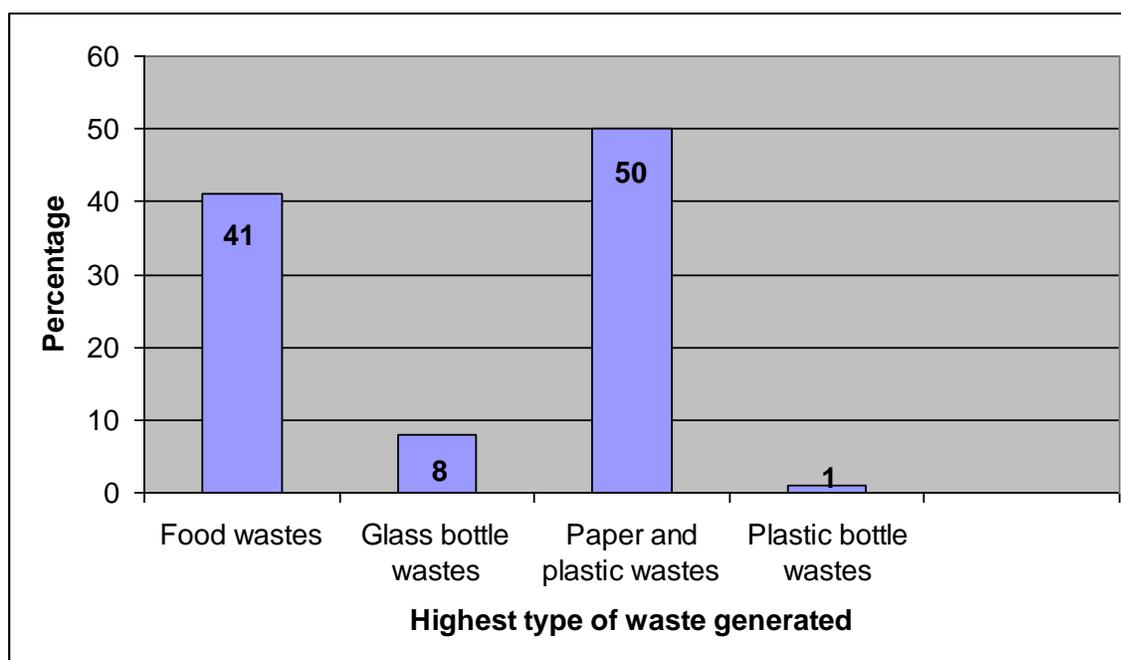
#### **4.2.11: Largest form of waste generated by food outlets**

Results obtained from this enquiry are presented below in Table 4.2.11.1 and Figure 4.2.11.1. The results show that about half (50.60%) of food outlets generate paper and plastic wastes, 41.57% of them produce food wastes, 7.53% produce glass bottle wastes, and less than 1% of them produce plastic bottle wastes.

**Table 4.2.11.1: Highest type of waste generated by food outlets**

Type of waste generated	Frequency	Percent	Cum. Percentage
Food wastes	138	41.57	41.57
Glass bottle wastes	25	7.53	49.10
Paper and plastic wastes	168	50.60	99.70
Plastic bottle wastes	1	0.30	100.00
Total	332	100.00	

Figure 4.2.11.1 below provides a graphical depiction of the results shown above in Table 4.2.11.1.



**Figure 4.2.11.1: Highest type of waste generated by food outlets**

The figure shows that 50% of all food outlets generate paper and plastic wastes, 41% of all food outlets generate food wastes, 8% of all food outlets generate glass bottle wastes, and that 1% of all food outlets generate plastic bottle wastes. It can thus be deduced that the vast majority (91%) of all food outlets generate paper, plastic or food wastes.

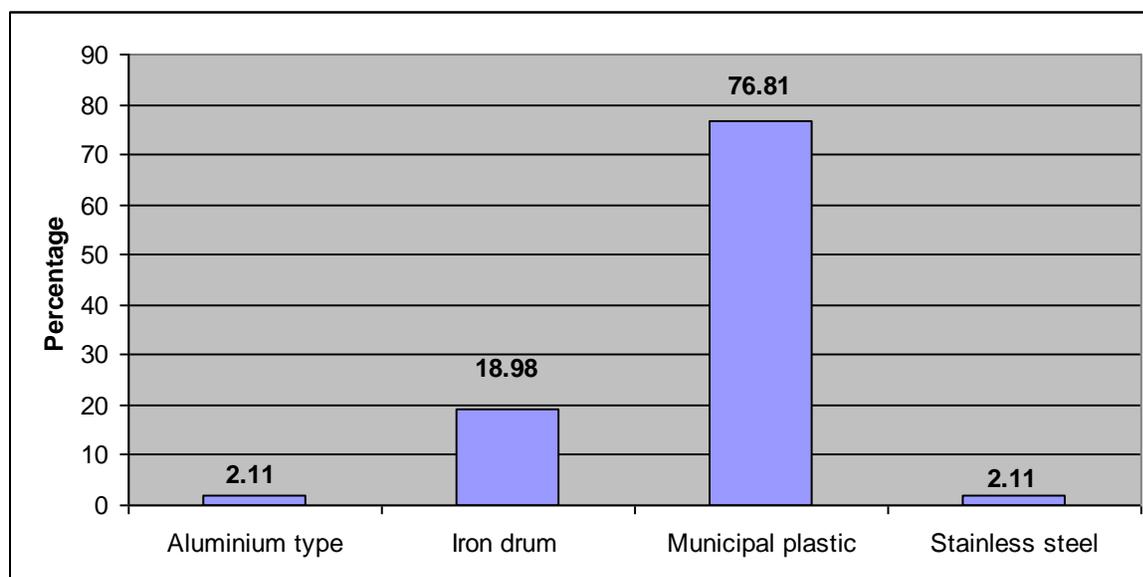
#### 4.2.12: Types of waste bins used by food outlets

Table 4.2.12.1 below shows the types of waste bins utilized by the 332 food outlets in the sample drawn for the study.

**Table 4.2.12.1: Types of waste bins used by food outlets**

Type of waste bin used	Frequency	Percent	Cum. Percentage
Aluminium type waste bin	7	2.11	2.11
Iron drum waste bin	63	18.98	21.08
Municipal plastic bin	255	76.81	97.89
Stainless steel waste bin	7	2.11	100.00
Total	332	100.00	

The table shows that the vast majority of the food outlets (76.81%) use municipal plastic bins for accumulating waste. The figure below presents a graphical depiction of the figures presented above. Cross-tabulated results between type of waste removal bin and efficiency in waste management show that 63.25% of food outlets that are efficient in waste management use municipal waste removal bins for routine waste disposal (Appendix 1).



**Figure 4.2.12.1: Types of waste bins used by food outlets**

#### 4.2.13: Cleaners of waste disposal bins at food outlets

About 74 % of food outlets in the sample use their own staff to clean up their waste disposal bins after the bins are emptied. Municipal or contract workers also clean up waste disposal bins although their percentage is quite small (4.52%). Cross-tabulated results between cleaners of waste removal bin and efficiency in waste management show that 58.43% of food outlets that are efficient in waste management use their own staff for cleaning up their waste disposal bins at their food outlets (Appendix 1).

**Table 4.2.13.1: Cleaners of waste bins used by food outlets**

Cleaners of waste disposal bins	Frequency	Percent	Cum. Percentage
Food outlet staff	246	74.10	74.10
Municipal contract workers	15	4.52	78.61
Unemployed individuals	20	6.02	84.64
Bin not cleaned	51	15.36	100.00
Total	332	100.00	

Table 4.2.13.1 shows that 15.26% of bins are not cleaned at all. Figure 4.2.13.1 provides a graphical summary of the results shown above.

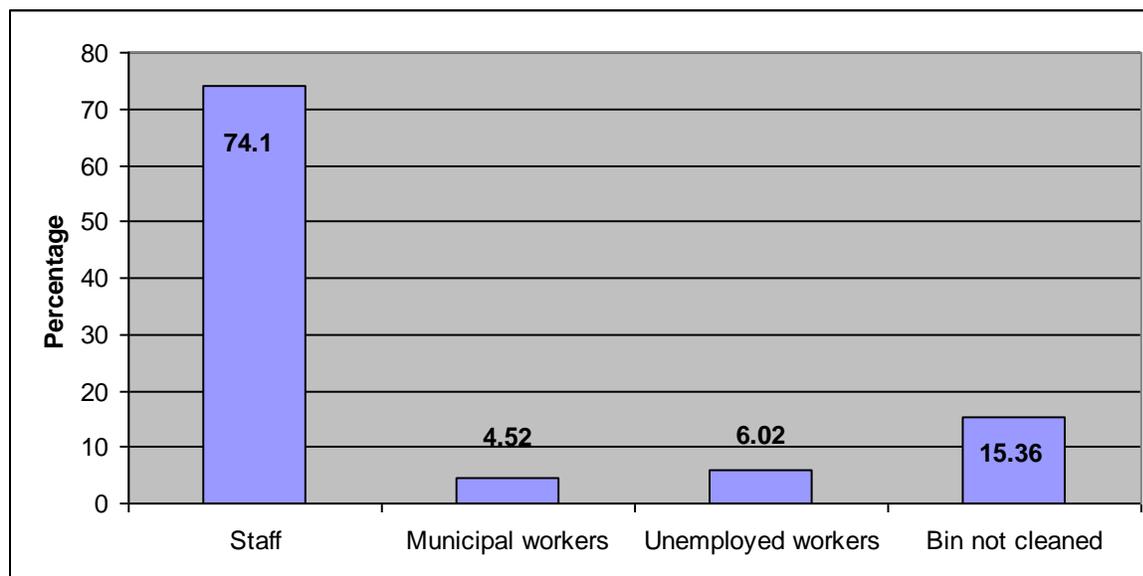


Figure 4.2.13.1: Cleaners of waste bins used by food outlets

## INFORMATION ON FACILITIES/FOOD OUTLETS

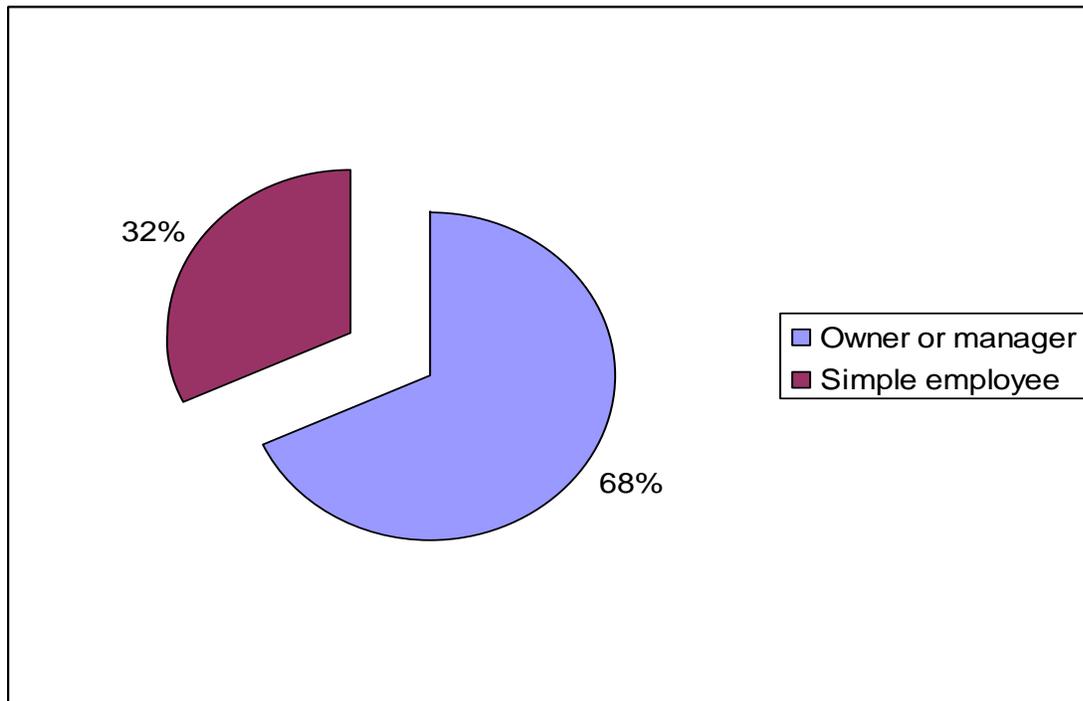
### 4.2.14: Distribution of owners and managers of food outlets

The results obtained indicated that 225 of the 332 of respondents (about 68%) in the study were owners of food outlets while 107 (about 32%) of them (Table 4.2.14.1) were employees who managed the business on behalf of the owners. Cross-tabulated results between status of operators and efficiency in waste management show that 62.34% of food outlets that are efficient in waste management are managed by their owners (Appendix 1). This shows that actual owners of food outlets manage proper waste disposal and general cleanliness much better than ordinary employees.

**Table 4.2.14.1: Distribution of owners and managers of food outlets**

Status of food outlet operator	Frequency	Percent	Cum. Percentage
Manager or owner of food outlet	225	67.77	67.77
Employee of food outlet	107	32.23	100.00
Total	332	100.00	

Figure 4.2.14.1 shows a graphical depiction of the information presented in the above table.



**Figure 4.2.14.1: Distribution of owners and managers of food outlets**

#### 4.1.15: Availability of dustbins for customers at food outlets

On the availability or provision of dustbins to customers at food outlets, Table 4.2.15.1 below shows that 76.81% of food outlets provide customers with this facility while 23.19% of them do not provide such facilities at their business outlets. Cross-tabulated results between availability of dustbins for customers at the food outlets and efficiency in waste management show that 65.67% of food outlets that are efficient in waste management provide convenient dustbins for customers (Appendix 1). This shows that the provision of dustbins to customers is quite helpful for overall cleanliness and efficiency in proper waste disposal.

Table 4.2.15.1: Availability of dustbins for customers at food outlets

Dustbins for customers at food outlets	Frequency	Percent	Cum. Percentage
Available	255	76.81	76.81
Not available	77	23.19	100.00
Total	332	100.00	

#### 4.2.16: Availability of toilets for customers at food outlets

Results obtained on the availability or provision of toilet facilities showed that 52 % of food outlets provide customers with toilets, while 48% of food outlets do not have toilet facilities for customers. Cross-tabulated results between availability of toilets for customers at the food outlets and efficiency in waste management show that 46.39 % of food outlets that are efficient in waste management provide toilets for customers (Appendix 1). This shows that the provision of toilets to customers is quite helpful for overall cleanliness and efficiency in proper waste disposal.

**Table 4.2.16.1: Availability of toilets for customers at food outlets**

Toilets for customers at food outlets	Frequency	Percent	Cum. Percentage
Available	173	52.11	52.11
Not available	159	47.89	100.00
Total	332	100.00	

**ASSESSMENT OF SERVICES****4.2.17: General state or condition of building used as food outlet**

The general condition of building used as food outlet was assessed. Accordingly, the assessment showed that 12.35% of premises were in excellent condition, 64.46% were in very good condition, and 18.37% were in satisfactory condition. About 5% of buildings were in less than satisfactory or poor condition.

**Table 4.2.17.1: General condition of building used as food outlet**

General condition of building used as food outlet	Frequency	Percent	Cum. Percentage
Excellent	41	12.35	12.35
Very good	214	64.46	76.81
Satisfactory or good enough	61	18.37	95.18
Less than satisfactory	14	4.22	99.40
Poor	2	0.60	100.00
Total	332	100.00	

**4.2.18: Perception on benefits of proper waste disposal**

Results obtained from the assessment of perception on the potential benefits of proper waste disposal at food outlets showed that about 3% of respondents viewed the concept as excellent, and about 46% of respondents viewed the concept as very good. Below 20% of

respondents viewed the concept in bad light. Table 4.2.18.1 below shows the summary of results obtained:

**Table 4.2.18.1: Perception on benefits of proper waste disposal**

Perception on benefits of proper waste disposal	Frequency	Percent	Cum. Percentage
Excellent	9	2.71	2.71
Very good	154	46.39	49.10
Satisfactory or good enough	112	33.73	82.83
Less than satisfactory	51	15.36	98.19
Poor	6	1.81	100.00
Total	332	100.00	

Figure 4.2.18.1 below shows a graphical depiction of the figures presented above.



Figure 4.2.18.1: Perception on benefits of proper waste disposal

#### **4.2.19: Score for proper waste disposal at food outlet**

Table 4.2.19.1 below shows that about 5% of food outlets had excellent scores, about 35% of food outlets had very good scores, about 42% of them had satisfactory scores, 14.16% of them had less than satisfactory scores, and about 3% of them had poor scores. The table

shows that 82.53% of food outlets had satisfactory performance in terms of disposing of waste properly.

**Table 4.2.19.1: Score for proper waste disposal at food outlet**

Score for proper waste disposal at food outlet	Frequency	Percent	Cum. Percentage
Excellent	17	5.12	5.12
Very good	118	35.54	40.66
Satisfactory or good enough	139	41.87	82.53
Less than satisfactory	47	14.16	96.69
Poor	11	3.31	100.00
Total	332	100.00	

## WASTE MANAGEMENT AND TREATMENT

Table 4.2.20 below presents a summary of four indicators of efficiency in waste management and treatment at the food outlets. The table shows that 62% of food outlets had a plan for waste management, whereas 38% of them did not have a plan. The table also shows that 74% of food outlets practice source reduction of waste, whereas 26% of them do not do the same. It can be seen from the table that 83% of food outlets practice waste recycling, whereas 17% of them do not do the same. Finally, the table shows that 58% of operators were familiar with the White Paper on waste disposal, whereas 42% of them are not.

**Table 4.2.20: Assessment of efficiency in overall waste management and treatment**

Characteristic	Yes		No	
	Freq.	Percent	Freq.	Percent
Availability of plan for waste management	206	62.05	126	37.95
Practice of source reduction of waste	247	74.40	85	25.60
Recycling of waste at food outlet	277	83.43	55	16.57
Familiarity with White Paper on waste disposal	193	58.13	139	41.87

Table 4.2.21 below presents an overall summary for two categories of food outlets. In Category 1, proportions are given for food outlets that dispose of waste efficiently. In Category 2, proportions are given for food outlets that do not dispose of waste efficiently. The table shows that 76% of efficient operators are managers or owners, 76% of efficient operators are male, 60% of efficient operators implement waste disposal plans, 93% of efficient operators believe that proper waste disposal is helpful, 80% of efficient operators practice source reduction of waste, and 82% of efficient operators provide customers with trash cans at their food outlets. In contrast to efficient operators, only 31% of inefficient operators are managers or owners, only 34% of inefficient operators believe that proper waste disposal is helpful. Only 29% of inefficient operators have waste disposal plans for their food outlets. Only 40% of inefficient operators provide their customers with trash cans at their food outlets. The table clearly shows that efficient and inefficient operators differ sharply with regards to being owners or managers, having the right perception about the benefits of proper waste disposal, and providing customers with trash cans at their food outlets.

**Table 4.2.21: Group proportions with regards to overall efficiency in waste disposal**

<b>Characteristic</b>	<b>Efficient (n=274)</b>	<b>Non-efficient (n=58)</b>
Category	Food canteen: 66% Food eatery: 8% Liquor store: 12% General food store: 13%	Food canteen: 59% Food eatery: 17% Liquor store: 12% General food store: 12%
Manager or owner	Yes: 76% No: 24%	Yes: 31% No: 69%
Gender	Male: 76% Female: 24%	Male: 76% Female: 24%
Average age of food outlet	4.55 years	4.43 years
Highest type of waste generated	Paper or plastic waste: 46% Food waste: 44% Glass: 9% Plastic bottle: 1%	Paper or plastic waste: 71% Food waste: 29% Glass: 0% Plastic bottle: 0%

Sorting waste	Yes: 76% No: 24%	Yes: 45% No: 55%
Implementation of plan for waste disposal	Yes: 60% No: 40%	Yes: 29% No: 71%
Personal hygiene	Adequate: 89% Poor: 11%	Adequate: 60% Poor: 40%
Perception on waste disposal	Good: 93% Bad: 7%	Good: 34% Bad: 66%
Source reduction of waste	Yes: 80% No: 20%	Yes: 50% No: 50%
Intent for implementing plan	Yes: 81% No: 19%	Yes: 14% No: 86%
Trash can available for customers	Yes: 82% No: 18%	Yes: 40% No: 60%

#### 4.3. PEARSON'S CHI-SQUARE TESTS OF ASSOCIATION

The Pearson chi-square test of association is a simple test (Dawson and Trapp, 2004) was used for performing a preliminary screening of influential factors that were significantly associated with poor or less than satisfactory performance in proper waste disposal. Table 4.3.1 shows a list of 16 factors that are significantly associated with poor or less than satisfactory waste disposal at the 0.001 level of significance.

The outcome variable of study, Y, is defined as follows:

$$\text{Score} = \begin{cases} 1 & \text{if } \textit{poor or less than satisfactory} \\ 0 & \text{if } \textit{satisfactory, very good or excellent} \end{cases}$$

**Table 4.3.1: List of 16 significant associations from Pearson’s chi-square tests of associations (P < 0.001)**

<b>Variable of study associated with overall efficiency in waste disposal</b>	<b>Observed chi-square value</b>	<b>P-value</b>
<b>Manager:</b> Are you the manager or owner of this food outlet or business?	43.42	0.000
<b>Seats:</b> Are there enough number of seats available for customers?	15.44	0.000
<b>Kitchen:</b> Do you have trash bins availability for disposal of solid or liquid wastes from the kitchen?	23.95	0.000
<b>Hygiene:</b> Personal hygiene of staff working inside the kitchen	35.86	0.000
<b>Perception:</b> Perception on the importance of efficient and proper waste disposal	128.90	0.000
<b>Frequency:</b> Frequency at which food outlet/business premises is inspected	34.86	0.000
<b>Enough:</b> Availability of enough waste bins in the outlet/business premises for disposal of waste materials	73.12	0.000
<b>Trash can:</b> Availability of trash cans within the food outlet/business premises for customers	65.35	0.000
<b>Maintain:</b> How would you rate the maintenance or cleanliness of trash bins and their environment in your organization?	44.80	0.000
<b>Plan:</b> Does your food outlet have any waste management plan?	20.47	0.000
<b>Implement:</b> Do you implement the waste management plan?	18.58	0.000
<b>Intent:</b> Do you intend to develop a plan in the near future?	28.44	0.000
<b>Sort:</b> Do you sort the wastes generated by your outlet?	22.98	0.000
<b>Reduction:</b> Do you manage waste through source reduction?	21.97	0.000
<b>Whitepaper:</b> Are you familiar with the South African Draft White Paper on environmental management?	26.94	0.000
<b>Cover:</b> Does your outside bin have cover?	22.13	0.000

Significant associations are characterized by large observed chi-square values and small P-values. It can be seen that all 16 associations shown above in Table 4.3.1 is highly significant at the 0.001 level of significance. Eight of the 16 predictor variables shown in Table 4.3.1 were used for subsequent analysis using binary logistic regression.

#### **4.4. BINARY LOGISTIC REGRESSION ANALYSIS**

Results from binary logistic regression analysis are theoretically more reliable than results from Pearson's chi-square tests of association (Hosmer and Lemeshow, 2000). This is because the measure of effect in binary logistic regression is the odds ratio, and not two-by-two significant associations. Logistic regression analysis allows multivariate analysis involving several variables that are influential over waste disposal. It is also possible to assess the reliability of the fitted logistic regression model based on highly reliable diagnostic tests such as the classification table, the likelihood ratio test, the Hosmer-Lemeshow goodness-of-fit tests, sensitivity and specificity.

##### **Selection of variables for binary logistic regression analysis**

The selection of variables used for binary logistic regression analysis was based on two criteria (relevance to the research questions of study and the presence of a significant association with the dependent variable of study at the 0.01 level of significance). Statistical significance was assessed based on Pearson's chi-square tests of association between the various independent variables of study and the dependent variable of study (proper waste disposal). At the end of the screening procedure, the following 8 independent variables were selected for binary logistic regression analysis:

**Manager:** Are you the manager or owner of this food outlet or business?

**Sort:** Do you sort the wastes generated by your outlet?

**Implement:** Do you implement the waste management plan?

**Hygiene:** Personal hygiene of staff working inside the kitchen

**Perception:** Perception on the importance of efficient and proper waste disposal

**Reduction:** Do you manage waste through source reduction?

**Intent:** Do you intend to develop a plan in the near future?

**Trash can:** Availability of trash cans within premises for customers

Table 4.4.1 below shows the categories of variables used for binary logistic regression analysis. It can be seen from the table that each of the 9 variables (one dependent variable + 8 independent variables of study) shown in Table 4.4.1 is dichotomous. Level 1 of each variable is associated with inadequate performance in waste disposal. Level 0 of each variable is associated with adequate performance in waste disposal.

**Table 4.4.1: List of variables used for binary logistic regression analysis and their levels**

<b>Variable of study</b>	<b>Level 1</b>	<b>Level 0</b>
<b>Score:</b> Overall score for proper waste disposal	Poor or less than satisfactory	Satisfactory, very good or excellent
<b>Manager:</b> Are you the manager or owner of this food outlet or business?	No	Yes
<b>Sort:</b> Do you sort the wastes generated by your outlet?	No	Yes
<b>Implement:</b> Do you implement the waste management plan?	No	Yes
<b>Hygiene:</b> Personal hygiene of staff working inside the kitchen	No	Yes
<b>Perception:</b> Perception on the importance of efficient and proper waste disposal	No	Yes
<b>Reduction:</b> Do you manage waste through source reduction?	No	Yes
<b>Intent:</b> Do you intend to develop a plan in the near future?	No	Yes
<b>Trash can:</b> Availability of trash cans within the food outlet/business premises for customers	Less than satisfactory	Satisfactory, very good or excellent

Table 4.4.2 below shows estimates obtained from binary logistic regression analysis. At the 0.05 level of significance, the table shows that overall efficiency in waste disposal at the 332 food outlets in the study is influenced by 4 key variables of study. These variables are wrong perception on the benefits of proper waste disposal, the non-availability of trash cans for customers at food outlets, operation of food outlets by casual employees, and failure to utilize source reduction of waste at food outlets, in a decreasing order of strength.

At the 0.05 level of significance, influential predictor variables are characterized by estimated odds ratios that differ from 1 significantly, P-values that are smaller than 0.05, and 95% confidence intervals of odds ratios that do not contain 1. Accordingly, it can be seen from Table 4.4.2 that all 4 predictor variables are significant at the 0.05 level.

**Table 4.4.2: Odds Ratios (OR) estimated from binary logistic regression analysis**

<b>Variable</b>	<b>Unadjusted OR and 95% C.I. <sup>+</sup></b>	<b>P-value</b>	<b>Adjusted* OR and 95% C.I. <sup>+</sup></b>
Manager	2.33 (1.03, 5.29)	0.043	2.36 (1.04, 5.32)
Wrong perception	10.87 (4.69, 25.25)	0.000	11.03 (4.72, 26.01)
Source reduction	2.25 (1.01, 5.07)	0.049	2.23 (1.01, 5.02)
Trash can	3.15 (1.43, 6.95)	0.004	3.17 (1.44, 6.98)

\*Adjustment was done for personal hygiene and intent; + C. I. = Confidence Interval

### **Summary of key findings**

The focus of the research is to identify factors that affect the efficient management of waste at the 332 food outlets selected for the study. The top 4 influential variables that affect efficiency in waste disposal are wrong perception, failure to provide customers with trash cans, the operation of food outlets by non-owners, and failure to use source reduction as a waste management tool, in a decreasing order of importance. The adjusted odds ratio of the variable perception is 11.03. This shows that a manager or owner who has the perception that proper waste management is not helpful is 11.03 times as likely to be inefficient in the proper management of waste.

The adjusted odds ratio of the variable trash can is 3.17. This shows that a food outlet where there is no trash can for customers is 3.17 times as likely to be inefficient in the management of waste in comparison with a food outlet where there is a trash can for customers. The adjusted odds ratio of the variable manager is 2.36. This shows that an outlet that is operated by someone who is not a manager or owner is 2.36 times as likely to be inefficient in the proper management of waste in comparison with an outlet that is operated by someone who is a manager or owner.

The adjusted odds ratio of the variable source reduction is 2.23. This shows that a food outlet that does not manage waste disposal through source reduction is 2.23 times as likely to be inefficient in the proper management of waste in comparison with a food outlet that manages waste disposal through source reduction. Adjusted odds ratios are more reliable than unadjusted odds ratios in epidemiological studies of this kind. In this study, the estimated odds ratios were adjusted for two potential confounding variables (personal hygiene and the presence of intent to implement waste disposal plan). The adjusted odds ratios did not differ much from the unadjusted odds ratios, thereby showing that none of the variables used for adjustment was a confounding variable. There was no effect modifying variable.

#### **4.5. GOODNESS-OF-FIT TESTS**

Goodness-of-fit tests are used in binary logistic regression analysis for assessing the degree of reliability of the fitted model. In this study, the reliability of the fitted model is assessed using commonly used standard diagnostic procedures. Each of the methods used confirms that the fitted model is adequate, and that results obtained from binary logistic regression analysis are highly reliable.

##### **4.5.1. THE CLASSIFICATION TABLE**

The classification table is the simplest and most commonly used measure of goodness-of-fit in binary logistic regression analysis. The table assesses the capacity of the fitted logistic regression model to accurately classify operators of food outlets as efficient or inefficient in

terms of disposing of waste. The table provides measures such as the overall percentage of correct classification, percentage sensitivity and percentage specificity.

**Table 4.5.1.1: The classification table as a measure of goodness-of-fit**

<b>Diagnostic measure</b>	<b>Percentage</b>
Sensitivity	60.34%
Specificity	95.62%
Positive predictive value	74.47%
Negative predictive value	91.93%
False + rate for true otherwise	4.38%
False - rate for true self initiated VCT	39.66%
False + rate for classified +	25.53%
False - rate for classified -	8.07%
Correctly classified	89.46%

The above classification table shows that the overall percentage of correct classification is 72.20%. The table also shows that the percentages of sensitivity and specificity are 56.25% (45/80) and 82.40% (103/125) respectively. These percentages are fairly large. Hence, the fitted logistic regression model is fairly adequate. The percentage of overall correct classification is equal to 89.46%, a figure which is above 75%. This shows that the fitted model is highly reliable in accurately classifying observations.

Sensitivity is an epidemiological measure of the capacity of the fitted model to accurately detect food outlets in which waste is not disposed of properly. The percentage sensitivity of the fitted model is 60.34%, a figure which is above 50%. This shows that the fitted model is fairly sensitive. Specificity is an epidemiological measure of the capacity of the fitted model to accurately detect food outlets in which waste is disposed of properly. The percentage specificity of the fitted model is 95.62%, a figure which is fairly close to 100%. Hence, the fitted model is almost perfectly specific.

#### 4.5.2. THE HOSMER-LEMESHOW GOODNESS-OF-FIT TEST

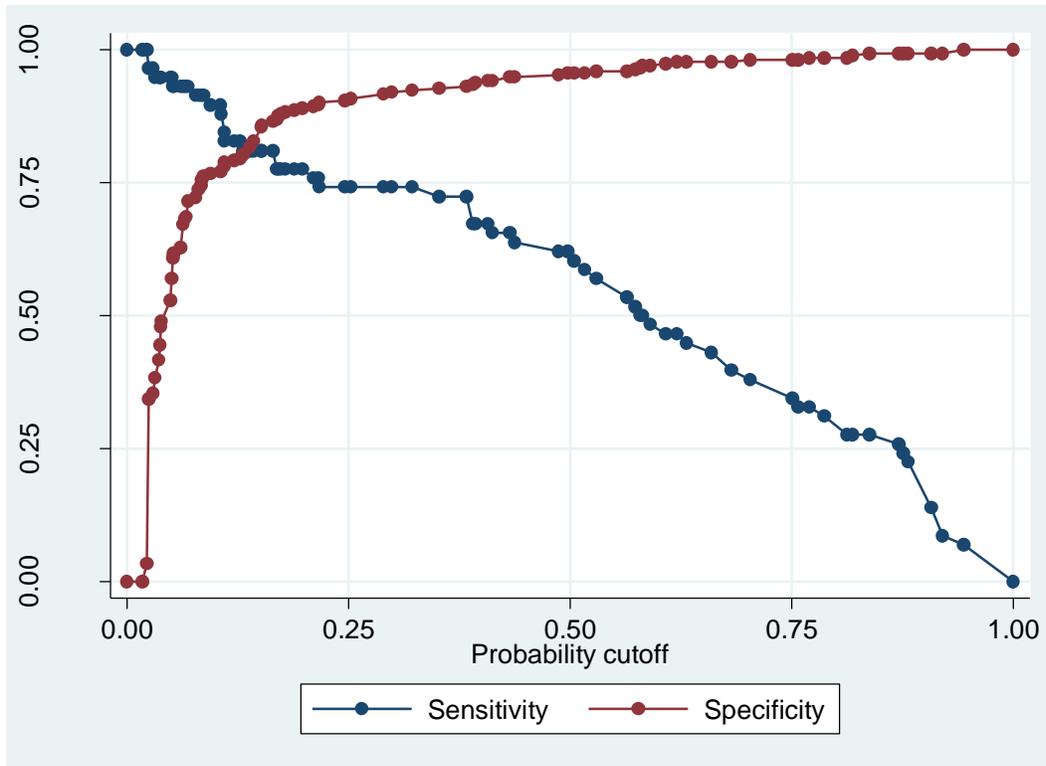
The Hosmer-Lemeshow goodness-of-fit test is used for testing the null hypothesis that there is no reason to doubt the adequacy or reliability of the fitted model. A P-value that is greater than 0.05 shows that the null hypothesis should be accepted at the 5% level of significance, thereby confirming that the fitted model is theoretically reliable. In this study, the P-value from the Hosmer-Lemeshow goodness-of-fit test is equal to 0.0942, a figure which is greater than 0.05. Hence, we have no reason to doubt the reliability of the fitted logistic regression model.

**Table 4.5.2.1: The Hosmer-Lemeshow goodness-of-fit test**

<b>Diagnostic measure</b>	<b>Magnitude</b>
Number of observations	332
Number of covariate patterns	87
Degrees of freedom of chi-square statistic	78
P-value	0.0942

#### 4.5.3. SENSITIVITY AND SPECIFICITY PLOTS

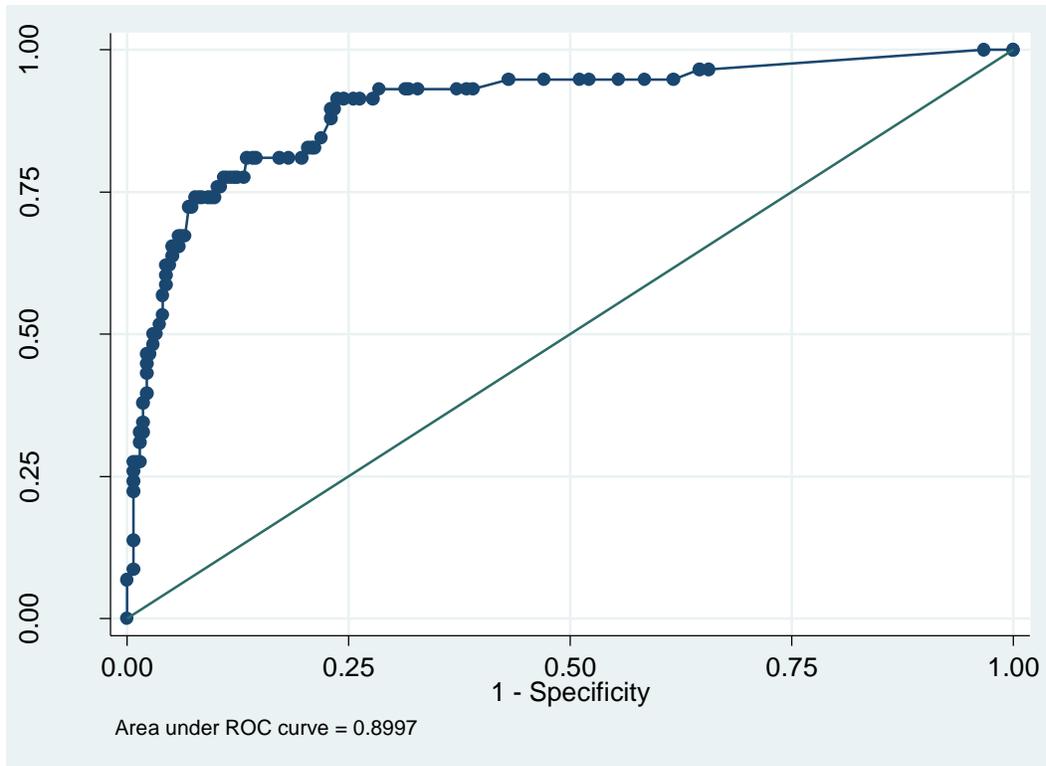
Figure 4.5.3.1 below shows a plot of sensitivity/specificity versus probability cut-off point. The two plots cross each other fairly close to the vertical axis. This shows that the fitted model is adequately sensitive and specific.



**Figure 4.5.3.1: Plot of sensitivity/specificity versus probability cut-off point**

#### **4.5.4. AREA UNDER THE ROC CURVE**

Figure 4.5.4.1 below shows a Receiver Operating Characteristic (ROC) plot. The magnitude of the area that lies under the ROC plot is a measure of variation explained by the fitted logistic regression model. In this case, the area under the ROC plot is 89.97%, a figure that is significantly above 75%. The unexplained proportion of variation is equal to roughly 10%. The large proportion of explained variation and the small proportion of unexplained variation show that the fitted model is highly reliable in explaining variability in waste disposal as a function of the explanatory variables used for logistic regression analysis.



**Figure 4.5.4.1: Area under the Receiver Operating Characteristic (ROC) plot**

#### **4.5.5: THE LIKELIHOOD RATIO TEST**

The likelihood ratio test is used for assessing the collective efficiency of the 8 predictor variables used for performing binary logistic regression analysis. At the 5% level of significance, a P-value that is smaller than 0.05 shows that the 8 predictor variables used for performing binary logistic regression analysis are jointly efficient. In this case, the P-value from the likelihood ratio test is equal to 0.000, a figure that is smaller than 0.05. This small P-value shows that the 8 predictor variables used for binary logistic regression analysis are collectively efficient in accounting for failure in the proper disposal of waste.

# CHAPTER 5: DISCUSSION OF RESULTS

## 5.1. INTRODUCTION

This section is dedicated for discussing key findings obtained from the study. Findings from this study are not surprising. The results are expected from a typical Sub-Saharan African country in which poverty, unemployment, massive immigration into urban centres prevail. Generally, awareness and regard for environmental sanitation is poor. The top 4 influential variables that affect proper waste disposal are wrong perception, failure to provide customers with trash cans, the operation of food outlets by non-owners, and failure to use source reduction as a waste management tool, in a decreasing order of importance.

Based on the results, a manager or owner who has the perception that proper waste management is not helpful is 11.03 times as likely to be inefficient in the proper management of waste. A food outlet where there is no trash can for customers is 3.17 times as likely to be inefficient in the proper management of waste in comparison with a food outlet where there is a trash can for customers.

An outlet that is operated by someone who is not a manager or owner is 2.36 times as likely to be inefficient in the proper management of waste in comparison with an outlet that is operated by someone who is a manager or owner. A food outlet that does not manage waste disposal through source reduction is 2.23 times as likely to be inefficient in the proper management of waste in comparison with a food outlet that manages waste disposal through source reduction.

Inhabitants of Pretoria are entitled to living in a clean environment based on the policies of DEAT. There are regulations that must be obeyed by all food outlets conducting business in Pretoria. However, not all food outlets comply with regulatory requirements. Not all customers that buy food from the food outlets generally obey sanitary regulations, and some of them actually dump food and wrapping materials on the streets. The relevant tools for intervention are health and sanitary education as well as the enforcement of rules and

regulations by dedicated employees of the CTMM, DEAT and the DOH. The disposal of waste is described as an activity that may result in a substantial detrimental effect on the environment. As a result, the Regulations regarding environmental impact reports produced by the DEAT, CTMM and the DOH should be enforced with vigour with a view to ensure environmental and sanitary cleanliness. The disposal of waste generated from food outlets conducting business in Pretoria on the streets is detrimental to the overall cleanliness of the City of Pretoria. The responsibility for refuse removal, refuse dumps and solid waste disposal is assigned by the Constitution of South Africa to the CTMM which is obliged to enforce the laws at all times. This amounts to enforcing the appropriate by-laws for sanitation and waste disposal.

The key tool to be utilized effectively is Section 24 of the Constitution of the Republic of South Africa (Act 108 of 1996) that states that the people of South Africa have a right to an environment that is not detrimental to human health, and imposes a duty on the state to promulgate legislation and to implement policies to ensure that this right is upheld. A number of regulations have been published so far by the South African government in addition to the municipal by-laws that are published by the CTMM in order to ensure cleanliness and efficient waste disposal. The key regulations are the Environmental Management Policy for South Africa of 1998, the publication of the Draft White Paper on Integrated Pollution and Waste Management of 1998, the promulgation of the National Water Act number 36 of 1998, the National Environmental Management Act number 107 of 1998, and the development of a National Waste Management Strategy of 1999. While the publication of the regulations above is a significant step in the right direction, the fact shows that the regulations are not vigorously enforced by the relevant authorities in the CTMM. As a result, waste produced by food outlets conducting business in Pretoria continues to be a significant negative factor in terms of keeping the city clean.

The efficient disposal of waste produced by food outlets at taxi ranks and the streets in the CBD of Pretoria City has numerous economic and health-related benefits to the inhabitants of the City of Pretoria. Disposing of waste in landfills is much better than using open dumps. Up until recently, emphasis has been placed on waste disposal and not management and recycling. Waste disposal, however, has an adverse impact on the environment and

public health, particularly in cases where there has been no thorough waste management planning, the landfill has been inappropriately sited and designed and inadequately managed and operated.

Until recently, the management of waste generated from food outlets conducting business in Pretoria CBD has not been given due consideration. The waste management that took place focused mainly on waste disposal and was reactive in that it addressed needs as they occurred. Holistic, integrated waste management planning was poorly done. The low priority that was historically accorded to waste management has resulted in waste impacting detrimentally on the South African environment and on human health. Waste Treatment: Standards for medical waste incinerator air emissions, as well as classification of all waste treatment facilities, will be reviewed, revised and enforced. A public awareness and waste management education campaign will be introduced to focus on the hazards of medical waste and the legal responsibilities of medical waste generators. Efficient waste disposal is a process that requires the full collaboration of all stakeholders on a community based collaborative approach. In addition to providing sanitary education and inspection services to the food outlets, clear incentives must be provided to ensure maximum success. The enforcement of regulations, the provision of incentives, adequate logistical resources, additional manpower, financial rewards, public-private partnerships and awareness campaigns are all essential (CTMM, 2008).

The treatment of waste produced by the food outlets in Pretoria CBD is similar to waste produced in a typical developing nation in the sense that treatment of this waste involves simply a reduction of its volume by use of methods such as baling or shredding, although some small-scale incineration and composting is practiced. The emphasis remains on disposal of general waste by landfill without treatment as the lowest cost disposal option, as landfill airspace is still available in South Africa. The lack of pre-treatment of general waste before disposal is therefore currently not regarded as a problem in South Africa. Incineration of general waste and hazardous waste is not acceptable to many stakeholders due to the poor operation of many existing facilities and non-compliance with existing by-laws. Incineration is not economically feasible in South Africa since its warm climate limits the market for the energy derived from the incineration process. The majority of

operating incinerators in South Africa are used for the treatment of infectious medical waste (DEAT, 2007).

Increasing general awareness about the benefits of proper waste disposal is the solution to success. The number of waste disposal sites is limited, and the disposal of waste is expensive. Since there are not enough of these facilities, hazardous waste is often transported over long distances, resulting in increased risks of accidents and higher transport costs. Some other helpful steps are to undertake an integrated plan in which waste is gathered and disposed of efficiently based on mutual collaboration among stakeholders, Strengthen the technical, financial, administrative and operating capacity of the institutions in the basic environmental sanitation sector, encouraging health education and community promotion activities, which are basic to the success of waste collection and disposal, especially at taxi ranks and the streets at the CBD of Pretoria, to provide clear incentives to food outlets that improve the quality of waste collection and disposal based on generally accepted standards. Technical cooperation among stakeholders must be directed toward the strengthening of institutions in the basic environmental sanitation sector and emphasis should be given to the following activities: operation and maintenance, community promotion, training, administration and management, the preparation of plans and studies helpful for efficient waste disposal, and the application of technologies that are helpful for efficient waste disposal.

Solid waste produced by food outlets contains large numbers of germs, some of which may cause food poisoning, diarrhoea or typhoid. Staff working in food outlets must be educated on the importance of proper waste disposal, cleanliness, and the use of keeping personal hygiene at all times because the health condition of customers depends on their degree of commitment to cleanliness and proper waste disposal. It is the duty of the CTMM to ensure the health and safety of customers buying food from food outlets operating in Pretoria. When people become infected after eating food from food outlets, they should be encouraged to find out the source of their sickness. Doing so enables health and environmental safety officials employed by the CTMM to take prompt action. The municipal bylaws actually allow the CTMM to suspend or cancel trade licenses of food outlets under circumstances in which the health of the public is at risk. Throwing away

waste, litter, excess oil, burned food, rotten vegetables and meat, broken bottles, etc on the streets or the backyards has the potential for causing infectious diseases that put the health of customers at risk. Employees of food outlets with cooking responsibilities must be inspected regularly and routinely in order to ensure public health and environmental sanitation.

The need for inspection becomes acute during rainy seasons and prolonged civil actions. In-depth interviews conducted with some of the managers of the 332 food outlets that took part in the study have revealed that the food outlets suffer enormously during prolonged strike actions. Waste material gets vandalized by scavengers as a result of delay in collection by service providers. It is too risky to leave waste uncollected during rainy seasons as waste could easily be mixed up with excreta that could be washed away by rain-water, ending up in wells and streams. The germs in the excreta could then easily contaminate drinking or washing water. In such situations, diarrhoeal diseases can spread from one person to another. Failure to dispose of waste can have a significant effect on the health of communities. Where refuse is not disposed of properly, it can lead to pollution of surface water, as rain washes refuse into rivers and streams. There may also be a significant risk of groundwater contamination. Refuse disposed of in storm drains may cause blockages and encourage fly and mosquito breeding. It is therefore very important that household waste is disposed of properly.

Municipal bylaws require that food outlets provide dustbins and toilets to customers. While 173 of the 332 food outlets (52.11%) provide toilets to customers, the rest 159 (47.89%) do not have toilets for customers. Considering the fact that efficient food outlets are characterized by the provision of toilets to customers, it becomes most helpful for food outlets to provide toilets to customers. Where a large number of people eat food from the same source, there is a greater risk of the spread of diseases such as diarrhoea, food poisoning, typhoid, cholera, hepatitis A, and other communicable diseases. All food outlets providing food-related services to the general public must have adequate sanitation and hygiene facilities such as toilets if they are to comply with municipal bylaws.

Although overall responsibility for the provision of sanitation facilities at food outlets rests with the CTMM, it is vital that the CIMM monitors and evaluates the state of sanitation

facilities in public places on behalf of the general public. Adequate support should be provided in this regard to the CTMM by the Gauteng Department of Health. According to Federico et al. (2009), there are several basic rules for ensuring sanitation in public places such as food outlets:

- Based on guidelines for primary health care that are recommended for developing nations by the World Health Organization (2007), there should be sufficient toilet facilities for the maximum number of people using the food outlet during the day. This normally means one toilet compartment for every 25 users. The toilet facilities should be arranged in separate blocks for men and women. The men's toilet block should have urinals and toilet compartments; the women's block toilet compartments only. The total number of urinals plus compartments in the men's block should equal the total number of compartments in the women's block.
- Toilet facilities should not be connected directly to kitchens. This is in order to reduce the number of flies entering the kitchen and to reduce odours reaching the kitchen. It is important that people using the toilet facilities cannot pass directly through the kitchen.
- There must be a hand washing basin with clean water and soap close to the toilet facilities. There should be separate, similar facilities near to kitchens or where food is handled.
- There must be a clean and reliable water supply for hand washing, personal hygiene and flushing of toilet facilities. The water supply should meet quality standards and be regularly tested to ensure that any contamination is discovered quickly and that appropriate remedial action is taken.
- Refuse must be disposed of properly and not allowed to build up, as it will attract flies and vermin.

Responsibilities for cleaning sanitation facilities should be very clearly defined. This could be done by the Gauteng Department of Health in collaboration with health inspectors working for the CTMM. Dirty food outlets make it more likely that people will continue to use the facilities badly or not at all. Clean facilities set a good example to users. It is important to make sure that information about health is available in public places. Such

information should be displayed in an eye-catching, simple and accurate way. Where appropriate, large posters with bright colours and well chosen messages, put up in obvious places, are effective. Health and hygiene messages may be passed on to the public using such posters in public places. These messages should include the promotion of hand-washing, use of dustbins, care of toilet facilities, the protection of water supplies, and the like. School teachers and students could be involved in preparing educational posters and notices for public places. In general, community participation is most beneficial for ensuring overall environmental cleanliness and hygiene.

Nimbalkar et al. (2009) have pointed out that source reduction of waste is important to improving efficiency in waste disposal. However, source reduction of waste requires technical skills and resources that are necessary for source reduction of waste. Methods such as source reduction of waste, reuse of materials, recycling, etc are preferred waste management strategies. Each food outlet is unique, and so is the preferred method of waste disposal and source reduction of waste. Some of the food outlets could try source reduction of waste by reducing the purchase or use of products that contain unnecessary or harmful ingredients. They could also monitor the use, storage, and disposal of products with potentially hazardous substances at their food outlets. Leftovers should not be mixed up with other products. Incompatible products might react, ignite, contaminate or explode at the food outlet.

Waste disposal plans are essential for ensuring overall cleanliness at the workplace. In this study, 206 of the 332 food outlets (62.05%) have waste disposal plans. The rest 126 (37.95%) do not have such plans for waste removal and disposal. Waste removal and disposal plans could help by articulating how often waste is collected, how it is disposed of, how source reduction of waste should be exercised, ensuring well functioning drainage, inspection of toilets and hand-washing facilities, interaction with health inspectors from the CTMM, how waste should be removed during strike actions, inspection of personal hygiene of staff who prepare food, the provision of health education to staff, incentives and other helpful measures. Individual waste disposal plans by food outlets must be in line with similar plans adopted by the CTMM. It is apparent that the 126 (37.95%) food outlets that do not have waste disposal plans require technical assistance in drawing up their own plans.

This task requires assistance from environmental health inspectors working for the CTMM. Providing assistance to food outlets that do not have their own waste removal and disposal plans is of strategic importance to the CTMM and the Gauteng Department of Health.

## **5.2. MAJOR FINDINGS**

The result showed that 18% of the 332 food outlets in the study were generally inefficient in waste disposal. Based on odds ratios estimated from binary logistic regression analysis, wrong perception (a factor of 10.88), failure to provide trash cans to customers (a factor of 3.15), the operation of food outlets by non-owners or managers (a factor of 2.33), and failure to practice source reduction of waste (a factor of 2.25) are the top 4 factors that affect the proper management of waste at 332 food outlets in the study.

The presence of wrong perception on the benefits of waste disposal is a major challenge. To rectify this issue, a fully fledged health and sanitary education and campaign must be conducted in Pretoria CBD. Clear incentives must be provided to food outlets that dispose of waste efficiently. Regulatory and legislative actions must be taken against those who fail to respect municipal by-laws that are related to cleanliness and proper waste disposal. The efficient disposal of waste generated by food outlets operating in the CBD of Pretoria has direct economic benefits to the CTMM and the people who live in the city. Waste should be gathered efficiently, and disposed of in accordance with the waste collection and management plan belonging to the CTMM. Management of waste must start at the lowest level. To ensure this, an education campaign must be conducted with a view to ensure the full collaboration of food outlets conducting business in the City of Pretoria. In terms of sanitation, the food outlets are required to obey municipal by-laws, and would be happy to work hand in hand with the CTMM. Some of the food outlets should be encouraged to use improved technology for source reduction and sorting. Proper waste disposal and overall sanitation are interlinked, and as such ensuring proper waste disposal amounts to contributing for the overall cleanliness of the City of Pretoria.

The recruitment of more sanitation employees and the use of improved technology have the potential for keeping the streets of Pretoria much cleaner than they are now. Highly incentivized municipal workers are more efficient in keeping the streets clean. Sanitary and health education are essential for improving efficiency and cutting down operational cost. Hence, an integrated approach of working hand in hand with the Departments of Health and Environmental Affairs and Tourism will help.

### **5.3 CONCLUSION**

A lot of waste is produced by the food outlets conducting business in the CBD of Pretoria on a daily basis. A sizeable proportion of the waste produced by the food outlets finds its way back to the streets of Pretoria, and is poorly managed. As a result, the degree of cleanliness of the city has decreased. Waste is the accumulation of undesirable or superfluous by-product, emission, or residue of any process or activity that has been discarded, accumulated or been stored for the purpose of discarding or processing. Waste products generated by food outlets are generally harmless, but have the potential for reducing the quality of environmental sanitation and cleanliness significantly.

The result of this study shows that 18% of the 332 food outlets in the study were generally inefficient in waste disposal. Based on odds ratios estimated from binary logistic regression analysis, wrong perception (a factor of 10.88), failure to provide trash cans to customers (a factor of 3.15), the operation of food outlets by non-owners or managers (a factor of 2.33), and failure to practice source reduction of waste (a factor of 2.25) are the top 4 factors that affect the proper management of waste at 332 food outlets in the study.

### **5.4 RECOMMENDATIONS**

Based on the findings of this study, a recommendation is made to the City of Tshwane Metropolitan Municipality (CTMM) with a view to initiate suitable intervention. The planned intervention shall be aimed at improving the proper disposal of solid and liquid waste at food outlets operating in the Central Business District of Pretoria. Sanitary and

health education should be provided to operators of food outlets to address issues such as wrong perception on the usefulness of proper waste disposal, the provision of customers with trash cans, the operation of food outlets by non-owners, and the need to exercise source reduction as a waste management tool. A copy of the major findings of this study shall be given to the Health Department of the CTMM. Discussions should be held with the relevant staff of the CTMM in order to facilitate the implementation of findings of this study.

Based on findings of this particular study, the following recommendations are made to the CTMM in order to improve overall efficiency in the collection and disposal of waste produced by food outlets in the City of Pretoria:

- Increase awareness about the benefits of proper waste collection disposal.
- Provide incentives to food outlets that do a good job in terms of waste collection and proper disposal.
- Improve the conditions of employment of municipal workers responsible for waste collection and disposal.
- The CTMM and the Gauteng Department of Health must provide technical assistance to food outlets that do not have their own waste management plans so that such food outlets can contribute for overall efficiency in environmental sanitation.
- Produce and implement an integrated plan of waste collection and disposal with the relevant stakeholders in the CTMM.
- Undertake the planning and programming of their investments in basic environmental sanitation, in harmony with their priorities and their investments in

other interrelated sectors and based on socioeconomic, technical and financial criteria.

- Strengthen the technical, financial, administrative and operating capacity of the institutions in the basic environmental sanitation sector.
- Support community-based health promotion activities by non-governmental organizations.
- Support research initiatives that have benefit for overall sanitation, environmental cleanliness and good personal hygiene in the CTMM by funding them.

## **5.5 LIMITATIONS OF STUDY**

The study has the following three minor limitations:

1. Due to limited time and financial resources, the research was limited to collecting data from formal food outlets conducting business at the CBD of Pretoria only. Non-formal food outlets were excluded from this study.
2. The study deals with waste generated by food outlets only. However, food outlets are not the only source of waste that is adversely affecting the City of Pretoria.
3. The study is a descriptive, cross-sectional study. More could have been done based on a longitudinal study of five years or more. Conducting a similar longitudinal study has the potential for accounting for key risk factors based on time series or survival analysis, which are more reliable theoretical methods of data analysis.

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# APPENDICES

## APPENDIX 1: CROSS-TABULATED RESULTS

### Crosstab between gender and score in efficient waste management (Table 4.3.1.1)

```
. use c:\john2.dta, clear
```

```
. tab2 gender score, cell chi2
```

```
-> tabulation of gender by score
```

```
+-----+
| Key   |
+-----+
|      |
| frequency |
| cell percentage |
+-----+
```

Gender of manager	Score out of 5 for proper waste disposal				Total
	Excellent	Less than	Poor	Satisfact	
Female	3	12	3	39	82
	0.90	3.61	0.90	11.75	24.70
Male	14	35	8	100	250
	4.22	10.54	2.41	30.12	75.30
Total	17	47	11	139	332
	5.12	14.16	3.31	41.87	100.00

Gender of manager	Score out of 5 for proper waste disposal	
	Very good	Total
Female	25	82
	7.53	24.70
Male	93	250
	28.01	75.30
Total	118	332
	35.54	100.00

```
Pearson chi2(4) = 2.1371 Pr = 0.711
```

### Crosstab between level of education and score in efficient waste management (Table 4.3.1.2)

```
. tab2 educ score, cell chi2
```

-> tabulation of educ by score

```

+-----+
| Key   |
+-----+
| frequency |
| cell percentage |
+-----+

```

Highest level of education	Score out of 5 for proper waste disposal				Total
	Excellent	Less than	Poor	Satisfact	
Degree or above	2 0.60	3 0.90	0 0.00	10 3.01	30 9.04
Diploma level	9 2.71	16 4.82	3 0.90	58 17.47	144 43.37
No formal education	0 0.00	1 0.30	0 0.00	1 0.30	2 0.60
Primary level	0 0.00	2 0.60	0 0.00	7 2.11	12 3.61
Secondary level	6 1.81	25 7.53	8 2.41	63 18.98	144 43.37
Total	17 5.12	47 14.16	11 3.31	139 41.87	332 100.00

Highest level of education	Score out of 5 for proper waste disposal	Total
Degree or above	15 4.52	30 9.04
Diploma level	58 17.47	144 43.37
No formal education	0 0.00	2 0.60
Primary level	3 0.90	12 3.61
Secondary level	42 12.65	144 43.37
Total	118 35.54	332 100.00

Pearson chi2(16) = 16.9399 Pr = 0.389

### Crosstab between duration of operation and score in efficient waste management (Table 4.3.1.3)

```
. tab2 dur score, cell chi2
```

-> tabulation of dur by score

```

+-----+
| Key |
+-----+
| frequency |
| cell percentage |
+-----+

```

Duration of service of manager at food outlet	Score out of 5 for proper waste disposal				Total
	Excellent	Less than	Poor	Satisfact	
1 to 2 years	1 0.30	6 1.81	2 0.60	20 6.02	45 13.55
3 to 5 years	6 1.81	25 7.53	5 1.51	60 18.07	146 43.98
6 years or more	10 3.01	16 4.82	4 1.20	56 16.87	136 40.96
Less than 1 year	0 0.00	0 0.00	0 0.00	3 0.90	5 1.51
Total	17 5.12	47 14.16	11 3.31	139 41.87	332 100.00

Duration of service of manager at food outlet	Score out of 5 for proper waste disposal	
	Very good	Total
1 to 2 years	16 4.82	45 13.55
3 to 5 years	50 15.06	146 43.98
6 years or more	50 15.06	136 40.96
Less than 1 year	2 0.60	5 1.51
Total	118 35.54	332 100.00

Pearson chi2(12) = 5.8522 Pr = 0.923

### Crosstab between category of food outlet and score in efficient waste management (Table 4.3.1.4)

```
. tab2 category score, cell chi2
```

-> tabulation of category by score

```

+-----+
| Key |
+-----+
| frequency |
| cell percentage |
+-----+

```

Category of food outlet	Score out of 5 for proper waste disposal				Total
	Excellent	Less than	Poor	Satisfact	
Commercial food cante	8	30	4	92	216
	2.41	9.04	1.20	27.71	65.06
Eatery (Snacks)	3	4	6	10	32
	0.90	1.20	1.81	3.01	9.64
General store with ca	3	7	0	24	45
	0.90	2.11	0.00	7.23	13.55
Liquor store	3	6	1	13	39
	0.90	1.81	0.30	3.92	11.75
Total	17	47	11	139	332
	5.12	14.16	3.31	41.87	100.00

Category of food outlet	Score out of 5 for proper waste disposal	
	Very good	Total
Commercial food cante	82	216
	24.70	65.06
Eatery (Snacks)	9	32
	2.71	9.64
General store with ca	11	45
	3.31	13.55
Liquor store	16	39
	4.82	11.75
Total	118	332
	35.54	100.00

Pearson chi2(12) = 34.5536 Pr = 0.001

### Crosstab between contractors and score in efficient waste management (Table 4.3.1.5)

```
. tab2 contractor score, cell chi2
```

-> tabulation of contractor by score

```
+-----+
| Key    |
|-----|
|  frequency  |
| cell percentage |
+-----+
```

Contractor providing service	Score out of 5 for proper waste disposal				Total
	Excellent	Less than	Poor	Satisfact	
Government waste disp	3	4	6	10	32
	0.90	1.20	1.81	3.01	9.64
Private waste contrac	8	30	4	92	216
	2.41	9.04	1.20	27.71	65.06
Self/Personal arrange	3	6	1	13	39

	0.90	1.81	0.30	3.92	11.75
Use of street kids a	3	7	0	24	45
	0.90	2.11	0.00	7.23	13.55
Total	17	47	11	139	332
	5.12	14.16	3.31	41.87	100.00

Contractor providing service	Score out of 5 for proper waste disposal	
	Very good	Total
Government waste disp	9	32
	2.71	9.64
Private waste contrac	82	216
	24.70	65.06
Self/Personal arrange	16	39
	4.82	11.75
Use of streets kids a	11	45
	3.31	13.55
Total	118	332
	35.54	100.00

Pearson chi2(12) = 34.5536 Pr = 0.001

### Crosstab between mode of waste disposal during strike action and score in efficient waste management (Table 4.3.1.6)

```
. tab2 strikel score, cell chi2
```

-> tabulation of strikel by score

```
+-----+
| Key   |
|-----|
| frequency |
| cell percentage |
+-----+
```

Waste disposal method used during strikes	Score out of 5 for proper waste disposal				Total
	Excellent	Less than	Poor	Satisfact	
Burying on land	2	1	1	0	6
	0.60	0.30	0.30	0.00	1.81
By burning in open ve	0	1	0	1	3
	0.00	0.30	0.00	0.30	0.90
By dumping on roadsid	0	0	0	1	2
	0.00	0.00	0.00	0.30	0.60
Disposal on empty lan	15	45	10	137	321
	4.52	13.55	3.01	41.27	96.69
Total	17	47	11	139	332
	5.12	14.16	3.31	41.87	100.00

Waste disposal method used during strikes	Score out of 5 for proper waste disposal	
	Very good	Total
Burying on land	2	6
	0.60	1.81
By burning in open ve	1	3
	0.30	0.90
By dumping on roadsid	1	2
	0.30	0.60
Disposal on empty lan	114	321
	34.34	96.69
Total	118	332
	35.54	100.00

Pearson chi2(12) = 17.0110 Pr = 0.149

### Crosstab between type of waste disposal bin and score in efficient waste management (Table 4.3.1.7)

```
. tab2 bin1 score, cell chi2
```

-> tabulation of bin1 by score

```
+-----+
| Key   |
+-----+
| frequency |
| cell percentage |
+-----+
```

Type of waste disposal bin	Score out of 5 for proper waste disposal				Total
	Excellent	Less than	Poor	Satisfact	
Aluminium type waste	1	2	0	3	7
	0.30	0.60	0.00	0.90	2.11
Iron drum waste bins	6	8	1	22	63
	1.81	2.41	0.30	6.63	18.98
Municipal plastic was	9	35	10	112	255
	2.71	10.54	3.01	33.73	76.81
Stainless waste bins	1	2	0	2	7
	0.30	0.60	0.00	0.60	2.11
Total	17	47	11	139	332
	5.12	14.16	3.31	41.87	100.00

```
| Score out
| of 5 for
| proper
| waste
```

Type of waste disposal bin	disposal Very good	Total
Aluminium type waste	1 0.30	7 2.11
Iron drum waste bins	26 7.83	63 18.98
Municipal plastic was	89 26.81	255 76.81
Stainless waste bins	2 0.60	7 2.11
Total	118 35.54	332 100.00

Pearson chi2(12) = 12.3179 Pr = 0.420

### Crosstab between cleaners of waste disposal bin and score in efficient waste management (Table 4.3.1.8)

```
. tab2 clean1 score, cell chi2
```

-> tabulation of clean1 by score

```
+-----+
| Key    |
|-----|
| frequency |
| cell percentage |
+-----+
```

Who cleans waste disposal bin	Score out of 5 for proper waste disposal				Total
	Excellent	Less than	Poor	Satisfact	
By the food outlet st	7 2.11	42 12.65	10 3.01	102 30.72	246 74.10
Municipal or contract	1 0.30	1 0.30	0 0.00	6 1.81	15 4.52
Unemployed individual	2 0.60	3 0.90	0 0.00	9 2.71	20 6.02
Usually left as it is	7 2.11	1 0.30	1 0.30	22 6.63	51 15.36
Total	17 5.12	47 14.16	11 3.31	139 41.87	332 100.00

Who cleans waste disposal bin	Score out of 5 for proper waste disposal	
	Very good	Total
By the food outlet st	85 25.60	246 74.10
Municipal or contract	7	15

	2.11	4.52
Unemployed individual	6	20
	1.81	6.02
Usually left as it is	20	51
	6.02	15.36
Total	118	332
	35.54	100.00

Pearson chi2(12) = 21.2083 Pr = 0.047

### Crosstab between status of operator and score in efficient waste management (Table 4.3.1.9)

```
. tab2 manager score, cell chi2
```

-> tabulation of manager by score

```
+-----+
| Key   |
+-----+
| frequency |
| cell percentage |
+-----+
```

Manager or owner of food outlet?	Score out of 5 for proper waste disposal				Total
	Excellent	Less than	Poor	Satisfact	
No	0	31	9	44	107
	0.00	9.34	2.71	13.25	32.23
Yes	17	16	2	95	225
	5.12	4.82	0.60	28.61	67.77
Total	17	47	11	139	332
	5.12	14.16	3.31	41.87	100.00

Manager or owner of food outlet?	Score out of 5 for proper waste disposal	
	Very good	Total
No	23	107
	6.93	32.23
Yes	95	225
	28.61	67.77
Total	118	332
	35.54	100.00

Pearson chi2(4) = 53.7344 Pr = 0.000

**Crosstab between availability of dustbins for customers and score in efficient waste management (Table 4.3.1.10)**

```
. tab2 bin2 score, cell chi2
```

-> tabulation of bin2 by score

```
+-----+
| Key   |
+-----+
|      |
| frequency |
| cell percentage |
+-----+
```

Bins for customers available	Score out of 5 for proper waste disposal				Total
	Excellent	Less than	Poor	Satisfact	
No	3 0.90	17 5.12	4 1.20	39 11.75	77 23.19
Yes	14 4.22	30 9.04	7 2.11	100 30.12	255 76.81
Total	17 5.12	47 14.16	11 3.31	139 41.87	332 100.00

Bins for customers available	Score out of 5 for proper waste disposal	
	Very good	Total
No	14 4.22	77 23.19
Yes	104 31.33	255 76.81
Total	118 35.54	332 100.00

Pearson chi2(4) = 16.1556 Pr = 0.003

**Crosstab between availability of toilets for customers and score in efficient waste management (Table 4.3.1.11)**

```
. tab2 toilet1 score, cell chi2
```

-> tabulation of toilet1 by score

```
+-----+
| Key   |
+-----+
```

| frequency |  
 | cell percentage |  
 +-----+

Toilet for customers	Score out of 5 for proper waste disposal				Total
	Excellent	Less than	Poor	Satisfact	
No	5	30	9	76	159
	1.51	9.04	2.71	22.89	47.89
Yes	12	17	2	63	173
	3.61	5.12	0.60	18.98	52.11
Total	17	47	11	139	332
	5.12	14.16	3.31	41.87	100.00

Toilet for customers	Score out of 5 for proper waste disposal	
	Very good	Total
No	39	159
	11.75	47.89
Yes	79	173
	23.80	52.11
Total	118	332
	35.54	100.00

Pearson chi2(4) = 25.1622 Pr = 0.000

## **APPENDIX 2: LETTER OF INTRODUCTION**

**Department of Environmental Science College of Agriculture and Environmental Science, University of South Africa (UNISA)**

**Research questionnaire**

**Title of MSc research: AN INVESTIGATION INTO THE FACTORS THAT AFFECT THE EFFICIENT MANAGEMENT OF WASTES FROM FOOD OUTLETS IN PRETORIA, SOUTH AFRICA**

### **LETTER OF INTRODUCTION FOR DATA COLLECTION**

#### **Introduction**

I am a Masters' student in the Department of Environmental Sciences, University of South Africa (UNISA) conducting research towards fulfilment of the requirement for the award of the degree. Your food outlet among others has been selected for this study. The purpose of this questionnaire is for research purpose aimed at assessing the current quality/level of management of waste disposal at food outlets in the City of Pretoria. As we all know, food outlets serve a large number of customers who have access to empty bottles, cans and food packaging materials. Some of these materials litter the streets and the surrounding environment.

To achieve this, information and responses are required from stakeholders. Filling the questionnaire implies that verbal informed consent has been obtained and information you provide on or on behalf of your food outlet will be kept in confidence. There shall be no reference to any food outlet by name or any description whatsoever. Results of this study shall be analyzed on data sets that are completely anonymous.

NB: Should you feel uncomfortable answering any question, please leave the item blank and answer the next question.

Thank you.

Mr. Yohannes Worku (Student Number: 43336019)

MSc student of Environmental Sciences

University of Pretoria, Pretoria, South Africa

35 Merle Street, Riviera

Pretoria 0084, South Africa

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# APPENDIX 3: QUESTIONNAIRE OF STUDY

## QUESTIONNAIRE

### FACTORS THAT AFFECT THE MANAGEMENT OF WASTE MATERIALS FROM FOOD OUTLETS IN PRETORIA

Questionnaire Number:									
Date:	D	D	M	M	Y	Y	Y	Y	

#### PART 1: BIOGRAPHICAL INFORMATION

Name of food outlet:		
Name of suburb:		
Municipal district number:	<b>1</b>	
<i>(Please tick appropriate choice)</i>	<b>2</b>	
	<b>3</b>	
	<b>4</b>	
Age of the manager of food outlet:	Less than 20 years	<b>1</b>
<i>(Please tick appropriate choice)</i>	20 to 24 years	<b>2</b>
	25 to 29 years	<b>3</b>
	30 to 39 years	<b>4</b>
	40 to 49 years	<b>5</b>
	50 years or older	<b>6</b>
Race of manager of food outlet:	African	<b>1</b>
<i>(Please tick appropriate choice)</i>	Coloured	<b>2</b>
	Indian	<b>3</b>

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Record  
No.

A1

A2

A3

A4

	White	4	A5
	(Others specify): .....	5	
Gender of manager of food outlet:  <i>(Please tick appropriate choice)</i>	Female	1	A6
	Male	2	
Highest level of education of manager/owner of food outlet:  <i>(Please tick appropriate choice)</i>	No formal education	1	For office use only
	Primary level	2	
	Secondary level	3	
	Diploma level	4	
	Degree or above	5	
Age of food outlet:  <i>(Please tick appropriate choice)</i>	Less than 1 year	1	A7
	1 to 2 years	2	
	3 to 5 years	3	
	6 years or more	4	
Duration of service of manager at food outlet:  <i>(Please tick appropriate choice)</i>	Less than 1 year	1	A8
	1 to 2 years	2	
	3 to 5 years	3	
	6 years or more	4	
Number of customers observed inside food outlet:  <i>(Please tick appropriate choice)</i>	5 or less	1	A9
	6 to 10	2	
	11 to 15	3	
	16 to 20	4	
	21 or more	5	
Time customers observed:  <i>(Please tick appropriate choice)</i>	Before 10 AM	1	A10
	10 AM to 11:59 AM	2	
	12 PM to 3:59 PM	3	
	4 PM to 6:59 PM	4	
	7 PM or later	5	
			A11

## PART 2: NATURE AND MODE OF WASTE DISPOSAL

Indicate the category of food outlet your business belong.  <i>(Please tick appropriate choice)</i>	Commercial food canteen	<b>1</b>		
	Eatery (Snacks)	<b>2</b>		
	Liquor store	<b>3</b>		
	General store with canteen	<b>4</b>		<b>B1</b>
	<b>(Others specify):</b> .....			
Indicate the waste disposal contractor you patronize.  <i>(Please tick appropriate choice)</i>	Private waste contractors	<b>1</b>		
	Government waste disposal	<b>2</b>		
	Self/personal arrangement	<b>3</b>		
	Use of street kids and waste scavengers.	<b>4</b>		<b>B2</b>
	<b>(Others specify):</b> .....			
Indicate a rough estimate of the volume of waste generated by your food outlet/business.  <i>(Please tick appropriate choice)</i>	Less than 1, 000 kg per week	<b>1</b>		
	1, 000 – 2, 000 kg per week	<b>2</b>		
	2, 000 – 5, 000 kg per week	<b>3</b>		
	5, 000 – 10, 000 kg per week	<b>4</b>		<b>B3</b>
	<b>(Others specify):</b> .....			
Indicate how you dispose your wastes during strikes by the waste collectors.  <i>(Please tick appropriate choice)</i>	Disposal on empty land	<b>1</b>		
	Burying on land	<b>2</b>		
	By burning then in open veldt	<b>3</b>		
	By dumping on roadsides	<b>4</b>		<b>B4</b>
	<b>(Others specify):</b> .....			
Indicate the highest type of waste you generate and disposed.	Food wastes	<b>1</b>		
	Glass bottle wastes	<b>2</b>		
	Plastic bottle wastes	<b>3</b>		

<i>(Please tick appropriate choice)</i>	Paper and plastic wastes	4		<b>B5</b>
	<b>(Others specify):</b> .....			
Indicate the nature/type of waste disposal bin you use outside your food outlet or business.  <i>(Please tick appropriate choice)</i>	Municipal plastic waste bin	1		
	Iron drum waste bins	2		
	Stainless waste bins	3		
	Aluminium type waste bin	4		<b>B6</b>
	<b>(Others specify):</b> .....			
Indicate who clean the waste bin after disposal of waste.  <i>(Please tick appropriate choice)</i>	Municipal/contract worker	1		
	By the food outlet staff	2		
	Unemployed individual	3		
	Usually left as it is	4		<b>B7</b>

**PART 3: INFORMATION ON FACILITIES**

Please provide <b>Yes</b> or <b>No</b> answers to each of the following questions				
Questions		Yes	No	Comments
1.	Will you freely fill this questionnaire/ allow an interview on behalf of your food outlet?	1	2	
2.	Are you the manager/owner of this food outlet or business?	1	2	
3.	Is your business environment generally clean?	1	2	
4.	Is the business premise rented?	1	2	

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**C1**

**C2**

**C3**

**C4**

5.	Are trash such as bottles, cans and food packing materials thrown outside food outlet?	1	2		C5
6.	Do your employees wear official uniforms while working in the food outlet or business activities?	1	2		C6
7.	Are there enough number of seats available for customers?	1	2		C7
8.	Are dust bins available for customers use?	1	2		C8
9.	Do you have trash bins availability for disposal of solid/liquid wastes from the kitchen?	1	2		C9
10.	Do you have toilet(s) facility for customers at food outlet?	1	2		C10
11.	Do the toilets have adequate cleaning, washing & drying materials?	1	2		C11
12.	Does your food outlet have separate seating for smokers?	1	2		C12
13.	Has the food outlet ever been inspected?	1	2		C13
14.	Is the food outlet/ business premises inspected regularly?	1	2		C14
15.	Has anyone ever given health education to the food outlet?	1	2		C15
16.	Has your food outlet or business premises ever been closed down by the municipal health inspector?	1	2		C16
17.	Do you have valid permit to operate the food outlet/business?	1	2		C17

## PART 4: ASSESMENT OF SERVICES

Use the following scale to evaluate each of the six statements:

- 1 : Poor
- 2 : Less than satisfactory
- 3 : Satisfactory or good enough
- 4 : Very good
- 5 : Excellent

Assessment criterion		Poor	Inadequate	Good	Very good	Excellent	
1.	General condition of building used for food outlet.	1	2	3	4	5	D1
2.	Cleanliness of kitchen.	1	2	3	4	5	D2
3.	Personal hygiene of staff working inside the kitchen.	1	2	3	4	5	D3
4.	Perception on the importance of efficient and proper waste disposal.	1	2	3	4	5	D4
5.	Overall score for proper disposal of waste.	1	2	3	4	5	D5
6.	Frequency at which food outlet/business premises is inspected.	1	2	3	4	5	D6
7.	Availability of enough waste bins in the outlet/business premises for disposal of waste materials	1	2	3	4	5	D7
8.	Availability of trash cans within the food outlet/business premises for customers.	1	2	3	4	5	D8
9.	How would you rate the maintenance/	1	2	3	4	5	D9

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	cleanliness of trash bins and their environment in your organization?					
10.	How would you rate the efficiency of waste collection by the operator you are using/chosen in Part 1 above?	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>

<b>D10</b>

**PART 5: WASTE MANAGEMENT AND TREATMENT**

Please provide <b>Yes</b> or <b>No</b> answers to each of the following questions				
<b>Questions</b>		<b>Yes</b>	<b>No</b>	<b>Comments</b>
1.	Does your food outlet have any waste management plan?	<b>1</b>	<b>2</b>	
2.	If “YES” do you implement the plan?	<b>1</b>	<b>2</b>	
3.	If “NO” do you intent to develop a plan in the near future?	<b>1</b>	<b>2</b>	
4.	Do you sort the wastes generated by your outlet?	<b>1</b>	<b>2</b>	
5.	Does your outlet treat any of the wastes generated?	<b>1</b>	<b>2</b>	
6.	Are you affiliated to any waste recycling organization?	<b>1</b>	<b>2</b>	
7.	Do you manage waste through source reduction?	<b>1</b>	<b>2</b>	
8.	Do you manage waste through	<b>1</b>	<b>2</b>	

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<b>E1</b>
<b>E2</b>
<b>E3</b>
<b>E4</b>
<b>E5</b>
<b>E6</b>
<b>E7</b>
<b>E8</b>

	recycling?				
9.	Do you manage waste by composting?	<b>1</b>	<b>2</b>		<b>E9</b>
10.	Are you familiar with the South African Draft White Paper on environmental management?	<b>1</b>	<b>2</b>		<b>E10</b>
11.	Is your premises littered with wastes from your outside bin after the weekend?	<b>1</b>	<b>2</b>		<b>E11</b>
12.	Do you pack these litters left along the road side?	<b>1</b>	<b>2</b>		<b>E12</b>
13.	Do you experience problem of waste disposal during strikes by waste collectors?	<b>1</b>	<b>2</b>		<b>E13</b>
14.	Do you notice the presence of vectors e.g. cockroaches, rodents, within and outside the food outlet/business premises?	<b>1</b>	<b>2</b>		<b>E14</b>
15.	Has there been an increase in the population of flies around your outlet?	<b>1</b>	<b>2</b>		<b>E15</b>
16.	Do you regularly fumigate your food outlet/business premises?	<b>1</b>	<b>2</b>		<b>E16</b>
17.	Does human waste bin pickers as well as animals e.g. dogs contribute to waste littering?	<b>1</b>	<b>2</b>		<b>E17</b>
18.	Does your outside bin have cover?	<b>1</b>	<b>2</b>		<b>E18</b>

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**PART 6: COMPLAINTS FROM MEMBERS OF THE COMMUNITY**

**only**

During the past year, how many complaints have you received from members of the community about solid or liquid waste from your food outlet? (Please tick appropriate answer)	None	<b>1</b>
	One	<b>2</b>
	2 to 3	<b>3</b>
	4 to 5	<b>4</b>
	6 or more	<b>5</b>

**F1**

**Recommendations for improvement:**

What do you think should be done in order to improve the quality of waste management at your food outlet?

**Thank you for participating in the study**

**APPENDIX 4: MAP OF THE CITY OF TSHWANE METROPOLITAN MUNICIPALITY**