AN ASSESSMENT OF THE HOUSEHOLD FOOD WASTAGE IN A DEVELOPING COUNTRY: A CASE STUDY OF FIVE AREAS IN THE CITY OF TSHWANE METROPOLITAN MUNICIPALITY, GAUTENG PROVINCE, SOUTH AFRICA

by

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DECLARATION

Student No.: 49028464

I, Ramukhwatho Fhumulani Ruth, hereby declare that this dissertation for the Master's Degree in Environmental Management with specialisation in food waste, at the University of South Africa, is my own original work and has not been previously submitted to any other university. I also declare that all the sources I have used or quoted have been indicated and acknowledged by means of a complete reference.

Signed:……

(Ms Fhumulani Ruth Ramukhwatho)

Date: ……..

DEDICATION

I warmly dedicate this study to my son Tshilidzi and to the poor black child who thinks that poverty defeats our dreams. I encourage them to persevere and not give up on their dreams because the future belongs to those who prepare for it today. I wish to gratefully thank my parents; I will never forget you. To God, Almighty ‘Consuming Fire’, I thank you for your grace upon me.

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ABSTRACT

Food waste has been proclaimed to be the key issue of concern that has drawn the attention of national and international scientific communities. This is due to changes in food systems and global situations. The issue of food waste is important because a large amount of food is being wasted during the production and distribution of food. One-third of food produced globally is wasted or lost from farm to fork.

The primary aim of this study was to evaluate and quantify the factors that contribute to generation of household food waste. The evaluation was done using face-to-face interviews based on a structured questionnaire and the actual weighing of households' food wasted was quantified using a weighing kitchen scale. A total of 210 participants were interviewed. Food waste samples were collected from five selected study areas of the City of Tshwane Metropolitan Municipality (CTMM): Atteridgeville Ext 6, 16 and 17, Lyttelton, Montana Park, Olievenhoutbosch Ext 36 and Silver Lakes Golf Estate, in Gauteng province, South Africa. The acquired data was captured into Microsoft Excel, and analysed. The chi-square statistical test was done using SAS statistical software.

Out of 210 interviewed participants, 55% of the households had a monthly income of R10 000+ and 45% had a monthly income of less than R10 000. A total of 59% of respondents agreed that they wasted food, while 41% thought they did not waste food at all. The results also show that 35% of households included in the survey in selected areas of the CTMM threw away pap (referred as maize porridge), 26% wasted rice, 25% bread and 14% fruit and vegetables.

Households wasted an average total of 6 kg per week per household. This was attributed to over preparation of porridge and rice; buying too much food; falling for special offers; poor storage; food residue, and fruit and vegetables going off. Households with a monthly income of R500 - R5 000 wasted more food than households with an income of more than R5 000. As such, it can be concluded that income has an impact on the amount of food wasted within the selected areas of CTMM. Moreover, analysis of the data confirmed that there is a statistically significant relationship between income level and food waste. The statistical chi-square test was applied and a probability value (p-value) of < 0.0001 was obtained, indicating that the difference between income categories was more than just a

random pattern. (Note that any p-value of < 0.05 is considered to be statistically significant, i.e. an indication of an underlying consistent, non-random pattern.)

Key terms

Food waste drivers; Household income; Assessment

ACRONYMS AND ABBREVIATIONS

BMR	Bureau of Market Research
BOGOF	buy one get one free
CO_2	carbon dioxide
CTMM	City of Tshwane Metropolitan Municipality
DEA	Department of Environmental Affairs
DEFRA	Department for Environment, Food and Rural Affairs
DKK	Danish Krone
EC	European Commission
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FUSIONS	Food Use for Social Innovation by Optimizing Waste Prevention Strategies
GDP	gross domestic product
GHG	greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
kg	kilogram
kJ	kilojoule
NORSTAT	Norway Statistic
NSW	New South Wales
PPE	personal protective equipment
RSA	Republic of South Africa

SACN	South African Cities Network
SEPA	Swedish Environmental Protection Agency
TMA	Tshwane Metropolitan Area
UK	United Kingdom
UN	United Nations
UNEP	United Nations Environment Programme
USA	United States of America
USEPA	United States Environmental Protection Agency
WRAP	Waste and Resources Action Programme

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CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1 Background of study

Municipal solid waste, more commonly known as trash, garbage, refuse or rubbish, consists of daily materials such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint and batteries (Nannyonga, 2006). The municipalities or other governmental authorities are responsible for the collection of waste from houses, streets, shops, offices, industries and hospitals (Nannyonga, 2006). A large part of municipal solid waste generated by households is food waste (US Environmental Protection Agency (USEPA), 2012; Muth, 2011).

Food waste is any waste that is raw, cooked, edible and associated inedible material (e.g. bones, eggshells, fruit and vegetable peelings) generated during the preparation or consumption of meals or all food produced or purchased that is unused by humans (Griffin *et al.*, 2009). The issue of wasting food is crucial because during the food production and distribution stages, large amounts of energy and other resources such as water, transportation and land are required. When food is wasted it leads to wasted resources, environmental impacts such as climate change (gas emissions) which could be avoided and also impacts food security (Oelofse & Nahman, 2013). Environmental impacts associated with food waste are caused by the decomposition of food waste that emits greenhouse gas (GHG) methane and carbon dioxide (CO_2) (Kevin, 2009). Methane from rotten food waste in landfills is 25 times more powerful a GHG than CO_2 (Kevin, 2009). Food waste has become a focus of interest in the world due to changes in food systems and global warming (Morgan, 2009).

With an alarming population growth, reducing the amount of food wasted is very important, especially because it has been estimated that by 2050 the global population would have increased to nine billion people (Gustavsson *et al.*, 2011). This means that if the amount of food wasted is not reduced, there will be a need to increase food production globally. Currently one-third of food produced globally is wasted or lost from farm to fork (Food and Agriculture Organization (FAO), 2011). Reducing, recovering and treating of food waste divert organic materials from landfills and incinerators, thus reducing GHG emissions from landfills and waste combustion (Beavan, 2007). The use of treated food

waste (compost) has many environmental benefits, such as improving soil health and structure, increasing drought resistance and reducing the need for supplemental water, fertilizers and pesticides (Lundqvist *et al.,* 2008; USEPA, 2011). Everyone who eats is responsible for preventing and reducing food waste.

This study was therefore designed with the aim of assessing and quantifying the amount of household food waste generated in order to achieve a better understanding of the complexity of food wastage. The volumes of food waste were also quantified in homes at Atteridgeville Ext 6, 16 and 17, Lyttelton, Montana Park, Olievenhoutbosch Ext 36 and Silver Lakes Golf Estate. These were done by classifying the type of food that is wasted the most and quantifying the amount of food thrown away in kilograms. Factors that drive households to throw away food were also assessed. Additionally, the relationship between income levels and food waste were established in an attempt to provide data on the types and causes of food waste in South African townships and suburbs in order to suggest possible mitigation measures that can be implemented to reduce such wastages.

1.2 Problem statement

With an increase in the South African population growth, the demand for food and other essential resources such as water and electricity is increasing accordingly (FAO, 2013). In the same fashion, over 9 million tons of food waste is generated every year in South Africa (Oelofse, 2012). Considering these amounts of household food waste and the pressure that is being imposed on landfill sites, there is a need to devise practical mitigation measures that can curtail the impacts of food waste in order to conserve the environment. Food waste has negative impacts on the environment and economy because when food is wasted, resources such as water, electricity and fertilizers are also wasted (Oelofse & Nahman, 2013). To the author's knowledge, there are no documented studies in academic literature reporting on household food waste generation rates in South Africa. As such, there is a need to conduct a household food waste assessment. Currently there is a scarcity of landfill airspace in Gauteng, South Africa. Three of the nine landfills within the City of Tshwane Metropolitan Municipality (CTMM) reached full capacity and were closed over the last five years (DEA, 2012).

1.3 Motivation for the study

The National Waste Management Strategy targets are to divert recyclable waste from landfills by 25%, by separating waste at source and have 80% of municipalities ensuring public awareness of the impact of waste on their health, well-being and the environment by means of an awareness campaign by 2016 (DEA, 2011). An amount of 8.3 million tons of recyclable waste that ends up at landfills from municipalities is food waste generated at household level (Muth, 2011). Oelofse and Nahman (2013) emphasise that when food is wasted it has an environmental and economic impact because when food is wasted, resources such as water, electricity and fertilizers are also wasted. Food waste that ends up in landfills produces a large amount of methane which is a more powerful greenhouse gas than carbon dioxide. Due to these concerns, this study was conducted in order to assess household food waste volumes in terms of income, geographical area, age and highest qualification level.

The Waste Information Baseline report (DEA, 2013) estimates that the average waste generation rates in kilograms per person per day by income level are: very low income 0.3 kg, low income 0.46 kg, medium income 1.03 kg, high income 1.68 kg and very high income 1.85 kg per capita per day. The waste characterisation studies available in South Africa include studies estimating the magnitude of food losses and food waste generated in South Africa (Oelofse & Nahman, 2013) and waste stream analysis for the CTMM (Snyman, 2008). It was therefore relevant to conduct a study in order to be able to quantify the amount of food wasted in selected areas of the CTMM at household level.

It is estimated that up to 12 million (24.5%) of the South African population go to bed hungry each day (Hosken, 2013) and yet the country has the largest proportion of food wastage in Africa (Allafrica, 2010). In other poor areas around Cape Town and Msunduzi in KwaZulu-Natal, between 80% and 87% of the population, go hungry daily (Hosken, 2013). Yet, needy poor households in South Africa and specifically in these areas grow their own food (SACN, 2011).

In order to save food in the fight against global food waste, people must be made aware that an abundance of food will not always be available to satisfy the excessive way we consume and waste food the way we do today (Stuart, 2009), especially because the number of South Africans living in poverty has increased since 2010 (Lehohla, 2015). Due

to these concerns, there was a need to assess household food waste and quantify the types of food waste that emanate from households, particularly focusing in the CTMM also referred to as Tshwane. The study will help to understand the actual root cause of why food is thrown away and what can be done to reduce household food waste. This will help not only to reduce the overfilling of landfill sites, but also to educate the population on how to save money, which in turn can uplift the economic well-being of its citizens and provide the CTMM with household food waste data (Department for Environment, Food and Rural Affairs (DEFRA), 2010).

1.4 Research questions

This study attempted to provide answers to the undermentioned research questions:

i. What are the types of food that are most wasted by households in the CTMM?
ii. How much food is wasted by CTMM households per week (in kilograms)?
iii. What are the drivers of wasted food in CTMM households?
iv. Is there a correlation between food wastage and household income level?
v. What possible mitigation strategies could be implemented to minimise food wastage in CTMM households?

1.5 Aim and objectives of study

1.5.1 Aim

The overall aim of the research study was to assess household food wastage in selected areas in the CTMM.

1.5.2 Objectives of the study

The following were the objectives to provide answers to the research questions:

i. To determine and categorise the types of food wasted the most in CTMM households.
ii. To quantify the amount of food waste generated in households.
iii. To evaluate factors which influence the generation of household food waste.
iv. To establish relationships of food waste generation profiles between low-, middle- and high-income households.
v. To develop food waste minimisation and management strategies within CTMM households.

1.6 Thesis layout

CHAPTER 1: INTRODUCTION AND BACKGROUND

Background information is given to households' food waste and their potential environmental and socioeconomic impacts. This chapter also covers the problem statement, the motivation for the study, research questions and the aim and objectives of the study.

CHAPTER 2: LITERATURE REVIEW

This chapter presents a concise literature review of food waste as well as causes and disposal of food waste. Socioeconomic and environmental impacts that emanate from food waste disposal are discussed. The global estimates and perspectives of food waste in different countries are outlined in this chapter. Awareness campaigns that are used to educate households about the importance of food waste management are discussed in detail.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

The methodological framework applied in this study is explained. The sampling, research design, study methodology, data collected, data analysis and quality controls are covered. Additionally, the pilot testing of the questionnaire is explained and ethical considerations as well as limitations of the study are presented.

CHAPTER 4: INTERPRETATION AND DISCUSSION OF RESULTS

Household food waste results from the assessment in the CTMM are analysed and presented. The types and amount of food wasted and the drivers or causes of food waste are identified, and a correlation is made between food wastage and household income level.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

This chapter elaborates on the findings of the household food waste study and recommendations are made. Moreover, suggestions for further research are given in this chapter.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Literature on food waste is reviewed and food waste definitions are given in this chapter. Terms used in the study are explained and reasons for food waste are investigated. Demography plays an important role in food waste; it has an influence on how the household is run and how waste is handled, which is why it was included in this study. The literature review was done in terms of gender, age, highest qualification, household size and income categories and disposal methods employed by households. The reasons for household food waste identified in the literature will be compared in Chapter 4 with the reasons for food waste data from this study. The socio-economic and environmental impacts of food waste, global food waste estimates and perspectives are discussed from different household food waste studies that were conducted internationally, followed by a discussion of household food waste status in South Africa. Food waste awareness campaigns that have been conducted are discussed.

2.2 Defining Food waste

Waste can be defined as anything that is no longer useful and needs to be disposed of (Department of Environmental Affairs and Tourism (DEAT), n.d.). Different authors define food waste differently because there is no internationally accepted definition of food waste (FAO, 2013). An example of a definition found in the literature is: food waste at household level represents "any food that is brought in the home that is not ingested by humans" (WRAP, 2007a and DEFRA, 2010). Griffin *et al.* (2009) and Lebersorger and Schneider (2011) define food wasted as unconsumed or unwanted food materials which can be cooked or consumed raw, i.e. food waste generated during and after meal preparation in the household. It includes materials such as vegetable peelings, meat trimmings and spoiled or excess ingredients or prepared food as well as bones, carcasses and organs (the latter two generally do not occur in homes). For the purpose of this study, food waste is defined as edible and inedible food that is thrown away by households into the garbage bin whether it is cooked or not, composted or fed to pets.

Main classification categories of food waste are shown in Figure 2.1.

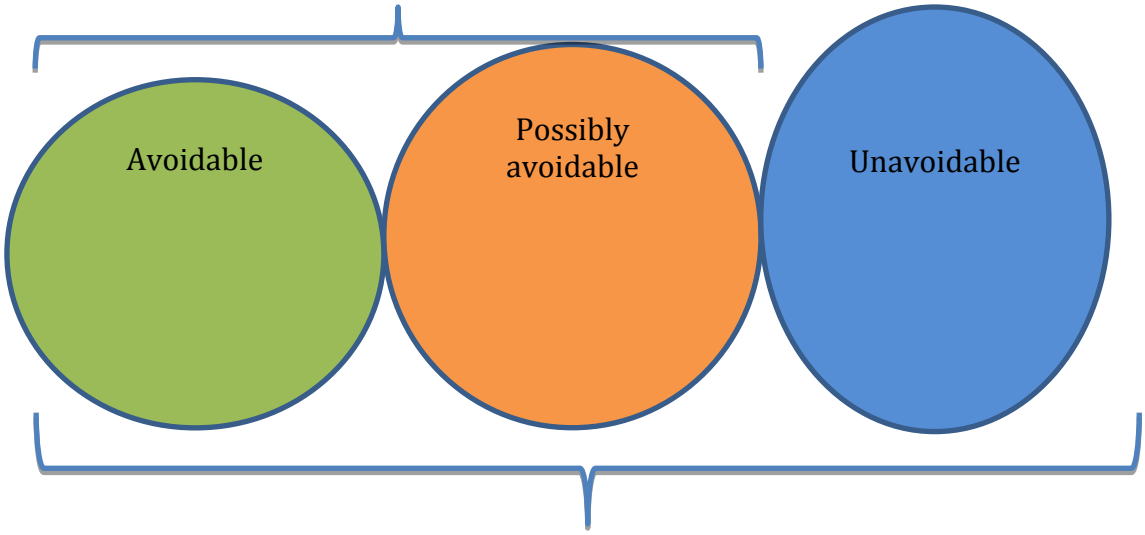

Figure 2.1: Food waste classification (Adapted from WRAP, 2009b)

Waste and Resources Action Programme (WRAP), 2009b) classifies food waste into three categories, namely avoidable, possibly avoidable and unavoidable, as illustrated in Figure 2.1. Edible food waste falls into the avoidable and possibly avoidable categories. Inedible food waste falls into the unavoidable food waste category (WRAP, 2009b). The United Nations Food and Agriculture Organization (FAO, 2011) explains that edible food waste refers to what may normally be eaten (fit to be eaten by humans), such as a slice of bread, apples, meat and plate residue. Something which is edible may sometimes be uneatable, meaning that avoidable food waste may be referred to as food that is edible at the point when it is discarded. DEFRA (2010) maintains that this food waste accounts for one-quarter of all avoidable food waste. Possibly avoidable food waste, e.g. bread crusts, potato skins and apple skins, is waste generated because of people's preferences – food which specific people eat and others do not. Unavoidable food waste is referred to as food that is unfit to be eaten (not edible), e.g. bones (meat and fish), fruit and vegetable peels, eggshells and teabags (WRAP, 2009b).

A survey by Lyndhurst (2007) revealed that more food that is wasted is cooked rather than raw. The survey found that 56% of the consumers wasted inedible food, e.g. peelings and

bones. Additionally, it was found that 32% of the consumers left food on the plate after the meal (Lyndhurst, 2007). Furthermore, the same study found that 30% of consumers wasted fruit and vegetables, 20% wasted bread and cake and 16% wasted raw meat and fish. Vegetables (19%), followed by milk produce (17%), bread (13%) and fruit and berries (13%) were the main discarded food items by consumers (Silvennoinen *et al.*, 2012). Parfitt *et al.* (2010) state that fresh fruit and vegetables are wasted the most, followed by bakery and dairy products and then meat and fish.

Buzby *et al.* (2014) found that meat, poultry and fish (30%), vegetables (17%) and dairy products (17%) are the top wasted food groups by United States' consumers. Therefore, there seems to be a difference between the food wasted by different populations. Crutch (2014) reports that 4.4 million tons of food is wasted every year by British households; of this, bread is wasted the most. This is in line with a study by Stefan (2011), who found that bread and other bakery products are mostly wasted. However, in a study by Ramukhwatho *et al.* (2014) in Mamelodi, South Africa, it was found that porridge (58%), referred to as "pap" as a staple food was wasted most, followed by rice (26%) and bread (16%). Staple food may be defined as food that is frequently eaten and it forms such a high proportion of the meal that it constitutes a dominant part of a diet in a given population (FAO, n.d.).

2.3 Reasons for food wastage

Parizeau *et al.* (2015) conducted a study with the aim to survey households' beliefs, attitudes and behaviours towards food waste. They observed that there are multiple behaviours which cause food waste, for example behaviours relating to household shopping practices which include the way households plan their shopping, behaviours during food preparation, the way food is stored and the way in which food is consumed. Factors that influence food waste, according to Parizeau *et al.* (2015), include social, cultural, economic and institutional factors.

Buzby and Hyman (2012) maintain that households waste food because they buy too much food and end up discarding it. Several studies that have been conducted on household food waste identify reasons for this waste as cooking too much, food not used in time (past expiry date), special offers, food going mouldy, plate leftovers, and food that looked bad and smelt or tasted bad (Hamilton *et al.*, 2005; Lyndhurst, 2007; Eurostat, 2008; WRAP,

2008; WRAP 2009b; EC, 2010; Silvennoinen *et al.,* 2012; Stefan *et al.,* 2013; Ramukhwatho *et al.,* 2014; Parizeau *et al.,* 2015).

Lyndhurst (2007) gave 33 reasons that lead consumers to waste food. There are only 6 of these which appear to be the key ones: 34% of respondents wasted food because the date had expired, 30% because of its appearance (food visibly went bad, e.g. looked or smelt bad), 30% said that the Buy One Get One Free (BOGOF) special offers led to food wastage, 27% prepared too much food, 25% did not eat the food that needed to be eaten first and 22% bought too much food.

The main reason for consumers wasting food, as reported by Silvennoinen *et al.* (2012), is food spoilage; and it was found that 29% of respondents wasted food because of mouldiness, 19% because the food was past its best before date, 14% threw away leftovers and 13% prepared too much food. In another study, 11.4% of respondents wasted avoidable food waste because of mouldiness, 19.8% because the food was past its best before date, 30% threw away leftovers and 11.5% because the food "looked bad" (WRAP, 2008). Additionally, the main cause of food waste in a survey by Koivupuro *et al.* (2012) was that households did not reuse leftovers, as well as buying too much and cooking or serving too much.

There are several factors that cause food waste, for example behaviours relating to household shopping practices which include the way households plan their shopping, behaviour during food preparation and the way food is stored and consumed (WRAP, 2007b). Williams *et al.* (2012) found that, of the food waste generated at household level, 20 - 25% could be associated with packaging. Consumers identified packages that were too big and/or difficult to empty, e.g. yoghurt, mayonnaise, sour milk or jam packed in liquid packaging board or in glass (Williams *et al.,* 2012).

Williams *et al.* (2012) state that in their study it was very difficult for households to empty all of the food in the board packaging (known in South Africa as tetra pack); households in the study had to squeeze the packaging in order to empty all of the food. Respondents preferred packaging which was easy to empty, easy to reseal and easy to recycle. Using packages that are easy to empty and available in small sizes will play a part in reducing food that is wasted unintentionally (Williams *et al.,* 2012). Demography also plays a notable role in food waste. Each of the individual aspects are discussed in detail below.

2.3.1 Household behaviour

Ownership of the households has significant impacts on the behaviours of household occupants towards food wastage. Parizeau *et al.* (2015) point out that in Guelph, Ontario, there is a close relationship between food waste production, beliefs, attitudes and behaviours at household level. In their study, they reported that 97% of respondents owned the house they lived in and only 3% were tenants renting the houses. The character of the households has an influence on how the household is run and how waste is handled. The way households plan and shop has a huge impact when it comes to food wastage (Parizeau *et al.*, 2015).

This was further verified by a survey conducted by the US Environmental Protection Agency (USEPA, 2009) which showed that 66% of respondents 'mostly' or 'always' checked the food they had in the house before shopping for food. Over half of the survey respondents drafted a food shopping list and stuck to it as much as possible when shopping for food (USEPA, 2009). This plan for managing food before and during shopping corroborated a study by Parizeau *et al.* (2015) wherein 82% of respondents drafted a shopping list and stuck to it during shopping. Doing this helps avoids buying food that people still have in their homes. This indicates that there are households who have a good management plan for food shopping.

There are numerous ways in which households practise avoiding wastage of food. Households use diverse ways to preserve their food from spoilage, such as cooling and freezing, which makes life easier, though this needs to be applied properly to avoid food waste (Cengel, 2007). In the study in Guelph, Ontario, by Parizeau *et al.* (2015) it was revealed that 62% of the respondents owned cooling facilities, 54% owned freezing facilities and the majority (71%) of respondents without freezing facilities often or always ate their leftovers.

2.3.2 The influence of demographic characteristics

A study by Gjerris and Gaiani (2013) showed that food waste is mostly determined by the combination of family size and composition, age, culture and income at household level. However, Koivupuro *et al.* (2012) found that a small number of factors in their study on the influence of socio-demographic, behavioural and attitudinal factors on the amount of avoidable food waste generated correlated negatively with the amount of avoidable food

waste generated at household level. Factors such as household size, gender, shopping frequency and the frequency of buying special offer products whose prices are reduced because they are old or near/past their best date also increased the amount of food waste at household level (Koivupuro *et al.,* 2012).

2.3.2.1 Gender

Gender has an influence on the amount of food that is wasted. Females mainly spend most of their time in the kitchen; as such they are more bound to waste food than males. The World Food Programme (2013) shows that females (63%) spend 85 - 90% of their time preparing food in their households and that causes females to waste food more compared to male respondents. This is in line with a study executed by Food Standards Agency (FSA) (2008), which reports that females waste more food compared to males because they are primarily responsible for cooking in many societies. Similarly, in a study by Koivupuro *et al.* (2012) it was found that households considered to waste more food are dominated by women, since females are mainly responsible for the grocery shopping and they have a say in what is going on regarding food in the household. This is the reason why gender was included in this study.

2.3.2.2 Age

The fact that age is one of the factors that contribute to households' food waste was validated by the studies conducted by Hamilton *et al.* (2005) and Lyndhurst (2007). In their studies, the authors proved that young people (dependants in households) waste more than older people due to a shallow understanding of cost involved in food purchases. Moreover, this was further proved in a study by the European Commission (EC) (2010): young people consume fewer meals at home and only some of them have knowledge of planning meals. Wassermann and Schneider (2005) proclaim that older people waste less food because they are more aware of saving and recycling.

Furthermore, research carried out by Lyndhurst (2007) for WRAP which investigated consumer attitude and behaviours relating to food and food waste and what might motivate consumers to throw away less food, found that high food wasters are young professionals (42%) aged 16 - 34.

2.3.2.3 Highest qualification

The level of education and extent of literacy play an important role in the management of food waste. People who are less educated are more likely to waste more food than people who are educated; this is attributed to the mere fact that educated people understand the costing involved and potential environmental impacts that arise from wasting food (Kumar & Singh, 2013). Kumar and Singh (2013) and Wassermann and Schneider (2005) note that the level of education correlates with household income. For example, households with higher income waste more food than households with low income and they do not use resources in a better way in terms of saving compared to lower income households. Though Kumar and Singh (2013) observe that households with lower income use resources efficiently, Murad *et al.* (2012) argue that people who practise improper methods of environmental management systems have lower levels of education.

Additionally, different authors have different views regarding household size and education level. For example, in a study by Ramukhwatho *et al*. (2014) it was found that there is a correlation between household size and education; households with educated people have fewer family members, while households with more illiterate or less educated people have more family members. This is evidence that the level of education does have an influence on the way in which people waste food. This is in line with results from a study by Barr (2002).

2.3.2.4 Household size

Composition of a household has a direct relation to the amount of food waste that is generated. More people in a house generate more food waste because more food will be prepared to cater for a large number of people (Wenlock *et al.*, 1980). Katajajuuri *et al.* (2014) and WRAP (2009a) concur that household size is one of the factors that correlates with the amount of food waste produced. Similarly, Lyndhurst (2007) reports that the amount of food wasted correlates to socio-demographic variables. Generally, household size has a positive correlation with the amount of food wasted by people, for example the number of people in a household and the amount of food waste produced per person in the household contribute to approximately 400 kJ (95 kcal) per day (Wenlock *et al.*, 1980).

Lyndhurst (2007) found that single-person households waste less food (3.5 kg per week) compared to larger households, which is expected and relevant to this study; households

with 5 family members waste 7.3 kg of food per week, while households with 6 family members waste 9.6 kg per week. WRAP (2008) reveals that larger households waste food more than single-person households; however, on a per capita basis, single-person households waste more food because they do not share their food with anyone. Koivupuro *et al.* (2012) also conclude that household size influences the amount of food waste generated. As such, it can be concluded that there is less food waste in households with fewer family members.

By contrast, Baker *et al.* (2009) argue that households with more than one person waste less food compared to households with single occupants because the latter have no one to share their food with. Therefore, when there are many people in the house, they are able to share and finish the food which was bought or prepared; however, the more people in the house, the more money is spent. Baker *et al.* (2009) conclude that large amounts of avoidable food waste are produced by households with persons living by themselves compared to other households with more family members. Therefore it can be seen that there are many different opinions regarding food waste and household size.

2.3.2.5 Income categories

Income level plays a pivotal role in the amount of food waste generated (Skourides *et al.*, 2008). High-earning people are prone to buy more food than people earning less due to the degree of affordability (Skourides *et al.*, 2008). An economic factor such as income influences households to waste food (Skourides *et al.*, 2008), although Koivupuro *et al.* (2012) found no correlation between households' income levels and the amount of food wasted. A study conducted by Ramukhwatho *et al.* (2014) found that household income level has an impact on the amount of food wasted. In their study, the respondent households with a monthly income of less than R5 000 wasted more food than those with a higher monthly income (Ramukhwatho *et al.*, 2014).

Jones (2003) reports that the more people earn, the more they waste food. This is further supported by Hamilton *et al.* (2005) and Skourides *et al.* (2008), who show that higher income households waste more food than those with lower income levels. This means that households with higher income generate more food waste.

2.4 Disposal of food waste

Food waste is mainly collected from houses and food-serving facilities and taken to the landfill by municipal trucks. With a drastic increase in population size, which causes more food waste to end up in landfills, South African landfills are reaching full capacity and there is limited disposal space available due to the large quantity of waste that is being disposed of (Oelofse, 2012). This has motivated the South African government to set a target in the National Waste Management Strategy to minimise waste to landfill by 25% by 2016 (National Waste Management Strategy, 2016).

Madubula and Makinta (2012) explain that composting is another alternative way to extend landfill lifespan and that will be a feasible substitute for South Africa, because of its high recyclable waste content. Composting diverts waste from landfills and reduces potential environmental impacts by using waste materials from households and thus reducing the impacts of greenhouse gas emission (USEPA, 2011).

To minimise food disposal, the Department of Environmental Affairs (DEA) (2013) encourages home composting as a way to divert organic and garden waste from landfills in order to produce products that will benefit individuals and the community at large. Parizeau *et al.* (2015) found that 71% of respondents relied on a municipality waste management programme as their food waste disposal method because it was effective and easy to use. However, 33% said that home-based composting was useful to them.

Lyndhurst (2007) indicates that consumers do not care about the environment in which they live and do not know if there is a connection between food waste and environmental impacts such as ground water, soil and air pollution due to release of gases to the atmosphere and leachates that affect the aesthetic value of land due to, inter alia, wearing off of colourants in food. Odours emanating from landfills due to decomposition of food degrade the quality of air that people breathe. Moreover, people do not care much about how to dispose of food waste, but are only concerned that they have wasted money and good food when they waste food (Lyndhurst, 2007).

2.5 Socio-economic and environmental impacts of food waste

With large amounts of food waste due to the increasing size of populations, there are serious environmental impacts which have evolved (Baker *et al.*, 2009; Göbel *et al.*, 2015).

When food wastes originating from households are disposed of in landfills, they undergo aerobic and anaerobic decomposition (EC, 2011). During anaerobic decomposition, organic materials are decomposed in the absence of oxygen, while during aerobic decomposition, organic materials decompose in the presence of oxygen. Both processes produce greenhouse gases which contribute to climate change. Methane, the gas produced during anaerobic decomposition, is a stronger greenhouse gas than carbon dioxide, which is produced during aerobic decomposition (USEPA, 2012). This will also contribute to climate change in the long run. Climate change, as defined by the Intergovernmental Panel on Climate Change (IPCC, 2007), refers to a change in the state of the climate that can be identified by changes in the mean and/or variability of its properties and that persists for an extended period. When there is global warming due to high loading of carbon dioxide and methane, the environment becomes extremely hot and species tend to migrate to cooler environments. Some species die because they cannot adapt to the prevailing conditions, thus leading to loss of biodiversity (FAO, 2013).

If the world avoids wasting food, there will be benefits to combat hunger and improve food security, which will be beneficial all around the world (Tukker, Eder & Sur, 2006). According to a study by WRAP (2007a) on consumer preferences, approximately 70% of respondents were concerned about the financial crisis caused by food waste. United States consumers spend almost $100 billion annually on food that is never used (Jones, 2006), while United Kingdom consumers waste an estimated £10 billion on food that is never eaten (WRAP, 2008). These numbers show that food waste has an impact on the economy.

As indicated in Chapter 1, before they reach the consumers, up to 40% of groceries are lost in Britain because of poor processing, transport and storage, while other less fortunate countries in the world are left starving (FAO, 2011). All around the world, food prices have increased over the past years due to poor harvests and high costs of energy, fertilizer and transport (Department of Transport, 2008). Moreover, in South Africa the cost impacts of wasted fruit and vegetables are the highest (42%), followed by meat (32%) (Oelofse & Nahman, 2013). Globally, food waste is a problem that is growing and consuming resources (Payne, 2014).

2.6 Food waste globally

2.6.1 Global estimates of food waste

The reporting of the amount of food wasted globally varies depending on several factors such as (1) the definition of food waste used; (2) methodology used to determine food waste and (3) the amount of food a country has available for consumption (Stuart, 2009; Buzby & Hyman, 2012). The volumes of food waste produced at household level were reported by Stuart (2009) to be 270 kg per year and by Buzby and Hyman (2012) to be 124 kg per year. Parizeau *et al.* (2015) explain that the difference in the amount of food wasted by consumers is because of seasonal factors; for example, fresh produce is more readily available during summer time and that is why more fresh produce is wasted in summer time at household level.

A survey conducted by WRAP (2009a) estimated that the average amount of food wasted per household ranges from 0.32 – 2.1 kg per week. An average household of 2.4 people annually produces 270 kg of avoidable food waste and this translates into 112.5 kg per capita per year of food wasted. Additionally, a study by Buzby and Hyman (2012) in Washington DC estimated that in 2008 single households wasted 124 kg of food annually and only 3 kg of food was wasted daily per capita. Of the 124 kg of food wasted, Buzby and Hyman (2012) calculated the amount of food wasted in each household of 2.4 people per year to be 297.4 kg per capita. This amount is higher than the results of WRAP (2009a) in the UK and also of the study on the global food losses and food waste in Finland by Gustavsson *et al.* (2011), who suggest that the amount of food waste should be roughly 95 - 115 kg per capita per year.

A household food wastage study conducted by Pekcan *et al.* (2006) in Turkey showed that an average household (2.4) wastes 298 kg of food annually, which amounts to 116 kg of food wasted annually per person. It is clear that there is an upward trend in the amount of food waste since 2006. WRAP (2009b) found that households waste more than 6 kg of food per week. This quantity is less than in the survey by Parizeau *et al.* (2015) in Guelph, Ontario, which indicated that 31.2 kg of food is wasted per week by households; this includes 24.1 kg of organic waste and 7.1 kg of residual garbage; the amount of food waste produced accounts for a total of 10.2 kg per person per week. Moreover, in a study by Koivupuro *et al.* (2012) in Finland, during the two-week test period, it was found that

households wasted up to 11.7 kg per person per week of avoidable food waste. Similar studies on the amount of food wasted were done by Hall *et al.* (2009), Griffin *et al.* (2009), Langley *et al.* (2010), WRAP (2011) and Law (2013).

2.6.2 Global perspectives on food waste

In the first global assessment of food wastage in 2007, Gustavsson *et al.* (2011) suggested that developing countries wasted less food than developed countries. On average sub-Saharan Africa and South and Southeast Asia wasted 120 – 170 kg per capita per year, while Europe and North America wasted 280 – 300 kg of food per capita per year. The United Nations (UN, 2011) has predicted that globally the population will increase to 9.3 billion by 2050. To feed a population of 9 billion, a 70% increase in food production would be required worldwide (Gustavsson *et al.,* 2011). Half of all the food that is produced for human consumption is wasted worldwide and this is food that could be used to feed hungry people as well as the rising population (Institution of Mechanical Engineers, 2013). Globally between 25% and 50% of all food produced for human consumption is estimated to be wasted along the food supply chain (Mena *et al.,* 2011). This statement is supported by Gustavsson *et al.* (2011), who estimate that one-third of edible food, which is 1.3 billion tons, is wasted annually along the global food supply chain. In Figure 2.2 global perspectives activities that cause an increase in food losses and waste in the food supply chain stages are shown. Food loss is part of food wasted but does not get wasted by the consumer. The term "food loss and waste" is used in literature to indicate the food that has been produced but that ends up not being consumed.

Food loss is defined as the food that spills, spoils, incurs an abnormal reduction in quality such as bruising or wilting, or otherwise gets lost before it reaches the consumer (Gustavsson *et al.*, 2011) and can therefore also regarded as food that is wasted. Food loss characteristically takes place at the production, storage, processing and distribution stages in the food value chain. It is usually the unintended result of an agricultural process or technical limitation in storage, infrastructure, packaging and/or marketing (Lipinski, 2013). Food waste is referred to as food that is of good quality and fit for consumption, but does not get consumed because it is discarded either before or after it is left to spoil. Food waste typically, but not exclusively, takes place at the retail and consumption stages in the food value chain. It is usually the result of negligence or a conscious decision to throw food away. Although both food loss and waste happen all over the world, food loss tends to be

more prevalent in developing countries, while food waste tends to be more prevalent in developed countries (Lipinski, 2013).

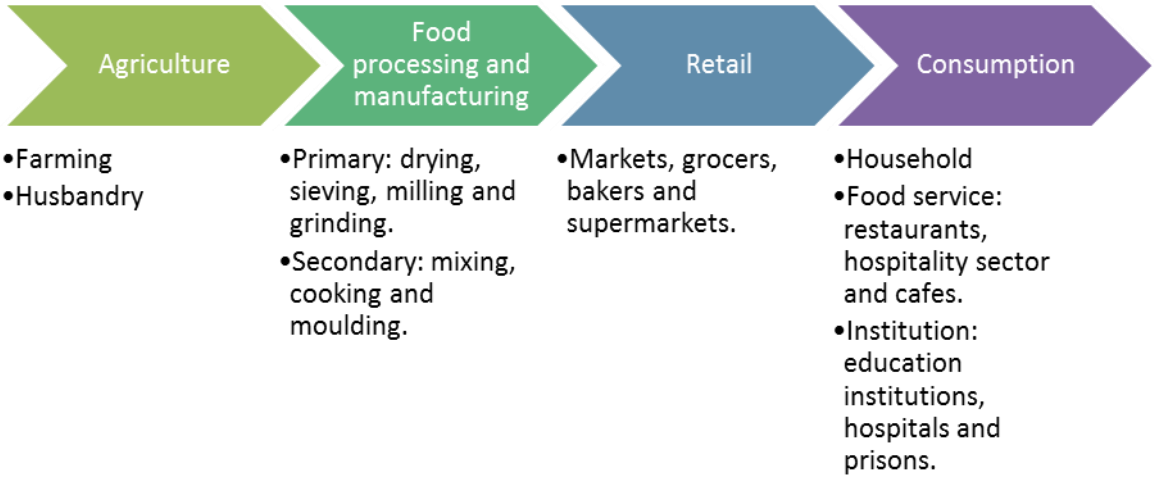

Figure 2.2: Actions causing an increase in food losses and waste in different stages of the food supply chain (Papargyropoulou *et al.*, 2014)

The first stages of the food supply chain are where developing countries experience more food waste; conversely, developed countries experience more food waste in the last stages of the food supply chain (Gustavsson *et al.*, 2011). Due to impoverishment in the developing countries, such as lack of advanced technologies for harvesting, lack of transport and lack of storage coupled with harsh weather conditions, there is more food waste in the first stages of the supply chain (Gustavsson *et al.*, 2011).

The following studies were found in literature and these studies were conducted to understand the behaviour of household participants towards food waste (WRAP, 2007a; Stefan, 2011; Koivupuro *et al.*, 2012; Mikkelsen, 2012; WRAP, 2013). However, according to Glanz (2008), very little has been done to establish what really drives households to generate the amount of food waste which they are currently wasting as well as to develop ways to reduce food waste. The majority of the studies on food waste were conducted in Europe, America and Asia (Wenlock *et al.*, 1980; Rathje & Murphy, 2001; Wassermann & Schneider, 2005; Pekcan *et al.*, 2006; Lyndhurst, 2007; Glanz, 2008; Hall *et al.*, 2009; WRAP, 2009a; Gooch *et al.*, 2010; Gustavsson *et al.*, 2011; Watanabe *et al.*,

2011; Williams *et al.,* 2012; Buzby & Hyman, 2012; Koivupuro *et al.,* 2012; Hanssen & Møller, 2013; Buzby *et al.,* 2014; Li *et al.,* 2014).

Studies on the cost of household food waste conducted in South Africa include that by Nahman *et al.* (2012), who found that households waste a total of less than 4% of food in the supply chain; Oelofse and Nahman (2013), who estimated that 9 million tons of food are wasted; Nahman and Lange (2013), who showed that the cost of food waste across the food value chain is 2.1% of South Africa's annual gross domestic product (GDP); Ramukhwatho *et al.* (2014), who assessed household food wastage and found that pap and rice are wasted because of excess preparation; Lundqvist *et al.* (2008), who estimated that 75% of food is lost globally before it reaches the consumers; Göbel *et al.* (2015), who found that there are different causes and effects of food waste in each stage of the food supply chain.

Additionally, because of the differences from stage to stage in the food supply chain, it is important to encourage communication between all food supply chain stakeholders to be able to come up with ways of sustaining the food system (Göbel *et al.,* 2015). Globally there is an increase of populace and this shows that there is a need to decrease the amount of food wasted to be able to protect our natural resources for future generations. Reducing food waste in the food supply chain needs all stakeholders to work towards a common goal and share responsibilities to identify the causes of food waste (Göbel *et al.,* 2015).

Schneider (2008) found that although 25% of the food wasted is no longer fit for human consumption according to health standards, 15% is still edible. She also found that food is wasted in all stages of the food life cycles, e.g. from harvesting, to processing and production to consumption. In the same study Schneider reports that no one has the intention to waste food, meaning that people do not waste food intentionally but situations and behaviour lead to food waste.

The study by Parfitt *et al.* (2010) confirmed that food is wasted in various stages in the food supply chain and in order to be able to reduce food waste, it is firstly vital to understand what the cause of avoidable food waste is in every stage of the food supply chain, e.g. starting from agriculture to processing and retail to consumption. Parfitt *et al.* (2010) also indicate that it is important to understand factors such as culture and political, geographical and economic forces on how they influence behaviour or cause food to be

wasted. Baker *et al.* (2009) assert that factors, such as household size and income, have a direct relationship to food waste.

The systems that specifically focus on reducing food waste, i.e. food waste-specific waste hierarchies, were developed because the waste hierarchy does not focus much on food waste but only provides general guidelines for all waste (European Commission (EC), 2008). For example, USEPA (2014) developed the Food Recovery Hierarchy in the United States, the UK developed the Food Waste Pyramid "Feeding the 5000" (Feedback, 2014) and the Netherlands developed the Moerman ladder (Ministry of Economic Affairs, Agriculture and Innovation, 2014). Prevention of food waste has the capability to provide significant benefits at environmental, social and economic levels.

Furthermore, Papargyropoulou *et al.* (2014) support the initiative that donating food and feeding hungry people will reduce food waste. They suggest that in order to tackle the issue of food waste, we should not focus only on the consumption stage in the food supply chain and think that we will be able to reduce food waste, but we should implement a sustainable production and ingestion tactic and reduce food surplus and waste along the global food supply chain.

Figure 2.3 illustrates activities that stakeholders may use to prevent and divert food waste from landfills. Firstly, in the food recovery hierarchy it is very important to prevent waste at the source before it is created; then fresh food which is still consumable may be donated to feed those in need. The food hierarchy encourages feeding pets with fresh food scraps and turning fats, oils and grease into useful products such as biofuel, and using food waste to nourish soil. Disposal to landfills should be the last resort (USEPA, 2014).

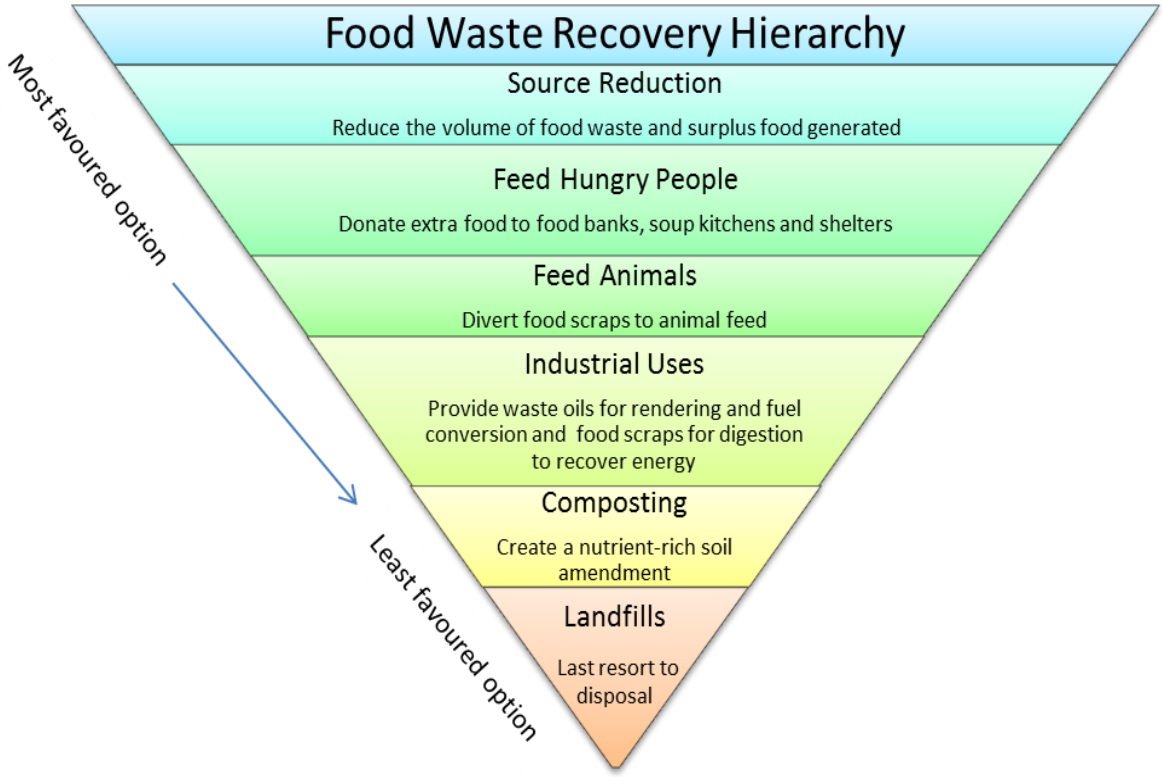

Figure 2.3: USA food recovery hierarchy (Adapted from USEPA, 2014)

The study by Papargyropoulou *et al.* (2014) demonstrated that a waste hierarchy that is specifically focused on food waste considers the environmental, economic and social benefits; it encourages waste producers, researchers and policy makers to reason intelligently and to develop food policies by proposing a more holistic approach that supports more sustainable resolution and holistic solutions along the food supply chain. To minimise household food waste, there is a need to understand how consumers behave towards food and how they generate food waste (Papargyropoulou *et al.*, 2014), which was assessed in this current study.

2.7 Food waste in different countries

Food waste differs between particular populations. Food waste from developed countries such as Sweden, Finland, Norway, the UK and Denmark where studies were done on food waste was compared with South Africa, a developing country.

2.7.1 Household food waste in Sweden

It is reported that the Swedish waste is 1 010 000 tons of food in a food supply chain annually, 674 000 tons of which is wasted annually by households (Franke, 2013). The

amount of food wasted during 2012 in Sweden was 771 000 tons according to the 2012 population number which is equivalent to 81 kg per person per year, and of this volume 35% of food waste was avoidable (Swedish Environmental Protection Agency (SEPA), 2013). The increase in food waste from 680 000 tons in 2010 to 771 000 tons in 2012 was due to a change in the food waste definition. In 2010 a stricter definition was used in which the food waste produced had to be fit for human consumption in order to be classified as food waste (SEPA, 2013). In 2012 Sweden adopted a food waste definition developed at EU level. It is therefore not advisable for the food industry to compare the 2010 and 2012 food waste data (SEPA, 2013).

In 2013 the Swedish National Food Agency conducted a survey on 2 050 people in Sweden. The results showed that 224 000 tons of food and drink were disposed of yearly. This amounts to 26 kg per person in a year, equal to 0.5 kg per person a week. Because of the food concern in Sweden, the government set goals to reduce the amount of waste and increase organic treatment of food waste (SEPA, 2013). The Swedish Waste Management Recycling Association (Avfall Sverige) receives separated food waste volumes from households sent for biological treatment, as targeted by the Swedish government. There is still a long way to go before the Swedish achieve 50% biological treatment of food wasted in order to intensify a better way of using resources in the food supply chain, though the separation of food waste at household level has increased.

Swedish Waste Management (2011), cited in Gjerris and Gaiani (2013), maintains that each person in a 4-person Swedish household annually throws away 30 kg of avoidable food waste. This is equivalent to 10 - 20% of all the food that is purchased. The Swedish National Food Agency (2013) indicates that the majority of Swedish households waste fruit and vegetables. Bread, meat, fish and eggs are not thrown away as much as fruit, vegetables and dairy products. The Agency has started advising consumers on how to plan meals in order to reduce food waste. The Swedish waste food mostly for the following reasons: past the expiry date, not eating leftovers, incorrect storage and stored for too long (Swedish Waste Management, 2011).

2.7.2 Household food waste in Finland

The Foodspill Project was carried out in 2010 in 380 Finnish households (Katajajuuri *et al.*, 2014). Households seem to be the biggest source of avoidable food wastage. Edible

food wasted in all Finnish households per year is 65% (Statistics Finland, 2011). It is estimated that every year a Finnish household uses 19% to buy food, the value of the discarded food being 35% (Tike, 2010; Silvennoinen *et al.*, 2012).

The project showed that annually the whole of Finland wastes 335 460 million kg of food. Finnish households waste 120 - 160 kg of food annually, with an average of 23 kg per person (5.1 kg per week) and 60 - 70 kg per household (in an average household size of 2.08 people). Finnish people purchase 500 kg of food per person annually; according to the results in the Foodspill Project, 4.5% of this food is discarded unnecessarily (Katajajuuri *et al.*, 2014).

The main reasons why Finnish households throw away food are spoilage, past best before date, not eating leftovers and preparing food in excess of needs. Finnish consumers indicate that they waste fresh and perishable food or leftovers from cooking and dining. Though home-cooked food, milk produce, bread, fruits and beans are wasted by Finnish households, vegetables are among the food wasted the most (Katajajuuri *et al.*, 2014).

2.7.3 Household food waste in Norway

A report by Olufssøn (2012) showed that Norway wasted 373 000 tons of food in 2011. Of this food wasted, 255 000 tons were wasted by households. This means that consumers account for more than 70% of the food wasted in Norway. The same study reported that Norwegian consumers produce 51 kg of food waste per capita annually (Olufssøn, 2012). The wastage of avoidable food waste in an average household in Norway is 4 kg per week (Quested & Johnson, 2009). Hanssen and Møller (2013) report on the NORSTAT survey that was done in the form of web panels with 1 000 respondents. In this survey 50% of the respondents indicated that they had become more aware of the food waste problem and almost 40% believed that they had reduced food wastage in their own households.

The amount of wet organic waste per capita decreased by roughly 5% from 2007 to 2011, from 117.5 to 112.4 kg per capita per year (3 kg per capita per week), which may indicate that food wastage has also decreased (Hanssen & Møller, 2013). More people (14%) in 2013 than in 2009 (7.7%) reduced their wastage, and 5% of consumers in 2013 threw away food because it had expired. Similarly, consumers (5%) stated that they took smaller portions in order to waste less food (Hanssen & Møller, 2013).

Williams *et al.* (2012) indicate that the reason for 20 - 25% of Norwegian households wasting food could be related to packaging. Their survey showed that consumers wasted food because it was past the expiry date indicated on the packaging, and also because of poor planning, poor storage, ruined packaging and packaging size. In a report by Hanssen and Møller (2013), it was indicated that consumers waste yoghurt and sour cream, fresh bakery products, fresh fruit and vegetables and fresh fish because of the expiry date. Consumers showed that their main reason for wasting food was poor storage.

2.7.4 Household food waste in the United Kingdom (UK)

Most, if not all, studies conducted in the United Kingdom were done by WRAP. The report compiled by WRAP (2008) states that UK households waste 6.7 million tons of food every year. There was an increase in food wasted by UK households in 2010; in 2010 WRAP indicated that households wasted 11.9 million tons of food, which accounts for 65% of the 18.4 million tons of the waste generated. WRAP (2008) reports that UK households purchase 21.7 million tons of food and of this amount of food, 5.9 million tons end up at landfills. UK households indicate that 800 000 tons of food wasted is composted, fed to pets or tipped down the kitchen sink. Most of the food wasted (61% or 4.1 million tons) is avoidable food waste, and if this were managed better, it could be eaten (WRAP, 2008).

In the same study by WRAP (2008), households indicated that they did not waste food at all, but those who apparently did not waste food at all were actually found to waste 88 kg of avoidable food a year and to contribute to 1.2 kg of food waste per capita per week. WRAP (2008) indicates that 46% of the avoidable food waste generated by the UK is in a fresh, raw or minimally processed state.

Reasons why UK households waste food are that food is left on the plate after a meal, past the best before date, appearance of food (food looks, smells or tastes bad), food went mouldy and leftovers uneaten. WRAP (2008) points out that the reasons for UK households wasting food differ according to the type of food wasted. For example, UK households commonly throw away starch foods after being prepared. UK consumers waste potatoes (359 000 tons go uneaten every year), which includes 177 400 tons (40%) of untouched potatoes wasted (WRAP, 2008). Salads are largely wasted as the food is bought and thrown away uneaten; 45% by weight of all purchased salad is thrown away and 60%

by cost (WRAP 2008). Bakery products and fruit are also wasted or thrown away by UK households. Foods that are commonly thrown away each year are individual items of fruit (7.7%), 4.7% of whole vegetables and 3.3% of bakery items (WRAP, 2008).

2.7.5 Household food waste in Denmark

The Danish Agriculture and Food Council (2011), estimates that Denmark wastes 540 000 tons of food annually, 237 000 tons of which are produced annually by Danish households. Denmark is concerned that there are almost 7 billion people on the planet and 925 million are starving, yet they produce enough food waste to feed 3 billion people (Stop Wasting Food, 2008).

A survey by the Danish Environmental Protection Agency (2012) on domestic waste from 800 households in Denmark showed that the majority of the respondents (48%) did not waste food. The survey indicated that 61% responded that action must be taken, when asked to describe their attitude towards food waste. 59% of consumers are responsible for food waste in the food supply chain in Denmark. Most of the foods wasted are vegetables, bread and dairy products. Every Danish citizen is estimated to waste an average of 63 kg of food annually (Danish Agriculture and Food Council, and Danish Environmental Protection Agency, 2006/2008).

Danes waste food because they do not plan what to buy and what to cook, they do not respect food, they lack responsibility, they lack knowledge about leftovers and portion size and lastly they have a use and throw away culture (Juul, 2011). The Danish Environmental Protection Agency (2012) asserts that it is very important to educate the consumers on what food waste is because many of them do not know and they consider themselves as not wasting food. Food waste initiatives in Denmark funded by the government have started to advise consumers on how to reduce food waste, buy only the amount needed, prepare the amount of food that can be eaten and finished, keep leftovers in the freezer for another day or in the refrigerator and eat them the following day (Stop Wasting Food, 2008).

2.7.6 Household food waste in South Africa

The only studies on food waste that have been conducted in South Africa at household level were done by Nahman *et al.* (2012), Ramukhwatho *et al.* (2014), Snyman (2008) and

Oelofse and Nahman (2013). Oelofse and Nahman (2013) estimate that 4.14% of food wasted in South Africa occurs at post-consumer stages and 8.67 million tons of food are wasted annually. The preliminary study of the magnitude of food loss and food waste generation in South Africa estimates that this is 9.04 million tons per annum (Oelofse & Nahman, 2013). This is annually translated to 177 kg per capita of food waste and is estimated at 7 kg per capita per week of food waste.

In 2011, South African households spent 22% on food (Bureau of Market Research (BMR), 2012). The study conducted by Nahman *et al.* (2012) estimated that the total cost to South African society associated with food waste-related problems is approximately R21.7 billion per annum. Ramukhwatho *et al.* (2014) conducted a study on household food waste in Mamelodi and the study showed that 82% of the households interviewed wasted food and threw away an average of one bag per week (24 kg).

The main reasons why Mamelodi households in South Africa throw away food are past best before date, food residue, special offers and preparing food in excess of needs (Ramukhwatho *et al.,* 2014). Although cereals, milk, oilseed, fish, bread, fruit and vegetables are wasted by South African households, fruit and vegetables are mostly wasted (Oelofse & Nahman, 2013).

2.8 Household awareness on food waste

Awareness plays an important role in changing households' attitudes towards food waste. Lyndhurst (2007) states that awareness is one of the main aspects of understanding consumers' behaviours towards food waste. The survey by Parizeau *et al.* (2015) found that food waste is caused by household attitude towards food, belief and lifestyle. The authors also observed that food waste awareness influences food waste production. When raising environmental awareness, it is alleged that it changes the way in which people think about food waste and they start to understand its consequences. People start to see food waste as wasted resources, not as just rubbish, and this mentality helps people to reduce food waste (Gregson *et al.,* 2010). Though environmental concerns have been raised, only 20% of UK households' express environmental concerns regarding food waste (Borisova, 2013).

Studies by Stefan (2011) and Borisova (2013) tested the impact of environmental awareness with the intention to avoid food waste in Romania and Denmark, respectively.

Both countries showed differences because the Danes directly linked awareness with behaviour, whereas Romanian behaviour towards food waste was unaffected by awareness. Imparting awareness through community education goes a long way in educating the public about the importance of food waste management. There are several ways in which the public is alerted about food waste avoidance. For example, the European and UK awareness campaigns cut across the following topics of awareness: i) Love Food Hate Waste, ii) Stop Spid af mad (Stop Wasting Food Movement), iii) Last Minutes Market and iv) the Food Use for Social Innovation by Optimizing Waste Prevention Strategies (FUSIONS). The outcomes of these campaigns are summarised in Table 2.1.

Table 2.1: Outcomes of selected food waste awareness campaigns in the UK and Europe

Launched by	Country	Awareness	Outcome
WRAP (2007a)	UK	Love Food Hate Waste	13% food waste reduction
Selina Juul (2008)	Denmark	Stop Spid af mad	Reduced food packaging by 25%
Prof Andrea Segre (2008)	Italy	Last Minutes Market	Developed media system to reach households
European Union (EU) (2011)	EU	FUSIONS	Targeted to reduce 50% food waste and 20% food chain resources

The Love Food Hate Waste campaign was launched in 2007 and is managed by WRAP in the UK (WRAP, 2007a). The aim of this campaign is to encourage behaviour change and to raise consumers' awareness of the economic and environmental consequences of food waste. The Love Food Hate Waste campaign advises households on how to plan their meals, store food correctly, interpret food labelling and make use of leftovers. This campaign results in a saving of £296 million a year and 137 000 tons of food waste are no longer thrown away because 1.8 million UK households have started reducing food waste

that they used to throw away. WRAP (2008) indicates that 84% of UK citizens still feel that they do not waste food.

The Stop Spid af mad (Stop Wasting Food Movement) awareness campaign was launched by Selina Juul in 2008 in Denmark (Juul, 2008). The aim of the campaign is to raise public awareness about food waste and to reduce food waste in Denmark. According to a study conducted in Denmark (Juul, 2008), 48% of Danes believed that they did not waste food. This campaign has managed to introduce "doggy bags" in Danish restaurants and to reduce food packaging by 25%, which has inspired Danish retail chain Rema 1000 to drop all quantity discounts in the chain's 200 plus Danish stores. The Stop Wasting Food Movement aims at reducing food waste by 50% in 2025.

The Last Minutes Market campaign was launched by Prof Andrea Segrè in 2008 in Italy (Segrè, 2008). The aim of the campaign is to raise awareness in Italy and Europe of why people waste food and the impacts of food waste. This campaign promotes a civil and scientific culture to find ways to reduce food waste. The Last Minutes Market initiative has developed a resourceful and operational management system through media (TV, radio and newspaper) (Segrè, 2008).

The FUSIONS campaign was launched by the EU in 2011 and is funded by the European Commission framework programme 7 (EU, 2011). The aim of the initiative is to reduce food waste by responsible use of resources in an efficient way. The target is to reduce 20% food chain resources and 50% food waste by 2020 (EU, 2011).

There is not much that has been done in South Africa by the government regarding food waste reduction, especially at household level. Although there are a small number of waste management companies in South Africa that are also involved in food waste campaigns, their focus is more on other waste materials rather than food waste and they are not national initiatives. Mohamed Kajee (3SMedia, 2012) estimated that in 2012 between 12 and 14 million people in South Africa were food insecure. Food Bank South Africa attempts to save 6 000 tons of food annually by donating food nearing expiry (food surplus) to those in need (3SMedia, 2012).

The South African government initiated the National Organic Waste Composting Strategy in 2013 to divert organic waste from landfills by promoting composting. Currently the government is working on implementing this strategy on the basis of the provisions of the

National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008), as well as the National Waste Management Strategy, 2011. The strategy's target is to divert 25% of recyclables from landfills by 2016 (DEAT, 2014). It is hoped that specifically food waste will be addressed in implementation.

2.9 Conclusion

From the literature it was found that different authors define food waste differently (DEFRA, 2010). The different definitions of food waste were outlined in this chapter. Reasons for food waste were identified to be in terms of gender, age, highest qualification, household size, income categories and disposal methods employed by households. Food is wasted in all stages of the supply chain, from agriculture to food processing and retail to consumption, as seen in Figure 2.2, and the causes of food waste differ at each stage of the food supply chain (Papargyropoulou *et al.*, 2014; Göbel *et al.*, 2015). A large amount of food wasted is from households (Baker *et al.*, 2009; Koivupuro *et al.*, 2012). When food is wasted, the resources used during the production of those foods are wasted (Oelofse & Nahman, 2013).

The literature reviewed in this chapter reveals that the problem of food waste is a global issue which is being experienced by both developed and developing countries (Gustavsson *et al.*, 2011). Environmental and socio-economic impacts caused by food waste are a global problem which is growing, costing money and consuming resources (Payne, 2014). The conclusion is that if food waste is dealt with at the source, the amount of food waste that ends up at landfills can be minimised and the amount of methane produced can be reduced. In the opinion of Madubula and Makinta (2012), composting is an alternative way to divert food waste from landfills and that will be a feasible substitute for South Africa, because of its high recyclable waste content.

The FAO (2013) further explains that when food is wasted there is biodiversity loss and a change in climatic conditions. An increase in temperature due to high loading of greenhouse gases to the atmosphere from, inter alia, food wasted leads to an increase in atmospheric temperature. An increase in temperature accelerates the reduction in biodiversity since conditions are too extreme for organisms to adapt (Bellard *et al.*, 2012).

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter outlines the methodological framework applied in this study. Sampling methods are presented and a description is provided of the study area. The research design, research methodology, data collection and data analysis are discussed, followed by quality control on how data was entered and validated. Pilot testing of the questionnaire and ethical considerations are also addressed. Limitations of the study are then identified.

3.2 Sampling

This study was conducted in the CTMM. A total of 250 households were identified and persons responsible for preparation of food in their houses were recruited, appointments were made and interviews were conducted accordingly. Out of 250 households, the questionnaires of only 210 households were analysed because they met the standard of storing waste for three weeks. To quantify the amount of food waste that is being generated in households, food waste was collected using disposal plastic bags and weighed on a kitchen scale. It was collected from the households on a weekly basis. The data was entered in Microsoft Excel spreadsheets to be analysed. There are two methods of sampling: one yields probability samples in which the probability of selection of each respondent is assured and the other yields non-probability samples in which the probability of selection is unknown (Polit & Hungler, 1995). In this study the researcher used a convenience sampling method of the non-probability sampling design to select the study areas. This method was selected because it offers easy access to the respondents. According to Cooper and Schindler (2006), convenience sampling is the purest form of probability sampling and is simple to apply.

3.3 Description and demography of the study area

The study was limited to five areas as the targeted population in the CTMM, as shown in Figure 3.1, because of the accessibility of different income groups.

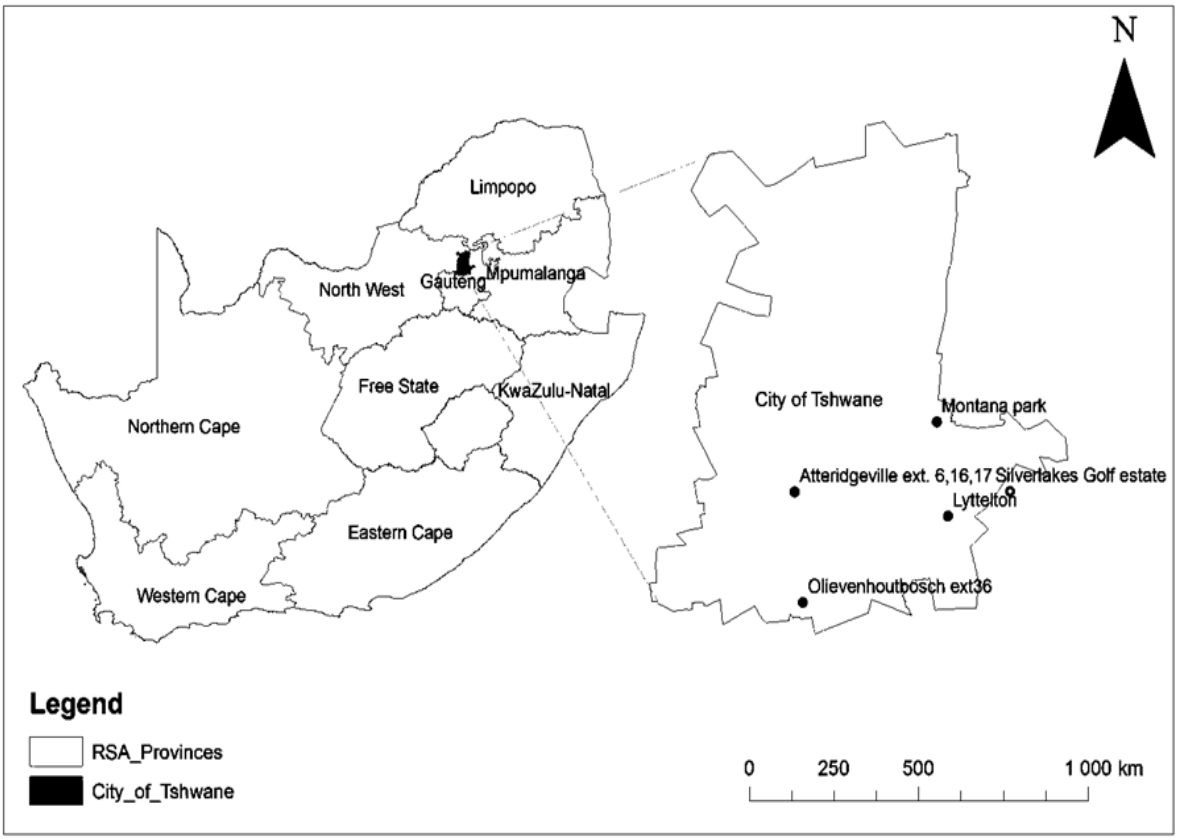

Figure 3.1: CTMM map with study areas (Source: field map)

3.3.1 Description of the study area

Generally it has been shown that there is no correlation between income level and food wastage (Wenlock & Buss, 1977), while Skourides *et al.* (2008) indicate that income has an influence on the amount of household food waste. This study focused on assessing household food wastage with the aim to determine, inter alia, where food is generated the most in terms of geographical area and wealth (Statistics South Africa, 2001). Purposive sampling, which is a type of non-probability sampling method, was used to select the study area (Leedy & Ormrod, 2009). These areas were purposely selected (i) to attain the view of residents in suburb and township households regarding the issue of food waste in terms of the income levels in this geographical area and (ii) to compare the difference between the different suburbs and townships in terms of food waste generation.

Atteridgeville Ext 6, 16 and 17 and Olievenhoutbosch Ext 36 were purposely selected in the sample because they are typical townships with well-arranged streets and modern houses in low-income areas. These townships are widely expanded into the scattered

informal settlements. Montana Park, Silver Lakes Golf Estate and Lyttelton were purposively selected to assess suburbs with townhouses, flats and estate houses in medium- and high-income areas (Statistics South Africa, 2011b).

The study was conducted in the CTMM, in the northern part of Gauteng; it is one of the country's capital cities, serving as the administrative capital (Cram101Textbook Reviews, 2012). The area is relatively flat with an extended built-up area. Proctor (2000) defines population as the total group of people or elements about which information is needed. The population of the CTMM stood at 2 921 488 in 2011. This figure is due to a high birth rate and rural-urban migration from nearby townships (Statistics South Africa, 2011a).

The CTMM consists of five different municipality regions, namely region 1 (North West), region 2 (Central Northern), region 3 (Central), region 4 (South West) and region 5 (North East), and there are low-, middle- and high-income people or families in all of these regions (Statistics South Africa, 2011b). The areas were selected as representative of each of the five municipal regions. The study area included suburbs and townships of the CTMM namely, Atteridgeville Ext 6, 16 and 17 from the central western region, Montana Park from the north-eastern region, Silver Lakes Golf Estate from the eastern region and Lyttelton (in Centurion) and Olievenhoutbosch Ext 36 covering the southern region.

3.3.2 Household income

Hamann and Horn (2014) indicate that the CTMM is divided into three household income classes, namely low-income group, middle-income group and high-income group. In this study the people living in Atteridgeville 6, 16 and 17 and Olievenhoutbosch Ext 36 are considered to be low income groups, whereas people in Montana Park and Centurion (Lyttelton) are considered to be middle-income groups (Hamann & Horn, 2014). Silver Lakes Golf Estate is generally considered to be high-income area.

Table 3.1 shows the income for household weighted (Statistic South Africa, 2011b). Atteridgeville Ext 6, 16 and 17 had the highest number (5 299) of people with no income whereas Montana had the lowest number (1 573) of people with no income. Additionally, Silver Lakes Golf Estate had the highest number of people with an income of R2 457 601 and more, while Atteridgeville had no one with an income of R2 457 601 and more.

Table 3.1: Geography by income category for person adjusted (Statistics South Africa, 2011b)

Geographical area	**No income**	**R1 to R4 800**	**R4 801 to R9 600**	**R9 601 to R19 600**	**R19 601 to R38 200**	**R38 201 to R76 400**	**R76 401 to R153 800**	**R153 801 to R307 600**	**R307 601 to R614 400**	**R614 001 to R1 228 800**	**R1 228 801 to R2 457 600**	**R2 457 601 or more**
Montana Park	1 575	49	70	256	344	392	819	931	593	217	28	30
Silver Lakes Golf Estate	2 339	24	24	137	366	194	359	569	656	561	185	83
Atteridgeville Ext 6, 16, 17	5 299	844	298	770	1177	940	518	121	26	1	3	0
Centurion Lyttelton	3 048	119	138	542	824	1 041	1 560	1 653	924	272	74	59
Olievenhoutbosch Ext 36	5 137	1 620	392	1 314	2 187	1 090	684	473	97	7	14	3

Table 3.1 is also supported by the BMR (2012), which reports that South African households in the highest income group earn an average of over R2 million per annum (see Table 3.2). The poor class, according to Table 3.2, has an income of R0 - R54 344 per annum and the upper-middle class has an income of R631 121 - R863 906 per annum.

According to Cameron and Krynauw (2001), low-income households have a monthly income of R3 000 or less, middle-income households have a monthly income of R3 001 - R 9 999 and high-income households have an income of R10 000 or more. The method Cameron and Krynauw (2001) used to classify households by income level was adopted in this study; households were classified in terms of the level of income.

Households with an income ranging from R500 - R5 000 were classified as the low-income class, those with an income of R6 000 - R9 000 per month fell into the middle class and the last class was the higher income with a monthly income over R10 000 per month.

Table 3.2: Distribution of household income by income group (BMR, 2012)

Class categories	Annual income
Poor	R0 - R54 344
Low emerging middle class	R54 345 - R151 727
Emerging middle class	R151 728 - R363 930
Realised middle class	R 363 931 - R631 120
Upper-middle class	R631 121 - R863 906
Emerging affluent class	R863 907 - R1 329 844
Affluent class	R1 329 845 or more

3.3.3 Demography

This section will outline the five areas in the CTMM as shown in Figure 3.1 in terms of demography.

Atteridgeville is a township in the west of the CTMM. The population of Atteridgeville is 64 425 residents. The study was conducted only in Atteridgeville Ext 6, 16 and 17. The total population of these extensions is 11 449 residents, with 49% males and 51% females (Statistics South Africa, 2011a). Statistics South Africa (2011b) places the majority of

people who are living in Atteridgeville Ext 6, 16 and 17 in the low-income group. Many people living in Atteridgeville Ext 6, 16 and 17 are black Africans (99.34%), followed by other foreign races (0.48%), coloureds (0.11%), Indians or Asians (0.04%) and whites (0.03%).

Centurion is a suburb located in the south of Tshwane. The population of Centurion is 2 365 80 residents. The study was conducted in Lyttelton, which is a suburb in Centurion with a population of 12 372 residents, with 48.34% males and 51.67% females (Statistics South Africa, 2011b). Statistics South Africa (2011b) places Lyttelton in the middle-income group. The majority of people living in Lyttelton are whites (72.40%), followed by black Africans (21.40%), Indians/Asians (2.62%), coloureds (2.60%) and other foreign races (0.99%).

Montana is a suburb in the north-east of Tshwane, and it lies in the foothills on the north face of Magaliesberg. Montana Park has a population of 6 717 residents, with 49% males and 51% females (Statistics South Africa, 2011b). Statistics South Africa (2011b) places Montana Park in the middle-income group. The majority of the people who are living in this area are whites (68.53%). Black Africans constitute 27.57% of the residents, Indians/Asians 1.55%, coloureds 1.24% and foreigners 1.13%.

Silver Lakes Golf Estate is a suburb in the east of Tshwane with a population of 5 899 residents, with 46.97% males and 53.03% females (Statistics South Africa, 2011b). Statistics South Africa (2011b) places Silver Lakes Golf Estate in the higher-income group. The majority of people who are living at Silver Lakes Golf Estate are whites (78.11%), followed by black Africans (16.10%), Indians/Asians (2.76%), coloureds (1.31%) and other foreign races (1.70%).

Olievenhoutbosch is a suburb dominated by black people, situated in the southern part of Midrand. The population of Olievenhoutbosch is 70 863 residents. The study in Olievenhoutbosch was conducted at Ext 36 which has a population of 14 365 residents, with 52.51% males and 47.49% females (Statistics South Africa, 2011b). Statistics South Africa (2011b) places Olievenhoutbosch Ext 36 in the low-income group. The majority of people who are living in Olievenhoutbosch Ext 36 are black Africans (99.09%), followed by coloureds (0.58%), Indians/Asians (0.13%), whites (0.08%) and other foreign races (0.11%).

3.4 Research design

A quantitative, descriptive research design was chosen to give a descriptive analysis of the research that was done in selected areas in the CTMM households. Quantitative research places emphasis on the use of a structured questionnaire (Hair *et al.,* 2008) as an effective instrument. The foundation of research and theory making relies on epistemology and ontology. These are both branches of philosophy that try to explain the existence of an entity or something (Guba & Lincoln, 1994).

Epistemology is defined as the research of philosophy which is concerned about how individuals determine the truth (Streubert & Carpenter, 2003). Epistemology inquires as to the nature of the get-together between the knower (the inquirer) and the known (or knowable) (Guba & Lincoln, 1994). The study conducted in the epistemological dimension is regarded as the pursuit of valid truth (Mouton, 1998). The epistemological situation of the researcher is that the researcher believes that all knowledge is constructed through a meaning-making process in the mind of the knower (Daly, 2007).

For this study this was challenging because the study dealt with human beings and their perception of food waste practices.

3.5 Research methodology

A structured questionnaire was adopted (Annexure A) as the data collection method for assessing household food wastage in the CTMM area and data was collected using a face-to-face approach and also by weighing collected food waste. According to Babbie *et al.* (2001), a questionnaire is the appropriate method for collecting survey data in studies in which the objective is to obtain information from the respondents about their demographic data, behaviour, opinions and attitude. Although there are established questionnaires used for similar studies in developed countries, the questionnaire used for this study was customised to local conditions and approved by UNISA. The questionnaire was chosen because: (i) it was easy to minimise non-response and maximise the quality of data collected; (ii) the presence of the interviewer made it easier for the respondent to either clarify answers or ask clarification of the questions on the questionnaire without researcher bias (Cohen *et al.,* 2000).

To determine the amount of food waste generated per household, households' food waste was collected using disposal plastic bags and quantified using a kitchen scale.

3.5.1 Structured questionnaire data collection

As supported by Streubert and Carpenter (2003), the study adopted this method because it is a good method for the student to be the primary researcher for collecting data in person. For this study email and fax were not chosen as a means of data collection because people can easily withdraw from such methods and it is difficult to control the communication system (Robson, 2011). The face-to-face questionnaire approach method was chosen, though it is costly in both time and money, but the benefits outweighed the disadvantages. A purposive sampling method which belongs to a class of non-probability and is known as a convenience sampling technique was used in this study. Pre-testing of the questionnaire was conducted in 15 households from the selected areas in the CTMM. Then participants from each area were recruited and questionnaires were handed to individuals who were primarily grocery shoppers or those that were primarily responsible for purchasing and preparing food in their households. If this person was not available, an appointment was made for a follow-up interview. Using 30 minutes of their time, participants were interviewed to answer the structured questionnaire.

For safety and reference purposes, hard copy questionnaire data was stored properly in the student's locker by using a lock pad to ensure security and will be kept for a year for reference. Electronic data was stored on the student's computer with a password. A total of 210 questionnaires from the selected suburbs of the CTMM were evaluated as indicated in Table 3.3.

Table 3.3: Number of households who completed questionnaire per area (n=210)

Areas	Number of households
Atteridgeville Ext 6, 16, 17	50
Lyttelton	32
Montana Park	40
Olievenhoutbosch Ext 36	50
Silver Lakes Golf Estate	38
Total	210

Table 3.3 indicates that Atteridgeville Ext 6, 16 and 17 completed 50 questionnaires, Lyttelton 32, Montana Park 40, Olievenhoutbosch Ext 36 50 questionnaires and Silver

Lakes Golf Estate 38. The aim of overall 50 interviews per suburb could not be attained due to a lack of willing participants and time constraints.

The survey was carried out between mid-April and November 2014 on a continuous basis stretching over different seasons to get a reliable average. Winter and summer were therefore not compared, but included. Data was collected on weekends and holidays (e.g. Saturdays and holidays between 11:00 and 17:00 and Sundays from 14:00 until 17:00).

3.5.2 Food waste data collection

Households were asked to separate and store food waste for a period of three weeks and they were told that the researcher would collect their food waste on a weekly basis. Although 133 respondents indicated on the questionnaire that they wasted food, there were challenges to weigh all 133 households' waste. Instead, food waste was weighed only from 123 households. Reasons for this were that ten households could not store their waste for the whole week; households could not store their waste for all three weeks and could only store it for less than a week. The food waste stored for less than a week, three or four days or only two weeks was therefore not included.

The researcher used brown plastic bags (Figure 3.2) which were marked per area to collect food waste in the five selected areas of the CTMM. These were taken to a central place at Pretoria CSIR Laboratory.

Figure 3.2: Brown plastic bags with food waste (Source: Field picture)

The researcher weighed food waste from five different selected areas in the CTMM in a central place (Pretoria CSIR Laboratory) using a mechanical kitchen scale, which is a stainless steel bowl and measures up to 5 kg (Figure 3.3). The mechanical kitchen scale was used because it was available to the researcher; the scale was calibrated using calibration weights. A cell phone camera was used to take food waste pictures when weighing.

Figure 3.3: Food waste weighed using mechanical kitchen scale (Source: Field picture)

3.5.3 Personal protective equipment during sampling

In terms of the Occupational Health and Safety Act 85 of 1993, section 8(2)(d) states that any employee working in a situation where they may be exposed to risk or potential risk is required to wear personal protective equipment (PPE) in order to protect their health and safety and provide the necessary means to apply such precautionary measures. This Act lists the PPE that may be required. For health and hygiene reasons, the following PPE was used at all times: gloves for handling food waste, facemasks for smelly food waste and a lab coat to protect the researcher's clothing during the weighing period.

3.6 Data analysis

Data in this study was validated, entered and cleaned before analysis was done as quality control (Cant *et al.,* 2005). This will be explained in section 3.7. Data analysis for this study included descriptive statistics (description of data and summarising of raw data (Taylor, 2002)) using Microsoft Office Excel 2010, which makes use of tables, graphs and percentages, and the chi-square statistical test. This program was used to assess socio-economic profiles of households, such as income, level of education and behaviour of participants towards food waste from each selected area of the CTMM as quantitative analysis (Poate & Daplyn, 1993). To find the average amount of household food waste per week, the amount of food wasted by all households was added up, then divided by the amount of numbers in the set (how many numbers there were).

The chi-square test is a test that is often applied to categorical data, i.e. data that is grouped into categories, which may or may not be ordered, and for which the number of occurrences within each category is counted or expressed as a proportion of the total. (For categorical data, the data is recorded as a category, as opposed to numerical data that is recorded as measurements, which could, for example, be averaged for different groups in the data). The chi-square test determines whether differences in proportions between groups may be attributable to random differences between the groups or whether they represent a consistent, non-random pattern of differences.

The chi-square test uses the chi-square probability distribution ($\chi 2$) to calculate the probability value (or p-value). Such probability values could be calculated using pivot tables and the chi-square. The test function in Excel or a statistical software package can be used for this. In this study, the statistical software SAS was used to apply the chi-square test and determine the relevant p-values.

3.7 Quality control

3.7.1 Data entry

Data entry is a process of transferring information from any acceptable data collection instrument into the computer before it is analysed (Roberts-Lombard, 2002). The researcher entered data into Microsoft Office Excel 2010 before it was analysed.

3.7.2 Data cleaning

Data cleaning is a crucial process that needs to be taken into consideration before analysing data, especially in cases like in this study, where data entry was done manually. A thorough data cleaning process was done by double checking before analysis to eliminate errors.

3.7.3 Errors

Errors in this study were dealt with according to Babbie and Mouton (2002), which involves the following: i) Using structured questionnaires where the researcher and respondents had direct contact; ii) Repeated visits to the respondents by the researcher; iii) Carefully constructing and pre-testing the questionnaire that was used to collect primary data; and iv) Removing sensitive questions from the questionnaire.

3.7.4 Pre-testing

Questionnaire was pre-testing by 15 respondents (N=15) from the selected areas in the CTMM with similar characteristics to the research sample before the questionnaire was used to collect data. All 15 participants responded that the questionnaire was simple, easy to understand, clear and straightforward. Therefore no adaptations were needed.

3.7.5 Reliability

The researcher ensured reliability by carefully phrasing all the questions in the questionnaire to avoid vagueness and did not guide the respondents to a specific answer. Respondents were informed of the purpose of the study and the need to respond truthfully. The fact that open-ended questions were minimised in the questionnaire also enhanced the reliability of the study.

3.8 Ethical considerations, consent form and questionnaire pilot testing

The study was conducted according to UNISA's Policy on Research Ethics, in particular part 2 "Guidelines for research involving human participants" (UNISA, 2007). Permission to conduct the study in the CTMM from the Executive Director: Waste Management Division, Ms Faith Mabindisa, was obtained before the pilot study (see Annexure B) and ethical approval was also obtained from UNISA (see Annexure C). The consent form was used as an introduction section at the beginning of the questionnaire, and it explained to respondents the motivation for the study, emphasised that households' responses were confidential and explained the use of the cell phone camera (Annexure D).

Respondents in the pilot and actual studies were requested to sign a written consent form (see Annexure D). Fifteen respondents (N=15) from the selected areas in the CTMM with similar characteristics to the research sample, who were not part of the main study, were included in the pilot study. Respondents of the household food wastage pilot and actual study were assured of the anonymity and confidentiality of their feedback and participation in the pilot study. Pilot testing of the questionnaire was conducted in order to identify and eliminate questions that could cause problems for the respondents (Sattari, 2007). Pilot participants responded that the questionnaire was simple and easy to understand. They agreed that the questions were clear and straightforward. Time for completing each questionnaire was assessed. This ensured the validity and reliability of the study.

The questionnaire was written and conducted in English, although for Olievenhoutbosch Ext 36 and Atteridgeville Ext 6, 16 and 17 respondents the researcher translated questions into *tsotsitaal* (a mixture of languages such as Afrikaans, Sesotho, English and isiZulu) for better understanding and comfort in the process of responding to the questionnaire.

3.9 Limitations

There were a number of limitations concerning the data collection; due to limited time and financial constraints, the sample of the survey was restricted to five areas in the CTMM. Since this study was limited to one municipality, it is not possible to generalise the findings to the whole of South Africa. The study assessed food waste at household level only, although household food waste is not the only source of waste that is affecting the CTMM. This study did not take into account edible food waste disposed of down the sink, composted or fed to pets, but focused only on food that ends up in the household garbage bin and removed by the municipal waste service. 16% of the households had defensive attitudes, which made it difficult to access their information. Accessibility of people who were responsible for food preparation or grocery was difficult. Although an appointment was made, still there were households not available to take part in this study. Nearly all of the household members thought that by responding to the household food waste questionnaire, the researcher would earn a great deal of money and so they wanted to be compensated, even though it was explained to them that this was a master's study project for the researcher's dissertation. Other households were concerned that by responding to the questionnaire, their personal details would be given to salespersons who could call them. Access to households in Montana Park, Silver Lakes Golf Estate and Lyttelton was difficult because of the security measures applied by gated communities. This resulted in obtaining most of the results from Atteridgeville Ext 6, 16 and 17 and Olievenhoutbosch Ext 36. The weighing part of food waste was a major challenge for the researcher and delayed the study because households were not cooperative. Although the period of the study overextended over two different seasons, data for two seasons was not compared since it was outside the scope of the study.

3.10 Conclusion

The methods and materials used were deemed suitable for answering the five research questions that needed to be assessed. This chapter has presented an outline of the study

area, research design and methodological framework conducted in this study. The process of data collection and data analysis was discussed in detail, and a brief description was given of study quality control. Limitations of the study were then identified.

CHAPTER 4: INTERPRETATION AND DISCUSSION OF RESULTS

4.1 Introduction

In Chapter 3, the study procedures were established and clarified. Appropriate procedural concerns such as study area and household selection, and the data collection procedure were deliberated. Fifty (24%) of the completed questionnaires were returned from Atteridgeville and Olievenhoutbosch, while 40 (19%) were returned from Montana, 38 (18%) from Silver Lakes and 32 (15%) from Centurion. The study intended to collect 250 completed questionnaires, but only 210 were completed and collected, attaining a total response rate of 84%. Although lower than the target of 100%, this number was still sufficient to draw valid conclusions from the data analysis (Sridharan *et al.,* 2006).

In this chapter a detailed discussion is given on the results obtained from administering the questionnaire. Data on the amount of food waste that is being generated in household using a kitchen scale is also discussed accordingly.

4.2 Demographics

Demographics is the study of the activities and other characteristics of a population in terms of statistics (Rouse, 2005), such as gender, age, education and income. Demographic factors are important in assessing who to survey and how to analyse survey responses into meaningful data and they are essential for determining if the study individuals are a representative sample of the target population for generalisation purposes (Wyse, 2012). Although the demographic profile was not part of this study objective, it provides an interesting issue that it is important to let know people how demographics influence people to waste food. The demographic profile of the respondents from each of the five geographic areas covered gender, age, education, household size and monthly income, provided as a summary in Annexure E.

4.2.1 Gender of respondents responsible for food

The number of female and male respondents is discussed in percentages.

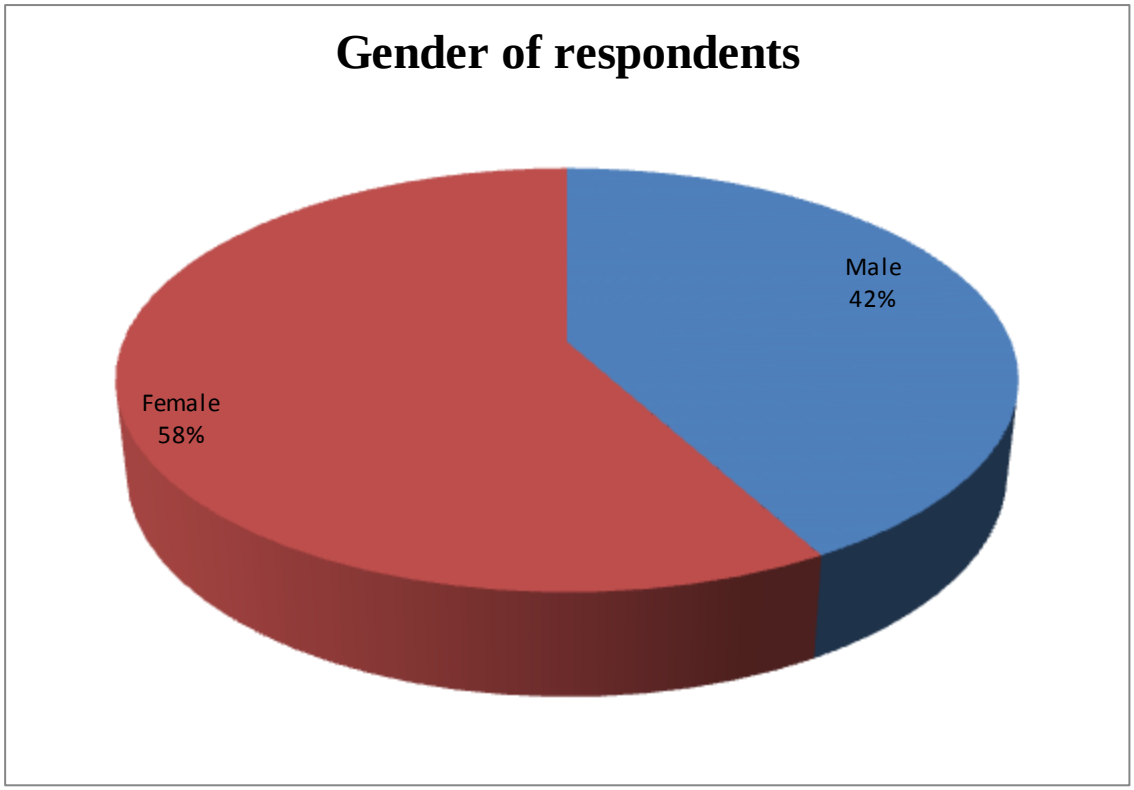

Figure 4.1: Gender of respondents (n=210)

Figure 4.1 shows that there were more female (58%) than male (42%) respondents in this study. The sample is a good representation of Tshwane's population which has more women (51.3%) than men (48.7%) (Statistics South Africa, 2011b). A survey by the World Food Programme (2013) shows that women take all responsibility in the household for grocery shopping and they are still primarily responsible for cooking. Women are therefore more cautious in their interpretation of the safety of food than men (World Food Programme, 2013).

4.2.2 Age range

In this section the age range is discussed in terms of geographical area. The graph depicts that the majority of the respondents were aged 21 - 30 years (43%), as referred to in Annexure E. This may be due to Tshwane having 65% of residents between the ages of 20 and 29 (Statistics South Africa, 2011b). This was followed by 31% respondents 31 - 40 years old, 14% respondents 41 - 50 years old and 8% of respondents aged 51 - 60 years old, as referred to in Annexure E. The age groups of 61 - 70 years (2%) and 70+ years

(1%) had the lowest number of participants, as referred to in Annexure E in this study. It must be emphasised that the results represent the findings of this study.

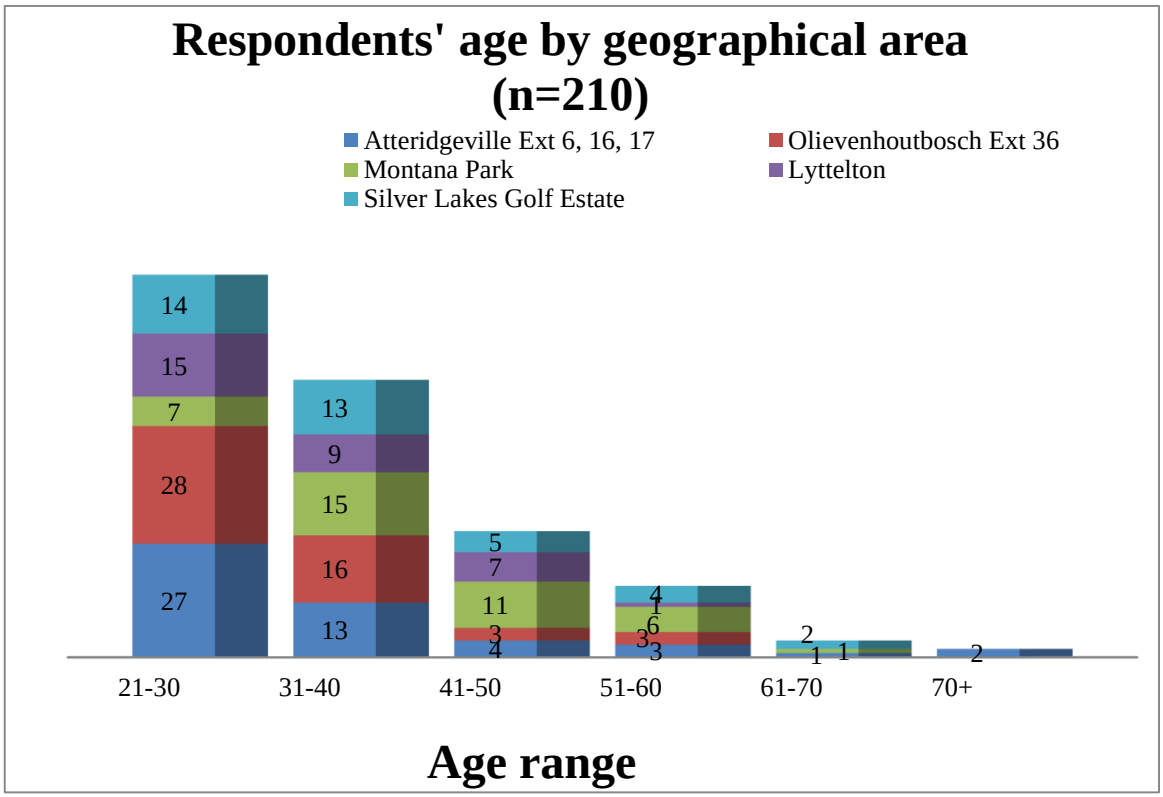

Figure 4.2: Age range percentages by geographical area (n=210)

As seen in Figure 4.2, the study shows that the majority of the respondents aged 21 - 30 were from Olievenhoutbosch Ext 36 (56%), (n=28). This result is in line with Statistics South Africa (2011b), which indicates that Olievenhoutbosch has more residents aged 21 - 30. Olievenhoutbosch Ext 36 had the highest number of respondents aged 31 – 40 years old at 32% (n=16). Respondents in the 41 - 50 years age range amounted to 28%, (n=11), while 15% (n=6) in the 51 - 60 years age range were from Montana Park. The study showed that 5% (n=2) of the respondents aged 61 - 70 years were from Silver Lakes. The wastage of food in terms of age of respondents will be discussed later under section 4.7.2.

4.2.3 Highest qualification

More than 90% of respondents had some form of education (e.g. matric, diploma and degree), while only 1% were unschooled (no form of education, no certificates). 31% of the respondents had acquired matric (Grade 12) as their highest qualification level. This is in line with Statistics South Africa (2011b), which indicates that 34% of Tshwane's

residents have Grade 12 as their highest level of education, 4% of the population have no schooling at all, while 23% of residents have completed higher education (Annexure E). This made it easier to explain to the respondents what the research was about and assisted with the accurate filling in of the questionnaires. Educational categories are discussed now in terms of geographical area.

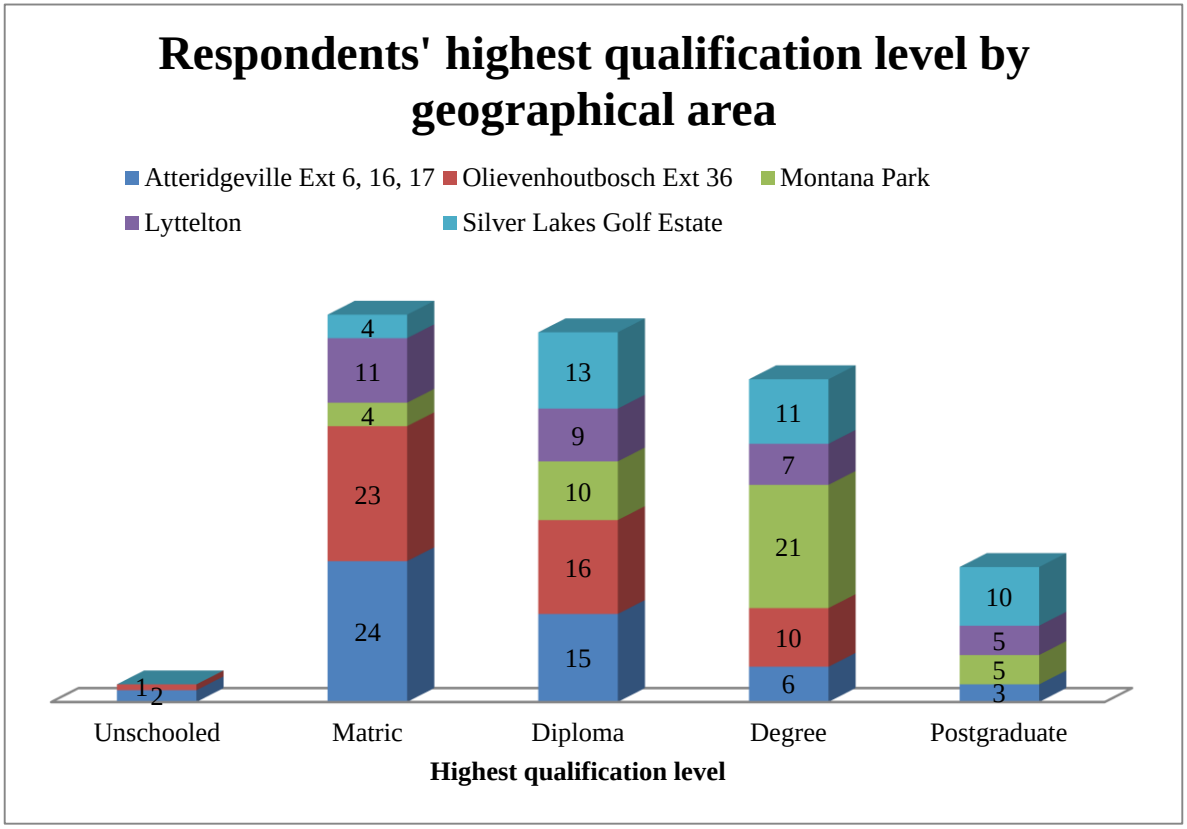

Figure 4.3: Households' highest qualification level by geographical area (n=210)

Figure 4.3 indicates that the highest qualification for each of the qualification categories is as follows: Silver Lakes Golf Estate had the highest number of respondents (26.3%) with a postgraduate qualification (n=10), while Montana Park had the highest number of respondents (52.3%) with a degree only (n=21). MacGregor (2009) found that higher education has the benefits of earning better jobs. In Olievenhoutbosch Ext 36, 32% of respondents had acquired a diploma as their highest qualification (n=16) and Atteridgeville Ext 6, 16 and 17 had the highest number of respondents (48%) with only matric (n=24). Olievenhoutbosch Ext 36 had nearly as many, namely 46% (n=23). Atteridgeville Ext 6, 16 and 17 and Olievenhoutbosch Ext 36 had 4% (n=2) and 2% (n=1) of unschooled respondents, respectively. This is in line with the results obtained by Statistics South Africa (2011b) that Atteridgeville has the highest number of unschooled residents. The

wastage of food in terms of respondents with highest qualification will be discussed later under section 4.7.3.

4.2.4 Household size

The number of persons living in the household per geographical area was determined. 28% of the respondents were from 2-member households, followed by 3-member households at 26% and then 4-member households at 20%, as referred to in Annexure E. Six-member households (1%) and 8-member households (2%) had the lowest number of respondents who participated in this study (Annexure E).

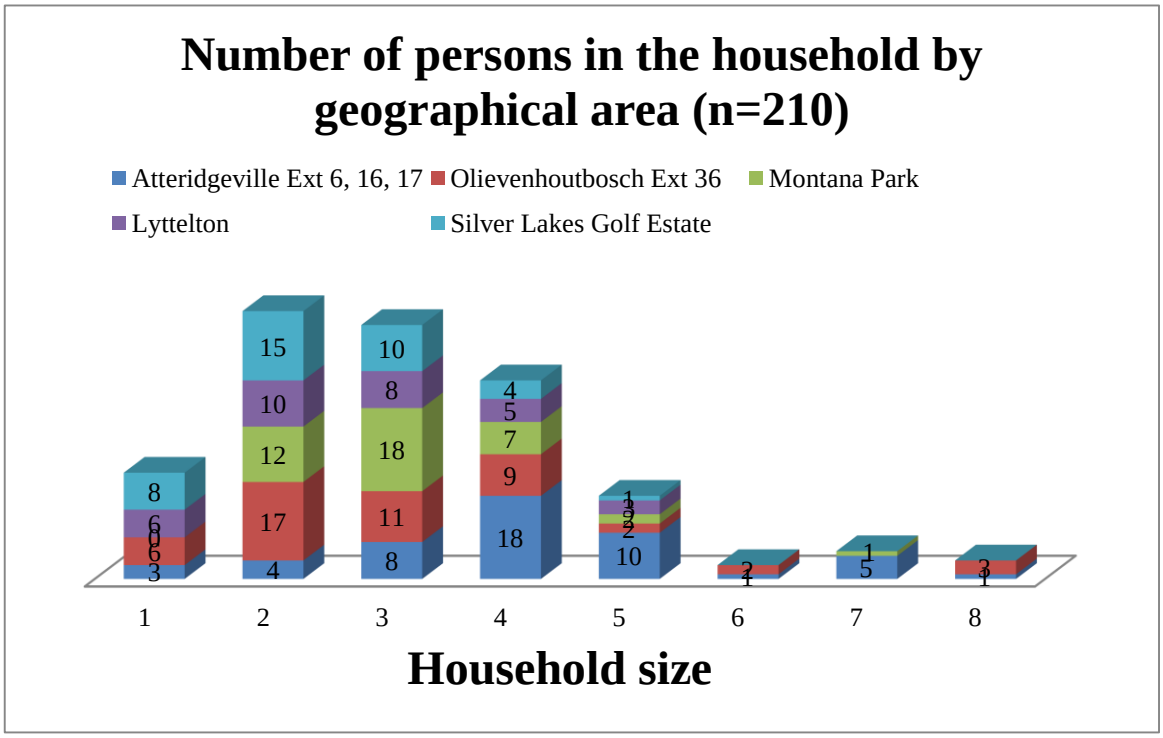

Figure 4.4: Household size by geographical area (n=210)

Figure 4.4 presents the results of respondents' household size in terms of geographical area. All 1- to 5-member households who participated were from all five areas in the CTMM, while 8-member households (n=3) were from Olievenhoutbosch Ext 36 (6%) and Atteridgeville Ext 6, 16 and 17 (2%), (n=1). The 7-member households (n=5) in this study were from Atteridgeville Ext 6, 16 and 17 (10%) and Montana Park (2.3%), (n=1), whereas 6-member households (n=1) were from Atteridgeville 6, 16 and 17 (2%) and Olievenhoutbosch Ext 36 (4%), (n=2). The majority of the respondents from 3-member households (n=18) were from Montana Park (45%), and Silver Lakes Golf Estate had the highest number of respondents (39.5%), (n=15), from 2-member households and 21.1%

from 1-member households (n=8). Atteridgeville Ext 6, 16 and 17 had the highest number of respondents in the 4- and 5-member household groups, at 36% (n=18) and 20% (n=10), respectively. The wastage of food in terms of household size of respondents will be discussed later under section 4.7.4.

4.2.5 Monthly income

The respondents' income percentage is now discussed in terms of geographical area. The majority of the respondents (55%) had a monthly income of over R10 000, a rather smaller percentage (25%) received a monthly income ranging from R500 - R5 000 and 20% had a monthly income of R6 000 - R9 000 (Annexure E). The difference in income in terms of who wastes less or more food will be discussed in section 4.5.

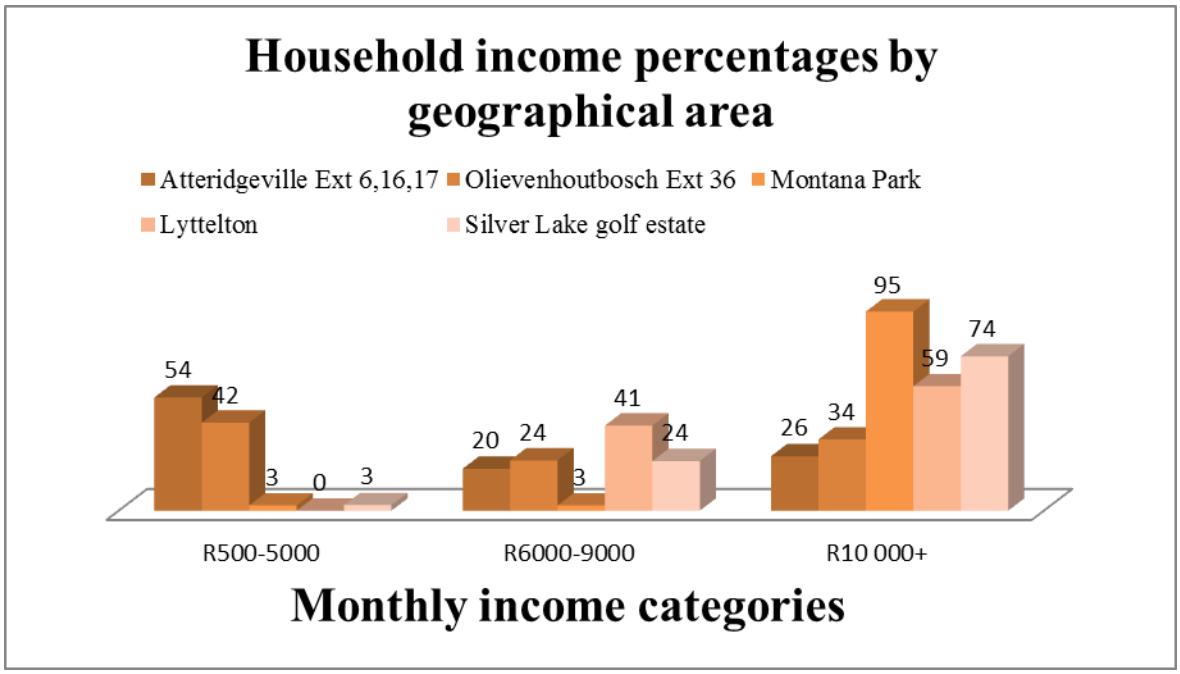

Figure 4.5: Households' monthly income

Figure 4.5 shows that in Montana Park, the majority of the respondents (95%) had a monthly income of R10 000+, while in Atteridgeville Ext 6, 16 and 17, 56% had a monthly income of R500 - R5 000 and in Lyttelton, 41% had a monthly income of R6 000 - R9 000. Based on the findings of the income reported by households in this study, it can be concluded that in relative terms Montana Park and Silver Lakes Golf Estate can be viewed as high-income areas, Lyttelton as a middle-income area and Olievenhoutbosch Ext 36 and Atteridgeville Ext 6, 16 and 17 as low-income areas.

4.3 Types of food wasted

In this section the researcher will outline the types of food wasted the most in the households (not all food types wasted by each of the households) in terms of respondents' geographical area, age range, highest qualification, household size and, lastly, monthly income categories. Although only 123 respondents as measured from the questionnaire agreed that they wasted food, when asked what type of food they wasted, 133 respondents indicated that they wasted the types of food indicated in Table 4.1. This table shows only four types of food wasted: pap (35%), bread (25%), rice (26%) and fruit and vegetables (14%). This was confirmed during the food waste weighing period. The number of respondents who wasted pap in this study was lower compared to the 58% of respondents who wasted pap in a study conducted by Ramukhwatho *et al.* (2014). The percentage of rice wasted in this study and that of Ramukhwatho *et al.* (2014) was the same. The 14% of fruit and vegetables wasted in this study was lower than the 17% found in a study by Buzby *et al.* (2014). Fresh fruit and vegetables were usually among the wasted items in studies conducted in the UK and Australia by Lyndhurst (2007), WRAP (2008), Morgan (2009) and Parfitt *et al*. (2010), but this was different in this study. The higher number of respondents who wasted pap may be due to the South African population's specific food preferences which vary by location (Statistics South Africa, 2008) and culture.

4.3.1 Type of food wastage by geographical area

Household food waste may be spoiled cooked food, excess cooked food, vegetable and fruit peelings, depending on the custom of people living in the area. The types of food waste are discussed in terms of geographical percentages.

Table 4.1: Households' type of food wasted in percentages by geographical area (n=133)

Type of food wasted	Atteridgeville 6, 16, 17	Olievenhoutbosch Ext 36	Montana Park	Lyttel-ton	Silver Lakes Golf Estate	Total
Pap	55	83	10	18	7	35
Bread	15	9	24	41	41	25
Rice	24	4	45	18	35	26
Fruit & vegetables	6	4	21	23	17	14
Total	100	100	100	100	100	100

Table 4.1 shows that the majority of people living in Atteridgeville Ext 6, 16 and 17 (55%) and Olievenhoutbosch Ext 36 (83%) responded that they wasted pap as a daily meal; this was determined through the questionnaire when households were asked which type of food they wasted the most. This was also reflected in a study conducted by Ramukhwatho *et al.* (2014) in Mamelodi, reporting that 58% of respondents wasted pap. It was found that in Montana Park and Silver Lakes Golf Estate respondents wasted rice (45%) and (35%), respectively, while respondents in Silver Lakes Golf Estate and Lyttelton wasted bread, each at 41%. Fruit and vegetables were wasted more in Lyttelton (23%), followed by Silver Lakes Golf Estate (17%) and Montana Park (21%). Atteridgeville and Olievenhoutbosch Ext 36 respondents wasted less fruit and vegetables at 6% and 4%, respectively. From the information presented in Table 4.1, households from higher income areas eat more rice compared to lower income areas where households eat more pap.

4.3.2 Type of food wasted by age range

Because of the relatively small sample size, Excel and chi square were used to analyse the results (chi-square results will be discussed in section 4.8). The types of food waste are now discussed in terms of age range percentages.

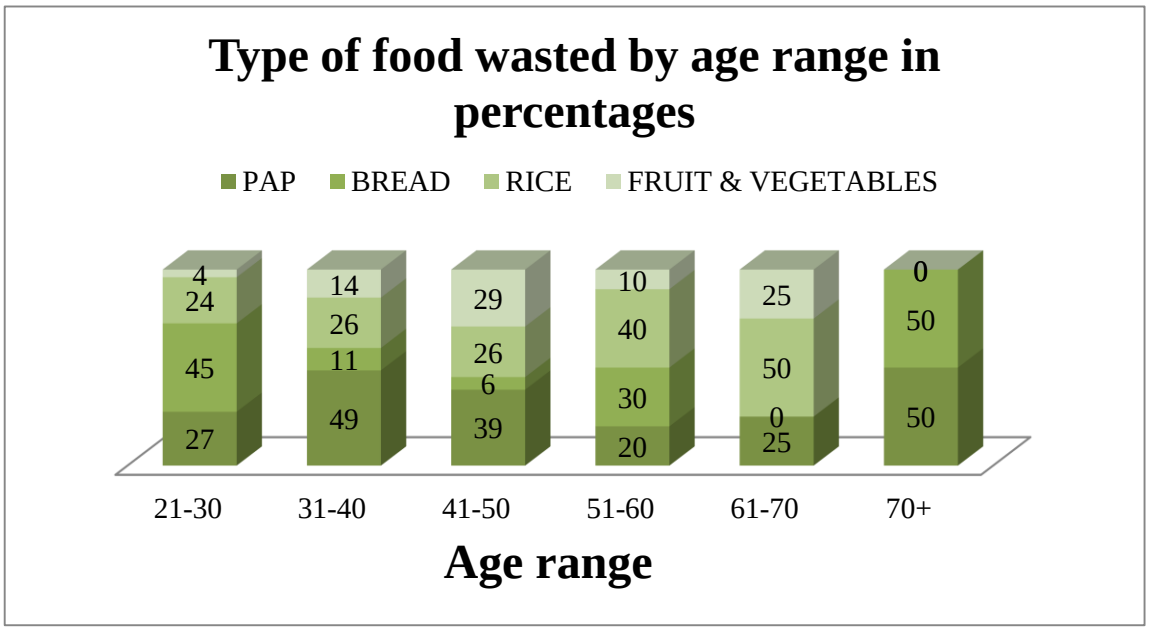

Figure 4.6: Type of food wasted by age range in percentages (n=133)

As indicated in Figure 4.6, rice was wasted the most by respondents aged 61 - 70 (50%). However, 25% of respondents aged 61 - 70 wasted pap and fruit and vegetables in their households. In the age group 41 - 50 years, 39% of respondents wasted pap and 29%

wasted fruit and vegetables. In the 31 - 40 year age group, the majority (49%) of respondents wasted pap, whereas 14% wasted fruit and vegetables. In the 21 - 30 year age group, 45% of respondents wasted bread, while 27%, 24% and 4% wasted pap, rice and fruit and vegetables, respectively. From the information in Figure 4.6, the wastage of rice increases with age (this observation is up to 70 years old as the sample of 2 for the 70+ age group is too small to be taken into consideration here). It must be emphasised that the results represent the findings of this study.

4.3.3 Type of food wasted by highest qualification

The types of food waste are now discussed in terms of households' highest qualification percentages.

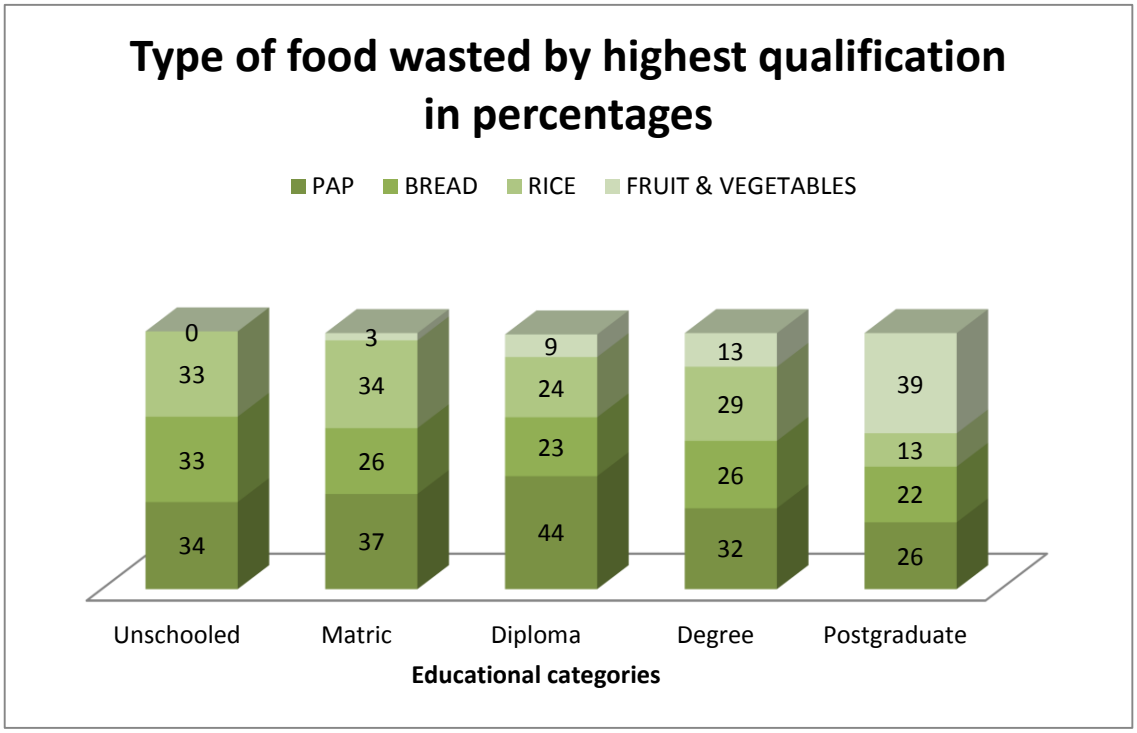

Figure 4.7: Types of food wasted by highest qualification level in percentages (n=133)

Respondents with no form of education (Figure 4.7) wasted mostly pap (34%), bread and rice at 33% each, but no fruit and vegetables. However, 39% of respondents with postgraduate qualifications, 13% with a degree, 9% with a diploma and 3% with matric wasted fruit and vegetables. Respondents with matric and those with a degree wasted bread (both groups at 26%), while 23% of diploma respondents and 22% of postgraduate respondents wasted bread in their households. Of the matric respondents, 37% wasted pap the most, 34% wasted rice the most and 3% wasted fruit and vegetables the most. Figure

4.7 shows that the wastage of pap decreases and the wastage of fruit and vegetables increases with increased levels of education. Though it was mentioned earlier that education results in a better job this may indicate that households with some form of education consume more fruit and vegetables compared to pap.

4.3.4 Type of food wasted by household size

The types of food waste are now discussed in terms of the percentages of number of people in the household.

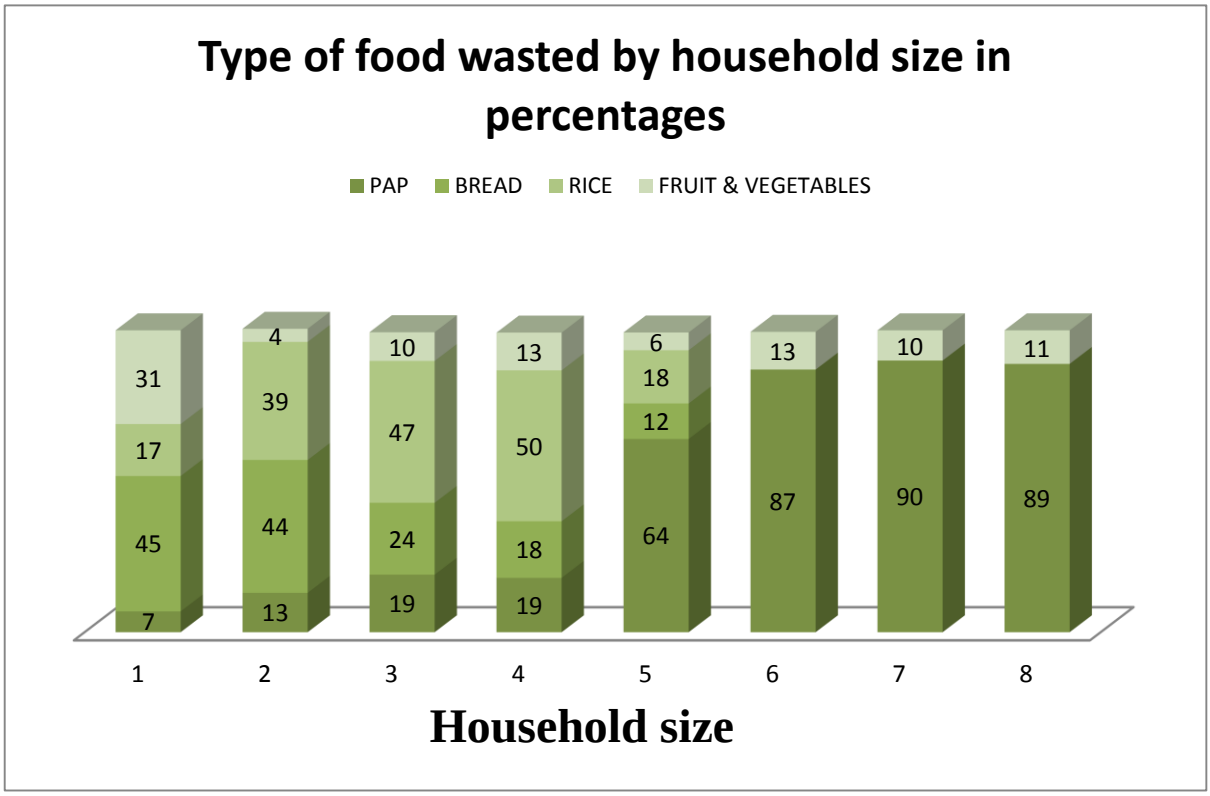

Figure 4.8: Type of food wasted by household size in percentages (n=133)

Figure 4.8 indicates that pap was mostly wasted by 90% of 7-member households, followed by 89% of 8-member households. 19% of 4-member households as well as 3-member households wasted pap. 13% and 44% of 2-member households wasted pap and bread, respectively. Bread was wasted mostly by 45% of 1-member households, and by 12% of 5-member households. Rice was wasted mostly by 50% of 4-member households. The majority of the respondents who wasted fruit and vegetables were 1-member households (31%), followed by 4%, 10%, 13%, 13%, 10% and 11% of 2-, 3-, 4-, 6-, 7- and 8-member households, respectively. The study showed that the more family members in the household, the more they wasted pap and that bread and rice were not wasted at all by

6-member households and higher. Households with more family members were from low-income areas and wasted pap more.

4.3.5 Type of food wasted by monthly income

The types of food waste are now discussed in terms of the households' monthly income percentages.

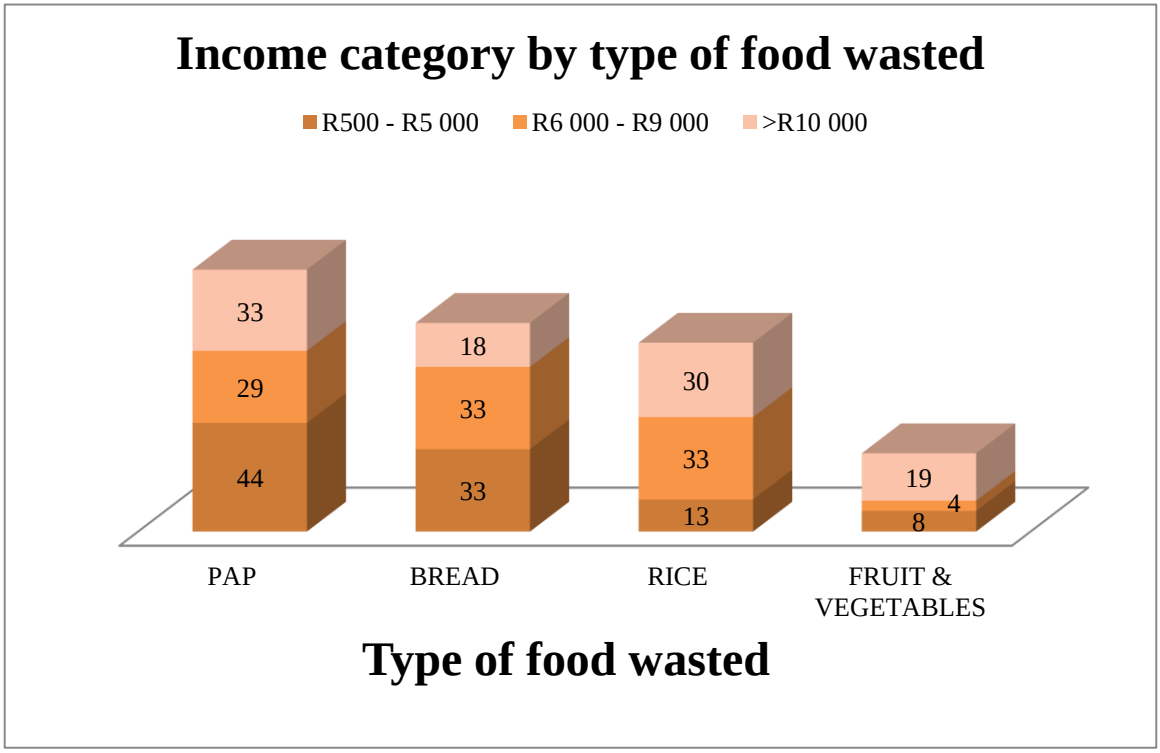

Figure 4.9: Type of food wasted by monthly income percentages (n=133)

With regard to wasting pap, Figure 4.9 indicates that 44% (n=16) of respondents with a monthly income of R500 - R5 000 wasted pap the most in their households, followed by 29% (n=7) with a monthly income of R6 000 - R9 000 and then 33% (n=24) with a monthly income of over R10 000. 33% (n=8) of respondents with a monthly income of R6 000 - R9 000 wasted bread and rice in their households, while 33% (n=12) with a monthly income of R500 - R5 000 wasted bread the most, followed by 14% (n=5) rice and 8% (n=3) fruit and vegetables in the same income range. Fruit and vegetables were wasted the most by 19% (n=14) of respondents with a monthly income over R10 000. Respondents with a monthly income of over R10 000 wasted rice 30% (n= 22) and bread n= 13 (18%). It is clear that pap was wasted the most by respondents, followed by rice and bread, while fruit and vegetables were wasted less.

4.4 Results of the reasons for food wastage

This section will outline respondents' reasons for wasting food in terms of geographical area, age range, highest qualification, household size and monthly income categories. Households were asked in the questionnaire when and why they threw away food; there was no list of reasons provided why households waste food. The researcher categorised all the reasons given by the households. This study found that 82% of respondents were not attracted by special offers; this was higher than was found by Ramukhwatho *et al.* (2014) which was 74%.

27% of the respondents indicated that they wasted food because they bought too much food; this percentage was higher than the 22% found in a study by Lyndhurst (2007). While 18% of respondents showed that they wasted food because of special offers, this was lower than the 30% of Lyndhurst's respondents. There were only 2% of respondents in a study conducted by Parizeau *et al.* (2015) reporting that they wasted food that they bought on sale. It can therefore be concluded that special offers do contribute to food waste, as referred to Table 4.17 in terms of income.

Table 4.2 shows that the study found that 36% of respondents wasted food because they cooked too much food; they prepared more than what their family members could consume. Moreover, in a study by WRAP (2008), it was also found that 31% of respondents wasted food because too much food was prepared. Respondents in this current study showed that they wasted food because fruit and vegetables went off (8%), food residue (leftover from pots/cooking) (7%) and poor storage (4%).

4.4.1 Results of the reasons for food wastage by geographical area

The reasons for food wastage in terms of geographical area percentages are now discussed. Buying too much, special offers, cooking too much, poor storage, food residue and fruit and vegetables going off were the reasons identified for food waste in this study.

Table 4.2: Reasons for wasting food in percentages by geographical area (n=210)

Reason for wasting food	Atteridgeville Ext 6.16,17	Olievenhout-bosch Ext 36	Montana Park	Lyttelton	Silver Lakes Golf Estate	Total sample (%)
Buying too much	22	30	20	31	31	27
Special offers	26	14	17	13	16	18
Cooking too much	38	44	32	35	26	36
Poor storage	8	6	3	3	3	4
Food residue	2	4	13	9	11	7
Fruit and vegetables going off	4	2	15	9	13	8
Total	100	100	100	100	100	100

As indicated in Table 4.2, 31% of the respondents in Silver Lakes wasted food because they bought too much and ended up throwing some of it away, followed by Lyttelton at 31%, Olievenhoutbosch Ext 36 at 30%, Atteridgeville Ext 6, 16 and 17 at 22% and Montana Park with the lowest at 20%.

Olievenhoutbosch Ext 36 had the highest number of respondents (44%) indicating that they wasted food because they cooked too much and Silver Lakes Golf Estate had the lowest number of respondents (26%): this is followed by Atteridgeville Ext 6, 16 and 17 with 38%, Lyttelton with 35% and Montana Park with 32%.

Some of the factors that influence food waste due to poor storage are lack of identification of retention period, as well as insufficient knowledge about methods of food storage, and

lack of consumers' attention to storage labels on the product. In Atteridgeville Ext 6, 16 and 17, 8% of respondents reported that they wasted food due to poor storage. This figure was 3% in Montana Park. Sometimes households store food in the fridge that could be better stored elsewhere, for example products like fruit, vegetables and eggs can stay fresh for a long time outside of the fridge.

Respondents who wasted food because of food residue (leftovers from pots/cooking) ranged from 2 - 13%. 13% of the Montana Park respondents wasted food because of food residue which they did not intend to waste. 2% of respondents in Atteridgeville Ext 6, 16 and 17 indicated that food residue was one of their reasons for wasting food.

The study found that Montana Park had the highest number of respondents (15%) who wasted fruit and vegetables that went off. Olievenhoutbosch Ext 36 had the lowest percentage of respondents (2%) in this group.

There are many factors that cause food to be wasted, such as geography and culture. The reasons differ from region to region and from nation to nation (Gjerris & Gaiani, 2013).

4.4.2 Results of the reasons for food wastage by age range

In this section the reasons for food waste are discussed in terms of age range percentages. The study identified reasons for food waste as buying too much, special offers, cooking too much, poor storage, food residue and fruit and vegetables going off.

Table 4.3: Reasons for wasting food in percentages by age range (n=210)

Reason for wasting food	**21-30**	**31-40**	**41-50**	**51-60**	**61-70**	**70+**	**Total sample (%)**
Buying too much	23	29	27	41	25	0	27
Special offers	15	14	23	29	25	50	18
Cooking too much	41	44	20	12	25	0	36
Poor storage	5	1	10	6	0	0	4
Food residue	6	5	13	6	25	50	7
Fruit and vegetables going off	10	7	7	6	0	0	8
Total	100	100	100	100	100	100	100

The results from this study (Table 4.3) indicate that respondents aged 51 - 60 had the highest number (29%) who wasted food because they bought too much, followed by 31 - 40 years old (29%) and 41 - 50 years old (27%). However, the 21 - 30 years age group had the lowest number of respondents who wasted food because they bought too much. There was not much difference between respondents aged 21 - 30, 31 - 40, 41 - 50 and 61 - 70 who wasted food because they bought too much; their percentages ranged between 22% and 30%.

Some 29% of respondents aged 51 - 60 years old and 25% of respondents aged 61 - 70 years old wasted food because of special offers. Not many respondents aged 31 - 40 years old wasted food due to special offers (14 %).

44% of respondents who indicated that they cooked too much were 31 - 40 years old, followed by 41% in the 21 - 30 age category and 25% in the 61 - 70 age category. Respondents of 51 - 60 years old had the lowest number at 12% who wasted food due to cooking too much.

The study results indicate that respondents who wasted food because of poor storage ranged from 1 - 11%. 10% of respondents aged 41 - 50 wasted food because of poor storage, followed by 1% of respondents aged 31 - 40.

The group aged 70+ had the highest number of respondents (50%) who wasted food because of food residue, followed by the categories of 21 - 30 years old and 31 - 40 years old, at 6% and 5%, respectively.

The age group 21 - 30 years old had the highest number of respondents (10%) wasting food because fruit and vegetables went off, while the 51 - 60 years age category had the lowest number (6%). It must be emphasised that the results represent the findings of this study.

4.4.3 Results of the reasons for food wastage by highest qualification

In this section the reasons for food waste are discussed in terms of the households' highest qualification level percentages. The study identified reasons for food waste as buying too

much, special offers, cooking too much, poor storage, food residue and fruit and vegetables going off.

Table 4.4: Reasons for wasting food in percentages by highest qualification (n=210)

Reason for wasting food	**Unschooled**	**Matric**	**Diploma**	**Degree**	**Post-graduate**	**Total sample (%)**
Buying too much	0	27	24	26	39	27
Special offers	67	15	22	11	22	18
Cooking too much	0	33	40	44	18	36
Poor storage	33	5	3	5	4	4
Food residue	0	8	6	5	13	7
Fruit and vegetables going off	0	12	5	9	4	8
Total	100	100	100	100	100	100

As seen in Table 4.4, 39% of postgraduate respondents wasted food because they bought too much; this was followed by 27% of respondents with matric and 26% with a degree. The lowest number was found to be respondents with a diploma (24%).

It is highlighted that 67% of respondents with no form of education wasted food because of special offers. Those with qualifications who wasted food for this reason ranged between 11% and 22%, which is much less.

44% of respondents with a degree wasted food because they cooked too much, followed by respondents with a diploma (40%) and matric (33%). The lowest number of respondents who wasted food because they cooked too much were postgraduates at 18%.

The study found that 33% of respondents with no form of education wasted food because of poor storage, followed by 5% each of matric and diploma respondents.

5 - 14% of respondents wasted food because of food residue. Postgraduate qualification respondents had the highest number (13%) who wasted food because of food residue.

Most of the fruit and vegetables were wasted because they went off. This was experienced by 12% of respondents with matric and 4% with postgraduate degrees.

4.4.4 Results of the reasons for food wastage by household size

The reasons for food waste are now discussed in terms of household size percentages. The study identified reasons for food waste as buying too much, special offers, cooking too much, poor storage, food residue and fruit and vegetables going off.

Table 4.5: Reasons for wasting food in percentages by household size (n=210)

Reason for wasting food	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total sample %**
Buying too much	26	22	42	19	22	0	17	25	27
Special offers	22	32	9	9	17	0	17	0	18
Cooking too much	9	36	40	35	27	100	66	75	36
Poor storage	4	2	5	5	17	0	0	0	4
Food residue	4	4	2	23	6	0	0	0	7
Fruit and vegetables going off	35	4	2	9	11	0	0	0	8
Total	100	100	100	100	100	100	100	100	100

Table 4.5 shows the statistics indicating the reasons for food wastage by household size. The percentages reported below must be seen in light of the total sample that was taken of each category, indicated in the last column of the table.

3-member households wasted more food (42%) compared to other size households. 17% of 7-member households wasted food because they bought too much – this was the lowest percentage.

32% of 2-member households were more attracted by special offers, followed by 22% of 1-member households.

Respondents of 6-member households did not waste food because of buying too much, special offers, poor storage, food residue or spoiled fruit and vegetables. However, all 6-member households indicated that they only wasted food because they cooked too much food, followed by 8- and 7-member households at 75% and 66%, respectively. Only 9% of 1-member households wasted food due to cooking too much.

17% of 5-member households wasted food because of poor storage' this was the highest number of respondents. 2% of 2-member households wasted food because of poor storage; this was the lowest number of respondents.

23% of respondents who wasted food because of food residue were from 4-member households. The lowest number was from 3-member households at 2%.

Regarding wasting food due to fruit and vegetables going off, results ranged from 2 - 35%. 35% of 1-member households wasted food for this reason.

4.4.5 Results of the reasons for food wastage by monthly income

In this section the reasons for food waste are discussed in terms of the households' monthly income percentages. The study identified reasons for food waste as buying too much, special offers, cooking too much, poor storage, food residue and fruit and vegetables going off.

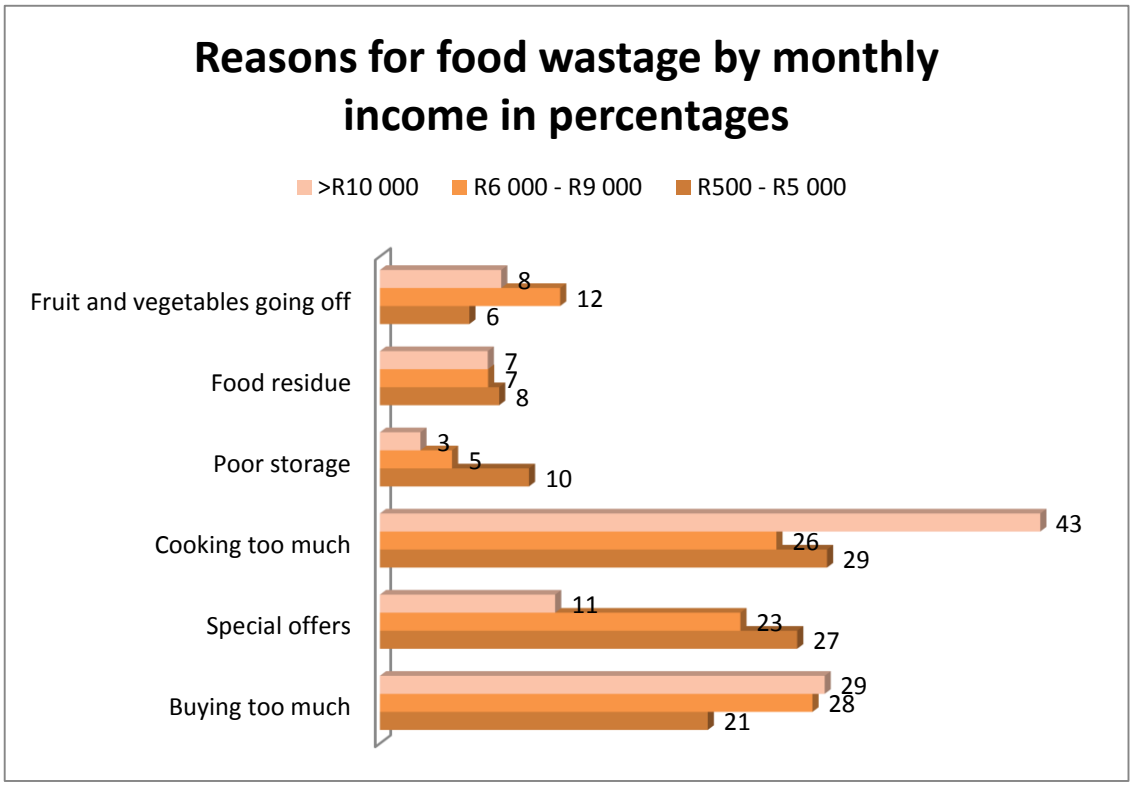

Figure 4.10: Reasons for food wastage by monthly income (n=210)

As presented in Figure 4.10, 29% of respondents with a monthly income of R10 000+ wasted food because they bought too much. There was not much difference between income categories: 28% of respondents in the R6 000 - R9 000 and 21 % in the R500 - R5 000 categories wasted food for this reason.

27% of respondents with a monthly income of R500 - R5 000 wasted food because of special offers, and only 11% with a monthly income of R10 000+ wasted food for this reason.

43% of respondents with a monthly income of R10 000+ wasted food due to cooking too much. 26% and 29% of respondents with a monthly income of R6 000 - R9 000 and R500 - R5 000 respectively, wasted food for this reason.

10% of respondents with a monthly income of R500 - R5 000 wasted food because of poor storage. However, the difference between the highest and the lowest numbers were small and ranged from 3 to 10% for the different income categories as can be seen in Figure 4.10.

The study found that respondents with a monthly income of R500 - R5 000 had the highest number (8%) of respondents who wasted food because of food residue. The range between

the categories, however, was very small and ranged between 7 and 8%. Respondents with a monthly income of R6 000 - R9 000 and R10 000+ had the lowest number (7%) of respondents who wasted food because of food residue.

The highest percentage, 12% of respondents with a monthly income of R6 000 - R9 000 wasted food because of fruit and vegetables going off.

4.5 Amount of food wasted per week in kilograms

In this section respondents' average amount of food wasted per week in kilograms is discussed in terms of geographical area, age range, highest qualification, household size and monthly income categories. The researcher weighed the food waste for a period of three weeks from 123 out of 133 respondents who indicated in the questionnaire that they wasted food. Ten households' results were not included in the analysis, because some households did not participate and others did not comply with the weighing standards of keeping food waste for seven days over a period of three weeks. For example, households kept food waste for a period of two weeks and others for four days and not a week, as explained in the limitation section in Chapter 3. A total of 2 202.9 kg of food was wasted by 123 households in a period of three weeks. Table 4.6 shows that respondents wasted an average of 5.9 kg of food per household during the first week, 6 kg in the second week and 6 kg in the third week. This amount of food wasted is less than the amount found in studies by WRAP (2009b) in the UK where households waste more than 6 kg of food per week and Parizeau *et al.* (2015) in Guelph, Ontario, from 68 households which indicated that 10.2 kg of food was wasted per week.

4.5.1 Average household food wastage by geographical area

Respondents' average amount of food wasted per week in kilograms is now discussed in terms of geographical area.

Table 4.6: Average household food wastage in kilograms per week by geographical area (n=123)

Weeks	Atteridgeville Ext 6, 16, 17 (N=28)	Olievenhout-bosch Ext 36 (N=22)	Montana Park (N=29)	Silver Lakes Golf Estate (N=27)	Lyttelton (N=17)	Total average per week (N=123)
Week 1	5.3	5.1	6.1	6.6	6.6	5.9
Week 2	5.4	5.2	6.1	6.3	7.0	6.0
Week 3	5.7	5.0	6.0	6.7	7.0	6.0
Average per week	5.5	5.1	6.1	6.5	6.9	6.0

As indicated in Table 4.6, the actual weighing results show that Lyttelton respondents wasted more food compared to other suburbs and townships selected for this study in the CTMM. Lyttelton respondents wasted an average of 6.9 kg of food in a period of three weeks, followed by Silver Lakes Golf Estate at 6.5 kg, Montana Park at 6.1 kg, Atteridgeville Ext 6, 16 and 17 at 5.5 kg and Olievenhoutbosch Ext 36 at 5.1 kg. It can therefore be concluded that there is little difference in food wastage (varying from 5.1 – 6.9 kg per week). Atteridgeville Ext 6, 16 and 17 and Olievenhoutbosch Ext 36, which are low-income areas, wasted less food compared to Montana Park and Silver Lakes Golf Estate, which are high-income areas. From the information presented in Table 4.6 and self-reported results in Table 4.12 under heading 4.7.1, it was found that the actual weighing results (food waste collection) and the self-reported results from the questionnaire did not correspond; Lyttelton had the highest number of respondents who wasted food in the actual weighing (6.9%), while Montana Park had the highest number of respondents who wasted food in the self-reported results (72.5%). The amount of food wasted varies depending on the definition of food waste used and the amount of food the country has available for consumption (Stuart, 2009; Buzby & Hyman, 2012).

4.5.2 Average household food wastage by age range

This section will outline respondents' average amount of food wasted per week in kilograms in terms of age range.

Table 4.7: Average household food wastage in kilograms per week by age range (n=123)

Weeks	**21 - 30 (N=57)**	**31 - 40 (N=34)**	**41 - 50 (N=19)**	**51 - 60 (N=11)**	**61 - 70 (N=2)**	**70+ (N=0)**	**Total average per week (N=123)**
Week 1	5.2	5.8	7.5	7.4	6.3	−	5.9
Week 2	5.4	5.3	7.6	7.5	8.5	−	6.0
Week 3	5.7	5.2	8.1	6.1	9.5	−	6.0
Average	5.4	5.4	7.8	7.0	8.1	−	6.0

The results from this study (Table 4.7) present the amount of food wasted in terms of age range. Although all respondents aged 70+ self-reported in the questionnaire that they did not waste food, they participated in the actual weighing of food waste. However, they did not comply with the weighing standards of keeping food waste for seven days over a period of three weeks and their results have not been included in this study. The households' self-reported results in Table 4.13 show that respondents aged 51 - 60 wasted more food compared to other age groups, followed by respondents aged 21 - 30 and 41 – 50 years old.

However, the situation was different with the actual weighing of food waste in this current study; respondents aged 41 - 50 wasted more food (7.8 kg) than other age groups. Respondents aged 61 - 70 wasted an average of 8.1 kg of food in a period of three weeks. This is not a good representative example, though, because only two households participated. Respondents aged 51 - 60 decreased the amount of food wasted in the third week. However, respondents aged 41 - 50 and 21 - 30 showed that the amount of food wasted increased from week 1 to week 3. The amount of food wasted by respondents aged 31 - 40 decreased from week 1 to week 3. Table 4.7 shows that an average of 5.4 kg of food was wasted in a period of three weeks by respondents aged 21 - 30. It can therefore be concluded that for this study there was a difference in the amount of food wasted between age groups shown as referred to in Table 4.18. This is different from studies by

Hamilton *et al.* (2005), Wassermann and Schneider (2005), Lyndhurst (2007), Göbel *et al.* (2012) and Quested *et al.* (2013), who found that young people waste food more than older people.

4.5.3 Average household food wastage by highest qualification level

In this section respondents' average amount of food wasted per week in kilograms is outlined in terms of highest qualification.

As presented in Table 4.8, there were no unschooled respondents in the weighing part of this study, as they did not store waste food for the required period of three weeks. In the questionnaire they reported that they did not waste food, but they participated in the weighing of food waste. Postgraduate respondents self-reported to waste more food (Table 4.14), but the actual results of this current study show that diploma respondents wasted more food compared to other education levels, with an average of 6.2 kg of food wasted in a period of three weeks. The lowest amount of food waste (5.4 kg) was recorded by respondents with a postgraduate degree as their highest qualification. Notably there is a slight increase (0.6%) in food wastage by respondents with matric and diplomas and a decrease (0.5%) in food wastage by respondents with degrees and postgraduate degrees. Therefore, the results in this study differ from those of Kumar and Singh (2013) and Wassermann and Schneider (2005), who found that respondents with higher education wasted more food. Moreover, the results of this study support the findings by Murad *et al.* (2012) and Epp and Mauger (1989) indicating that people who practise improper methods of environmental management systems have lower levels of education; people with higher education levels use resources more efficiently and they are more informed when buying food because they are aware of the effects of their own behaviour.

Table 4.8: Average household food wastage in kilograms per week by highest qualification (n=123)

Weeks	Unschooled (N=0)	Matric (N=27)	Diploma (N=45)	Degree (N=32)	Postgraduate (N=19)	Total average per week (N=123)
Week 1	−	5.7	6.3	5.9	5.4	5.9
Week 2	−	6.0	6.8	5.6	4.6	6.0
Week 3	−	6.5	5.6	6.2	6.1	6.0
Average	−	6.1	6.2	5.9	5.4	6.0

4.5.4 Average household food wastage by household size

Respondents' average amount of food wasted per week in kilograms is now outlined in terms of household size.

To find the average amount of household food waste per week, the amount of food wasted by all households was added up, then divided by the amount of numbers in the set (how many numbers there were). Table 4.9 indicates that 7- and 8-member households wasted more food for a period of three weeks, but this might be due to the low sample number of households. However, it was also statistically proven that there was a difference between household size and food waste, as referred to in Table 4.19 (p-value 0.0043). No 6-member households participated in the weighing of food waste for this study. The actual results (food waste collection) of this current study show that 5-member households wasted more food. The self-reported (questionnaire) results in Table 4.15 indicate that respondents of 4-member households wasted more food compared to other household sizes, while the actual results indicate that respondents of 4-member households wasted less food (5.7 kg/week). WRAP (2009a) states that approximately half the amount of food wasted per capita generated is wasted in households with 4 members compared to single occupancy households. Respondents with 1- and 2-member households wasted an average of 6.1 kg of food in a period of three weeks.

Table 4.9: Average household food wastage in kilograms per week by household size (n=123)

Weeks	**1 (N=14)**	**2 (N=37)**	**3 (N=36)**	**4 (N=28)**	**5 (N=6)**	**6 (N=0)**	**7 (N=1)**	**8 (N=1)**	**Total average per week (N=123)**
Week 1	6.2	6.0	5.9	5.8	5.3	–	7.1	6.9	5.9
Week 2	6.5	6.1	5.3	5.5	8.2	–	16.3	9.8	6.0
Week 3	5.6	6.1	5.6	5.9	7.1	–	17.9	7.6	6.0
Average	6.1	6.1	5.6	5.7	6.9	–	13.8	8.1	6.0

4.5.5 Average household food wastage by monthly income category

In this section respondents' average amount of food wasted per week in kilograms is outlined in terms of monthly income categories

As indicated in Table 4.10, there seems to be a decrease in food wasted with an increase in monthly income: the lower the income, the more food is wasted. Respondents with a monthly income of R10 000+ wasted an average of 5.7 kg of food in a period of three weeks, while respondents with a monthly income of R6 000 - R9 000 wasted an average of 6 kg. However, an average of 7.1 kg of food was wasted by respondents with a monthly income of R500 - R5 000 over the period of three weeks. Respondents with a monthly income of R6 000 - R9 000 reported in the questionnaire that they wasted food (72%), which is the highest when comparing income categories, but the actual weighing results of the current study show that respondents with a monthly income of R500 – R5 000 wasted more food (7.1 kg/week). Moreover, there was less food wastage in low-income than in high-income households, which is in line with what Lyndhurst (2007) and WRAP (2010) found. This current study found that the less income earned, the more food wasted. This is contrary to the studies by Jones (2003), Hamilton *et al.* (2005) and Skourides *et al.* (2008), which showed that higher income households wasted more food than those with lower income.

Table 4.10: Average household food wastage in kilograms per week by monthly income (n=123)

Weeks	R500 - R5 000 (N=17)	R6 000 - R9 000 (N=31)	R10 000+ (N=75)	Total average per week (N=123)
Week 1	6.5	5.8	5.8	5.9
Week 2	7.3	6.8	5.3	6.0
Week 3	7.6	5.2	6.0	6.0
Average	7.1	6.0	5.7	6.0

The total average of food wasted by respondents was 6 kg; this shows that all people from different income groups wasted food.

4.6 Disposal methods as mitigation strategies to minimise food wastage

The study assessed the amount of food going to black bin to landfill. Respondents' disposal methods in terms of geographical area, age range, highest qualification, household size and monthly income categories are outlined in this section.

The study presented three methods that respondents could employ to dispose of their food waste. As indicated in Table 4.11, the majority of the respondents (83%) in this study relied on the household garbage bin, i.e. municipal waste collection services. 14% of respondents fed their food waste to pets and 3% of respondents composted food waste for their garden. Lyndhurst (2007) found that the higher number of respondents who relied on the household garbage bin do not care about the environment which they live in because they do not know about the environmental impacts of food waste or do not care. The number of respondents who composted their food waste or fed their food waste to pets in this study was lower compared to the study conducted by Parizeau *et al.* (2015), in which 13% used backyard composters and 20% fed domestic or wild animals with food scraps.

4.6.1 Food waste disposal methods by geographical area

In this section respondents' disposal methods in terms of geographical area are discussed. The study presented three methods that respondents could employ to dispose of their food waste.

The results in Table 4.11 indicate that Atteridgeville Ext 6, 16 and 17 had the highest number of respondents (4%) who composted their food waste, with an average of 3%. Almost none of the respondents from the five areas of the CTMM composted food in their homes. Out of five areas only a small number of respondents from four areas composted their food waste. As much as the DEA (2013) encourages home composting, there is more work that needs to be done to encourage households to divert organic and garden waste from landfills.

Olievenhoutbosch Ext 36 had the highest number of respondents (20%) who fed their food waste to pets, followed by Montana Park at 17%. Lyttelton had the lowest number of respondents (6%) who fed their food waste to pets with an average of 14%.

Although 83% of the respondents relied on the household garbage bin, Silver Lakes Golf Estate respondents (92%) relied on the household garbage bin and 78 – 92% fed their food waste to pets.

Table 4.11: Food waste disposal method in percentages by geographical area (n=210)

Food waste disposal method	Atteridge-ville Ext 6, 16, 17	Olieven-houtbosch Ext 36	Montana Park	Centurion	Silver Lakes Golf Estate	Total sample %
Home compost	4	2	3	3	0	3
Fed to pets	80	78	80	91	92	14
Household garbage bin	16	20	17	6	8	83
Total	100	100	100	100	100	100

4.6.2 Food waste disposal methods by age range

In this section three methods that respondents could employ to dispose of their food waste are discussed in terms of age range.

The results (Figure 4.11) indicate that 5% of respondents aged 31 - 40 and 1% aged 21 - 30 composted their food waste.

18% of respondents aged 51 - 60, 30% aged 41 - 50 and 41% aged 31 - 40 fed their food waste to pets. Table 4.11 shows that there is an increase between respondents' age group up to 51 - 60 years old and feeding food waste to pets. 60 years also happens to be the retirement age in South Africa.

The majority of all respondents in all age groups used the garbage bin; the age group 21 - 30 had the highest number of respondents who relied on the household garbage bin for food waste disposal (99%) and the age group 51 - 60 had the lowest number of

respondents (50%). There were only two respondents (50%) each aged 70+ who both composted and fed pets their food waste. It must be emphasised that the results represent the findings of this study.

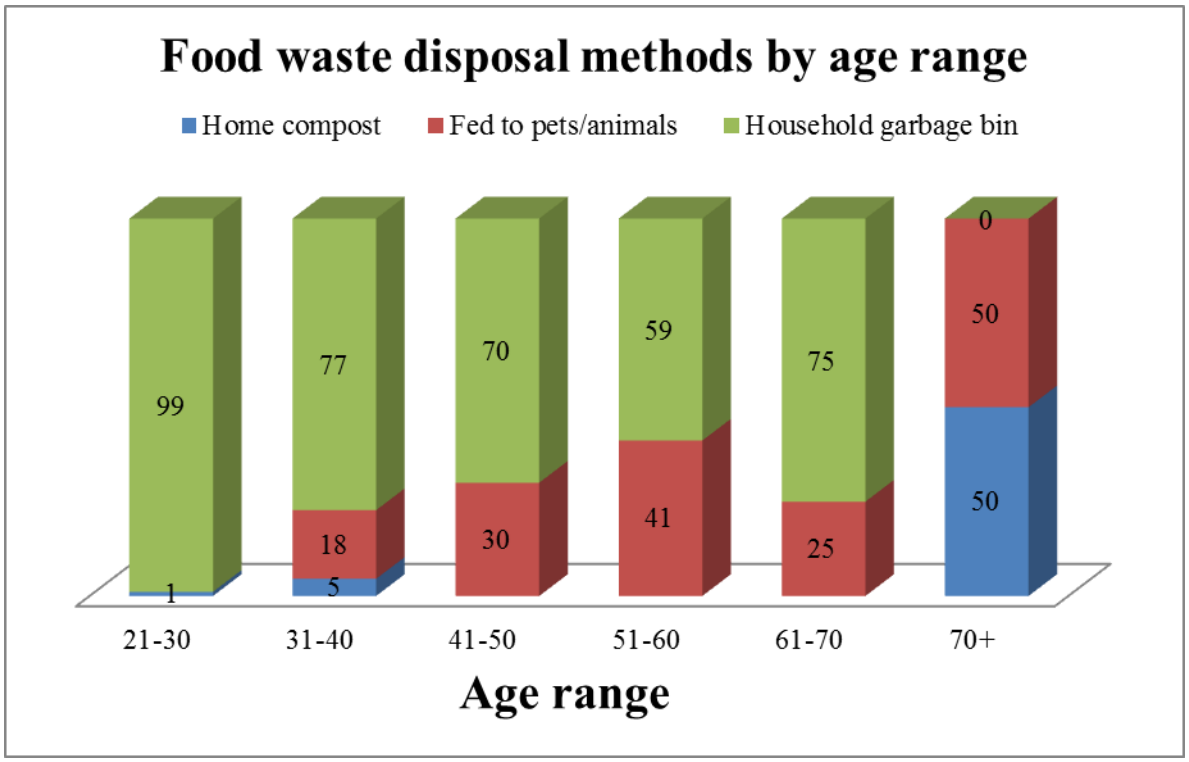

Figure 4.11: Food waste disposal method percentages by age range (n=210)

4.6.3 Food waste disposal methods by highest qualification level

The three methods that respondents could employ to dispose of their food waste are now discussed in terms of highest qualification.

As indicated in Figure 4.12, there were no unschooled respondents who composted their food waste, but neither were there any postgraduate respondents who did so. There is thus no apparent correlation between disposal method and qualification.

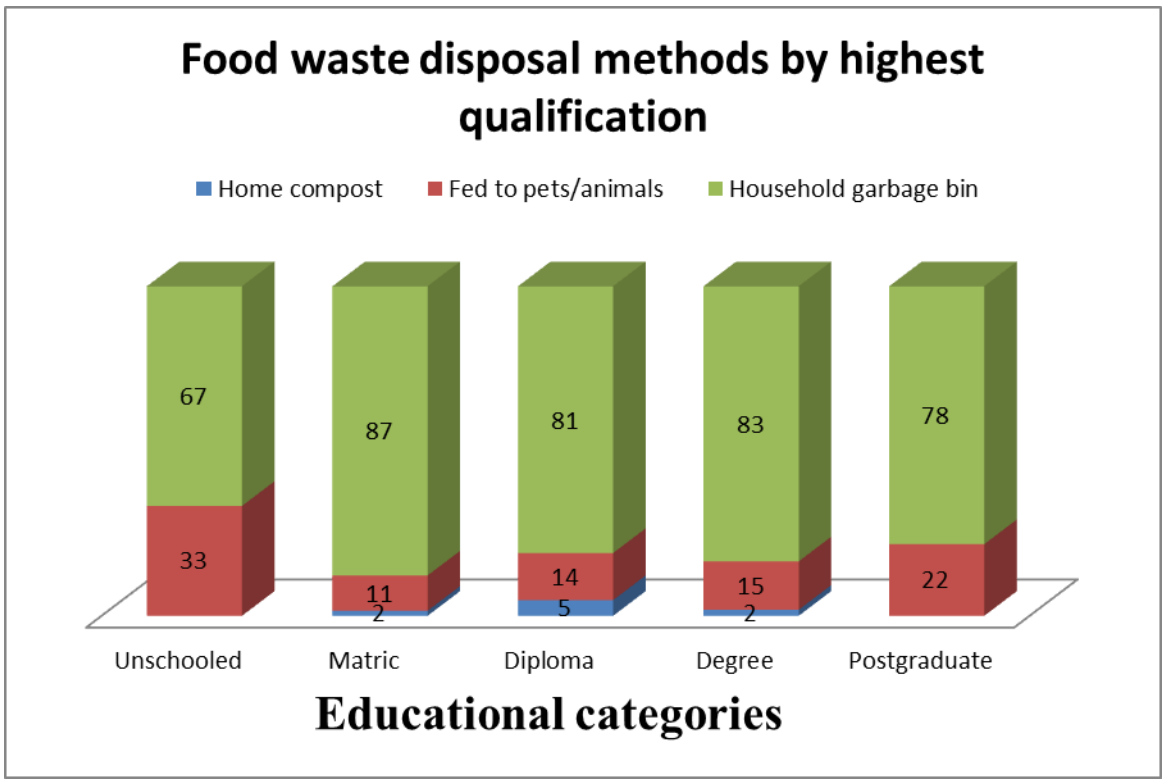

Figure 4.12: Food waste disposal method percentages by highest qualification level (n=210)

4.6.4 Food waste disposal methods by household size

Respondents' disposal methods in terms of household size are outlined in this section. The study presented three methods that respondents could employ to dispose of their food waste.

Figure 4.13 shows that respondent in 1-, 6-, 7- and 8-member households did not compost or feed their food waste to pets. However, 5-member households had the highest number of respondents (6%) who composted their food waste.

3-member households had the highest number of respondents (24%) who fed their food waste to pets, followed by 2-member households (16%) and 5-member households (11%).

All respondents in 1-, 6-, 7- and 8-member households reported that they relied solely on the household garbage bin to dispose of their food waste.

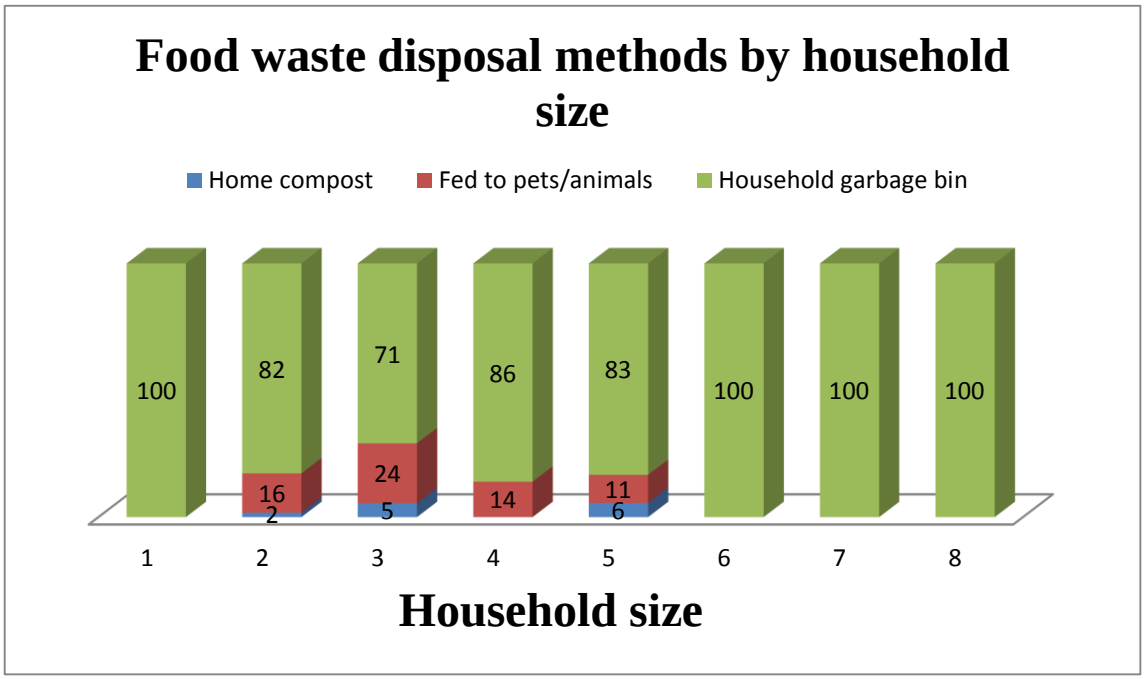

Figure 4.13: Food waste disposal method percentages by household size (n=210)

4.6.5 Food waste disposal methods by monthly income

In this section respondents' disposal methods are outlined in terms of monthly income categories. The study presented three methods that respondents could employ to dispose of their food waste.

As presented in Figure 4.14, households with a monthly income of R500 - R5 000 had the highest number of respondents who composted their food waste (6%). 2% of respondents with a monthly income of R6 000 - R9 000 composted their food waste and only 1% of those with a monthly income of R10 000+ did so. It can therefore be concluded that there is a correlation between income and food waste disposal methods; as referred to in Table 4.17, there was difference between income categories.

Households with a monthly income of R6 000 - R9 000 had the highest number (35%) of respondents who fed their food waste to pets and households with a monthly income of R10 000+ had the lowest number (4%).

95% of respondents with a monthly income of R10 000+ relied on the household garbage bin for their food waste disposal, followed by 75% with a monthly income of R500 - R5 000 and 63% with a monthly income of R6 000 - R9 000.

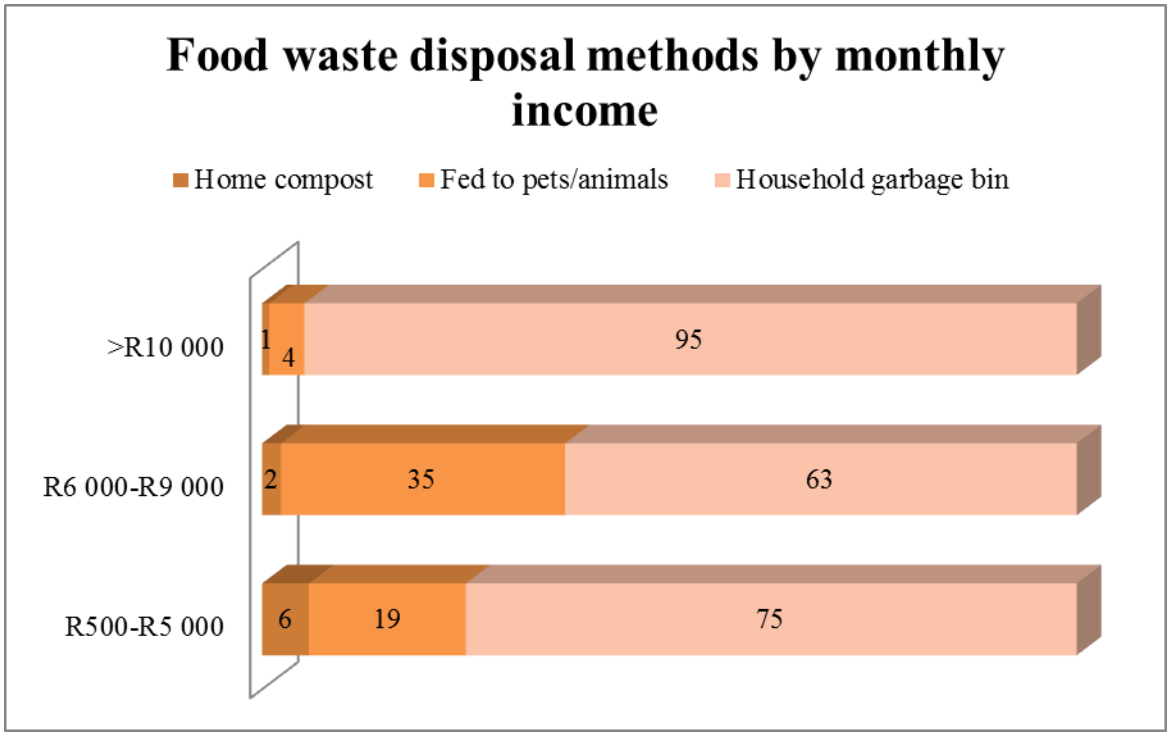

Figure 4.14: Food waste disposal method percentages by monthly income level (n=210)

4.7 Household shopping behaviour

In order to understand households' shopping behaviour and thus food wastage, respondents were asked whether they drafted a shopping list before they went shopping and if they stuck to their list. The number of respondents who indicated that they did draft a shopping list in this study was 68%, higher than the 53% found by the New South Wales (NSW) government (2011), but lower than the 82% reported by Parizeau *et al.* (2015). Of the 68% of respondents who drafted a shopping list, only 36% stuck to it. This number was lower than the 53% and 82% of respondents who stuck to their shopping list in studies by the NSW government (2011) and Parizeau *et al.* (2015), respectively.

90% of respondents owned a cooling facility in their households and 20% also owned a freezing facility. This was lower than the 54% of respondents who owned a freezing facility in a study by Parizeau *et al.* (2015). The number of respondents who owned a cooling facility in this current study was 96%, which was higher than the 62% in the study by Parizeau *et al.* (2015).

4.7.1 Geography

Some of the questions that respondents were asked in terms of geographical areas are now discussed, and they are presented in percentages. Questions such as "Do you waste food?",

“Do you generally use a shopping list?”, “Do you stick to your shopping list?”, “Do you own a cooling facility?” and “Do you own a freezing facility?” were asked.

Table 4.12: Household geographical area (n=210)

Responses		Household location											
		Atteridgeville Ext 6, 16, 17		Olievenhoutbosch Ext 36		Montana Park		Lyttelton		Silver Lakes Golf Estate		Sample	
Question number	**Responses**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
1	Yes	28	56	22	44	29	72.5	17	53	27	71	123	59
	No	22	44	28	56	11	27.5	15	47	11	29	87	41
2	Yes	32	64	26	52	30	75	23	72	32	84	143	68
	No	18	32	24	48	10	25	9	28	6	16	67	32
3	Yes	14	44	11	42	12	40	6	19	9	39	52	36
	No	18	56	15	58	18	60	26	81	14	61	91	64
4	Yes	49	98	43	86	39	97.5	32	100	38	100	201	96
	No	1	2	7	14	1	2.5	0	0	0	0	9	4
5	Yes	27	54	0	0	12	30	3	9	1	3	43	20
	No	23	46	50	100	28	70	29	91	37	97	167	80

		N=50 (24%)	N=50 (24%)	N=40 (19%)	N=32 (15%)	N=38 (18%)	N=210
Questions							
1	Do you waste food?						
2	Do you generally use a shopping list?						
3	Do you stick to your shopping list?						
4	Do you own a cooling facility?						
5	Do you own a freezing facility?						

Households in Silver Lakes Golf Estate (84%) had the highest number of respondents who drafted a shopping list before shopping for food, but only 39% stuck to the list. Households in Olievenhoutbosch Ext 36 (52%) had the lowest number of respondents who drafted a shopping list before food shopping. Of the 64% of Atteridgeville Ext 6, 16 and 17 respondents who drafted a list, 44% stuck to their list when shopping for food. This indicates that Atteridgeville Ext 6, 16 and 17 had the highest number of respondents who stuck to their shopping list. The household food purchasing behaviour of CTMM respondents shows that they did not stick to their shopping list, and this resulted in them buying more food. All Lyttelton and Silver Lakes Golf Estate respondents owned a cooling facility, while 30% of Montana Park respondents also owned a freezing facility. The study found that freezing facilities were owned by 20% (average 8.6) of the respondents.

4.7.2 Age range

Some of the questions that respondents were asked in terms of age range are now discussed, and they are presented in percentages. Questions such as “Do you waste food?”, “Do you generally use a shopping list?”, “Do you stick to your shopping list?”, “Do you own a cooling facility?” and “Do you own a freezing facility?’ were asked.

Table 4.13: Household age range (n=210)

Responses		**Household age range**													
		21-30		**31-40**		**41-50**		**51-60**		**61-70**		**70+**		**Sample**	
Question number	**Responses**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
1	Yes	57	63	34	52	19	63	11	65	2	50	0	0	123	59
	No	34	37	32	48	11	37	6	35	2	50	2	100	87	41
2	Yes	52	57	48	73	22	73	15	88	4	100	2	100	143	68
	No	39	43	18	27	8	27	2	12	0	0	0	0	67	32
3	Yes	21	40	9	19	8	36	11	73	2	50	1	50	52	36
	No	31	60	39	81	14	64	4	27	2	50	1	50	91	64
4	Yes	88	97	61	92	29	97	17	100	4	100	2	100	201	96
	No	3	3	5	8	1	3	0	0	0	0	0	0	9	4

5	Yes	21	23	12	18	7	23	3	18	0	0	0	0	43	20
	No	70	77	54	82	23	77	14	82	4	100	2	100	167	80
		N=91(43%)		N=66 (31%)		N=30 (14%)		N=17 (8%)		N=4 (2%)		N=2 (1%)		N 210	

Questions	
1	Do you waste food?
2	Do you generally use a shopping list?
3	Do you stick to your shopping list?
4	Do you own a cooling facility?
5	Do you own a freezing facility?

The majority of the respondents (68%) used a shopping list, between 56 and 89% were in the 21 - 60 year range. The highest percentage of respondents were in the 61 - 70 and 70+ (100%) groups but, seeing that the sample size was small, cannot be seen as a reliable trend. Only 36% of all respondents who indicated that they used a shopping list did not stick to it, and therefore the majority of people did not stick to a list. No particular trend could be deduced from the different sized households. 96% of all respondents indicated that they had cooling facilities, and 80% did not have freezing facilities. The highest percentage of respondents with freezing facilities were aged 21 - 30 years and 41 - 50 years, and the second highest at 18% were 31 - 40 years old and 51 - 60 years old. It must be emphasised that the results represent the findings of this study

4.7.3 Highest qualification

Some of the questions that respondents were asked in terms of highest qualification are now discussed, and they are presented in percentages. Questions such as “Do you waste food?”, “Do you generally use a shopping list?”, “Do you stick to your shopping list?”, “Do you own a cooling facility?” and “Do you own a freezing facility?” were asked.

Table 4.14: Household highest qualification level (n=210)

Responses		**Household highest qualification**											
		Unschooled		**Matric**		**Diploma**		**Degree**		**Postgraduate**		**Sample**	
Question number	**Responses**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
1	Yes	0	0	27	41	45	71	32	58	19	83	123	59
	No	3	100	39	59	18	29	23	42	4	17	87	41
2	Yes	3	100	46	70	41	65	39	71	14	61	143	68
	No	0	0	20	30	22	35	16	29	9	39	67	32
3	Yes	1	33	12	26	16	39	18	46	5	36	52	36
	No	2	67	34	74	25	61	21	54	9	64	91	64
4	Yes	3	100	63	95	58	92	54	98	23	100	201	96
	No	0	0	3	5	5	8	1	2	0	0	9	4

5	Yes	3	100	14	21	14	22	9	16	3	13	43	20
	No	0	0	52	79	49	78	46	84	20	87	167	80
		N=3 (1.43%)		N=66 (31.43)		N=63 (30%)		N=55 (26.19)		N=23 (10.95%)		N=210	

Questions	
1	Do you waste food?
2	Do you generally use a shopping list?
3	Do you stick to your shopping list?
4	Do you own a cooling facility?
5	Do you own a freezing facility?

Postgraduate respondents had the highest number (83%) that wasted food, followed by diploma and degree respondents with percentages between 59 and 69. All the other education level percentages are lower than 42%. The majority of the respondents who used shopping lists were unschooled (100%) but, seeing that the sample size was small, this cannot be seen as a reliable trend. Postgraduate, degree, diploma and matric respondents indicated that they used a shopping list with percentages between 60 and 72. All of the unschooled respondents used a shopping list before shopping for food, followed by 71% of respondents with a degree and 70% with matric. 61% of postgraduate respondents and 65% with a diploma used a shopping list when they shopped for food. All unschooled and all postgraduate respondents owned a cooling facility in their households, and all other educational levels also owned a cooling facility with percentages between 91 and 99. All unschooled

respondents owned a freezing facility, followed by diploma respondents (22%) and matric respondents (21%), but only 16% of degree respondents and 13% of respondents with a postgraduate degree owned a freezing facility.

4.7.4 Household size

In this section some of the questions that respondents were asked in terms of household size are discussed, and they are presented in percentages. Questions such as “Do you waste food?”, “Do you generally use a shopping list?”, “Do you stick to your shopping list?”, “Do you own a cooling facility?” and “Do you own a freezing facility?” were asked.

Table 4.15: Household size (n=210)

Responses		**Household size**																	
		1		**2**		**3**		**4**		**5**		**6**		**7**		**8**		**Sample**	
Question number	**Responses**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
1	Yes	14	61	37	64	36	67	28	68	6	33	0	0	1	17	1	25	123	59
	No	9	39	21	36	19	35	15	37	12	67	3	100	5	83	3	75	87	41
2	Yes	16	70	41	71	41	75	26	60	12	67	1	33	3	50	3	75	143	68
	No	17	30	17	29	14	25	17	40	6	33	2	67	3	50	1	25	67	32
3	Yes	9	56	10	24	8	20	9	35	12	100	1	100	2	67	1	33	52	36
	No	7	44	31	76	33	80	17	65	0	0	0	0	1	33	2	67	91	64
4	Yes	20	87	56	97	54	98	41	95	17	94	3	100	6	100	4	100	201	96

	No	3	13	2	3	1	2	2	5	1	6	0	0	0	0	0	0	9	4
5	Yes	2	9	6	10	16	29	8	19	6	33	0	0	4	67	1	25	43	20
	No	21	91	52	90	39	71	35	81	12	67	3	100	2	33	3	75	167	80
		N= 23 (11%)		N= 58 (28%)		N= 55 (26%)		N= 43 (20%)		N= 18 (9%)		N= 3 (1%)		N= 6 (3%)		N= 4 (2%)		N= 210	

Questions	
1	Do you waste food?
2	Do you generally use a shopping list?
3	Do you stick to your shopping list?
4	Do you own a cooling facility?
5	Do you own a freezing facility?

59% of the 1-4-member household respondents indicated that they wasted food with the highest percentages between 59 and 69. The majority of the respondents (68%) used a shopping list, and the 1-5-member household ranged between 60 and 75%. The highest percentages of respondents were for an 8-member household (75%) but, seeing that the sample size was small, this cannot be seen as a reliable trend. Only 36% of all respondents who indicated that they used a shopping list did not stick to it, and therefore the majority of people did not stick to a list. No particular trend could be deduced from the different sized households.96% of all respondents indicated that they had cooling facilities,

and 80% did not have freezing facilities. The highest percentage of respondents with freezing facilities were 7-member households, and the second highest at 33% were 6-member households. All the other households' percentages are lower than 30%.

4.7.5 Monthly income level

In this section some of the questions that respondents were asked in terms of monthly income level are discussed, and they are presented in percentages. Questions such as “Do you waste food?”, “Do you generally use a shopping list?”, “Do you stick to your shopping list?”, “Do you own a cooling facility?” and “Do you own a freezing facility?” were asked.

Table 4.16: Household income categories (n=210)

Responses		**Income categories**							
		R500 - R5 000		**R6 000 - R9 000**		**R10 000+**		**Sample**	
Question number	**Responses**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
1	Yes	17	33	31	72	75	65	123	59
	No	35	67	12	28	40	35	87	41
2	Yes	34	65	34	79	75	65	143	68
	No	18	35	9	21	40	35	67	32
3	Yes	11	32	15	44	26	35	52	36
	No	23	68	19	56	49	65	91	64

4	Yes	47	90	40	93	114	99	201	96
	No	5	10	3	7	1	1	9	4
5	Yes	16	31	8	19	19	17	43	20
	No	36	69	35	81	96	83	167	80
		N=52 (25%)		N=43 (20%)		N=115 (55%)		N=210	

Questions	
1	Do you waste food?
2	Do you generally use a shopping list?
3	Do you stick to your shopping list?
4	Do you own a cooling facility?
5	Do you own a freezing facility?

Respondents who drafted a shopping list before shopping for food (79%) had a monthly income of R6 000 - R9 000. However, the least number of respondents at 65% each who drafted a shopping list fell into the monthly income category of R500 - R5 000 and R10 000+. The study shows that of the 65% respondents with a monthly income of R10 000+, 35% stuck to their shopping list, and 32% of respondents with a monthly income of R500 - R5 000 stuck to their shopping list. Over 89% of respondents with a monthly income of R10 000+ and R500 - R5 000 owned a cooling facility, while the majority of respondents (31%) with a monthly income of R500 - R5 000 owned freezing facilities.

4.8 Results of statistical analysis

4.8.1 Correlation between income categories and food wastage

Chi-square results for the different income categories and questions related to food wastage are shown in Table 4.17. Any p-value of < 0.05 is considered statistically significant, i.e. an indication of an underlying consistent, non-random pattern. Any p-value of > 0.05 is considered not statistically significant. More details on the chi-square method were given in section 3.6 of this thesis.

Table 4.17: Chi-square results for the different income categories and questions related to food wastage

Questions regarding income categories	**P-value**	**Interpretation**
Do you waste food	The p-value is 0.0001, considered statistically significant	Differences between income categories shown
Drawn by special offers	The p-value is 0.0015, considered statistically significant	Differences between income categories shown
Do you use shopping list	The p-value is 0.2233, considered not statistically significant	No differences between income categories shown
Do you stick to shopping list	The p-value is 0.5452, considered not statistically significant	No differences between income categories shown
Do you use leftovers in any way	The p-value is 0.0007, considered statistically significant	Differences between income categories shown
Food waste disposal methods (Garbage bin, composting and feeding animals)	The p-value is 0.0001, considered statistically significant	Differences between income categories shown
Type of food wasted (Pap, rice, bread, and fruit and vegetables	The p-value is 0.0771, considered not statistically significant	No differences between income categories shown
Reasons for wasting food	The p-value is 0.1348, considered not statistically significant	No differences between income categories shown

The chi-square results show that there were statistically significant differences at ($p < 0.05$) in the values of questions regarding whether respondents wasted food, were attracted by special offers and used leftovers and which food waste disposal methods they used. There was no statistically significant difference in the results of the questions on whether they used a shopping list, stuck to the shopping list, the type of food they wasted and the reasons for wasting food.

4.8.2 Correlation between age group and food wastage

The chi-square results for the different age groups and questions related to food wastage are shown in Table 4.18. Any p-value of > 0.05 is considered not statistically significant. More details on the chi-square method were given in section 3.6 of this thesis.

Table 4.18: Chi-square results for the different age groups and questions related to food wastage

Questions regarding age group	**P-value**	**Interpretation**
Do you waste food	The p-value is 0.4057, considered not statistically significant	No differences between age group shown
Drawn by special offers	The p-value is 0.0001, considered statistically significant	Differences between age group shown
Do you use shopping list	The p-value is 0.0183, considered statistically significant	Differences between age group shown
Do you stick to shopping list	The p-value is 0.0002, considered statistically significant	Differences between age group shown
Do you use leftovers in any way	The p-value is 0.0001, considered statistically significant	Differences between age group shown

The chi-square results show that there was a statistically significant difference at ($p < 0.05$) in the values of questions regarding whether respondents were attracted by special offers, used leftovers, used a shopping list and stuck to the shopping list. There were no statistically significant differences in questions regarding whether respondents wasted food.

4.8.3 Correlation between household size and food wastage

Chi-square results for the different household sizes and questions related to food wastage are shown in Table 4.19. Any p-value of > 0.05 is considered not statistically significant. More details on the chi-square method were given in section 3.6 of this thesis.

Table 4.19: Chi-square results for the different household sizes and questions related to food wastage

Questions regarding household size 1 - 6+ family members	**P-value**	**Interpretation**
Do you waste food	The p-value is 0.0043, considered statistically significant	Differences between household size shown
Drawn by special offers	The p-value is 0.0001, considered statistically significant	Differences between household size shown
Do you use shopping list	The p-value is 0.149, considered not statistically significant	No differences between household size shown
Do you stick to shopping list	The p-value is 0.0001, considered statistically significant	Differences between household size shown
Do you use leftovers in any way	The p-value is 0.0001, considered statistically significant	Differences between household size shown

The chi-square results show that there were statistically significant differences at ($p < 0.05$) in the values of questions regarding whether respondents wasted food, were attracted by special offers, stuck to a shopping list and used leftovers. There were no statistically significant differences in questions regarding whether they used a shopping list.

4.9 Conclusion

The study found that there were more female than male respondents, and the majority of the respondents were 21 - 30 years of age. More than 90% of the respondents indicated that they had some form of education (e.g. certificate, diploma or degree). The majority who participated in this study were from 2-member households, with Silver Lakes Golf Estate having the highest number of respondents in 2-member households. The study shows that the majority of the respondents had a monthly income of over R10 000, followed by respondents receiving a monthly income ranging from R500 - R5 000 and respondents with a monthly income of R6 000 - R9 000.

There were four types of food wasted in this study: pap, bread, rice and fruit and vegetables. The majority of people living in Atteridgeville Ext 6, 16 and 17 and Olievenhoutbosch Ext 36 wasted pap as a daily meal. In suburbs such as Montana Park and Silver Lakes, respondents ultimately wasted rice, while respondents in Silver Lakes Golf Estate and Lyttelton wasted bread. Respondents wasting fruit and vegetables the most were from Lyttelton. There was a difference of 9% between respondents who wasted pap and rice; this may be because households from higher income areas eat more rice compared to lower income areas where pap is eaten more.

It was found that respondents with a monthly income of R500 - R5 000 wasted 44% of pap in their households and respondents with a monthly income of R6 000 - R9 000 wasted bread and rice in their households. The majority of respondents were not attracted by special offers in this study. The study found that respondents also wasted food because they bought too much food.

Another reason for respondents wasting food was that they cooked too much food; they prepared more than what their family members could consume. Respondents indicated that they wasted food because fruit and vegetables went off, food residue (leftover from pots/cooking) and poor storage. Respondents with matric wasted fruit and vegetables because they went off, and only few postgraduates did the same. It was found that

respondents with a monthly income of R10 000+ wasted food mostly because they bought too much and of these, respondents wasted food due to cooking too much. It was statistically proven that there is a relationship between income level and food waste as well as household size and food waste to a confidence level of $p < 0.0001$ difference between income categories.

At an average of 6 kg of food in a period of three weeks, households with more family members wasted less food compared to households with fewer members. This is because the former can share more and finish food which is bought or prepared. There is a need to confirm this finding with more representative samples of 5-, 6-, 7- and 8-member households because 1- and 2-member households wasted more than 3- and 4-member households. Generally, people are wasteful and the amount of food wasted at household level is higher than would be expected in a developing country (Gustavsson *et al*., 2011). This study found that the less income earned, the more food wasted, though there was no large difference in the amount of food wasted and household income level.

The majority of the respondents relied on the household garbage bin, i.e. municipal waste collection services, to dispose of food. Numerous respondents fed their food waste to pets and a small number of respondents composted food waste to produce compost for their garden. The higher number of respondents who relied on the household garbage bin may be an indication that consumers do not care about the environment which they live in because they do not know about the environmental impacts of food waste (Lyndhurst, 2007).

The researcher distributed 210 pamphlets to the participants of this study on how to compost, what needs to be composted or not, why composting should be done and composting troubleshooting (Annexure F). The researcher also distributed 210 pamphlets to the participants on how they would benefit if they focused on growing their own organic food and how they could start their own garden (Annexure G); these are possible mitigation strategies that the researcher suggested to minimise households' food wastage in the selected areas of CTMM. Due to time constraints, there was no follow-up on whether households were composting or growing their own food.

The next chapter of conclusions and recommendations will summarise the findings of this study and outline suggestions for future research.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The aim and objectives of this study were reached. The study was carried out to assess households' food waste in the selected five areas of the CTMM. The assessment was conducted by means of a face-to-face questionnaire approach and the actual collection and weighing of the food wasted at household level. This chapter summarises the study findings in terms of demographics, including income categories, highest qualification, household size and age range. The type of food wasted the most, the amount of food wasted per week in kilograms, food waste disposal methods, the relationship between household income level and food waste, and the drivers that cause households to waste food are also summarised. Recommendations from the findings are presented and suggestions for further research are outlined in this chapter.

5.2 Summary of the study findings

Of the 210 households that participated in this study, 58% of the respondents were females and 42% were males. This is an indication that women are more responsible for the household groceries and food preparations. The most dominant age group that participated in this study was 21 - 30 years (43%).

The study found that most (55%) of the respondents had a monthly income of R10 000+. The higher number of households with formal education may have contributed to their better lifestyle; this shows that there are benefits of acquiring education in one's life for better jobs. The results of this study show that most (28%) of the participants were from 2-member households, followed by 3-member households. Most (22%) of the respondents with a postgraduate degree as their highest qualification were from 1-member households, while there were no postgraduate respondents from 5- to 8-member households.

To assess the type of food wasted in the households, respondents answered that staple food such as maize porridge (pap) was wasted more (35%), followed by rice (26%), bread (25%) and fruit and vegetables (14%). The reason pap was wasted by many households

may be that food waste is determined by the culture and the South African population has diverse food preferences which vary by location.

Postgraduate respondents mainly wasted fruit and vegetables. There seems to be a connection between respondents who wasted fruit and vegetables and qualification level. Therefore, this might be the reason why the study revealed that 14% of respondents wasted fruit and vegetables. The study showed that the more family members in the household, the more they wasted pap, and 44% of the respondents with a monthly income of R500 - R5 000 wasted pap.

The actual results in this study reveal that 92% of respondents wasted food when only 59% of households self-reported that they wasted food. Households wasted an average total of 6 kg per week per household. When wasting food, automatically the money spent on buying that food is wasted. The study shows that 83% of the respondents relied on the household garbage bin as their food waste disposal method and only 3% of respondents composted their food waste, while others fed their food waste to pets (14%). It is further interesting to note that composting was done mostly by the 21 - 40 year old group.

There was an increase in food wasted with age range; the older the respondents, the more they wasted food; respondents aged 21 – 30 years wasted less food (total average of 5.4 kg per week. Respondents with a diploma wasted food more compared to other respondents. The 5-member households wasted more food compared to other household sizes. There was a decrease in food wasted with monthly income levels: the higher the income level, the less food wasted. Respondents with a monthly income of R10 000+ wasted less food compared to other income groups. It was therefore statistically proven that there is a relationship between income level and food waste where the confidence level was a $p < 0.0001$ difference between income categories; it was observed that more income does not necessarily lead to more food waste, but that less income does lead to more food waste.

Six reasons that drive households to throw away food were investigated: cooking too much, buying too much, special offers, fruit and vegetables going off, food residue and poor storage. The study found that the main driver of wasting food is cooking too much. Households prepare more than what their family members can consume. It was reported

that 33% of unschooled respondents were from Atteridgeville Ext 6, 16 and 17 and Olievenhoutbosch Ext 36, which are low-income areas. These respondents wasted food because of poor storage. At 13%, postgraduate respondents wasted food mostly through food residue. Respondents of 2-member households wasted more food because they bought too much food and this is because they were more attracted by special offers.

5.3 Conclusions

This chapter presented the findings in the selected areas of CTMM. It was discovered that there is a relationship between income level and food waste. Households waste an average total of 6 kg per week per household. Though households with a higher income waste more food, there is not much difference between low and medium income. Households with a monthly income of R500 - R5 000 waste more food than households that have an income of more than R5 000. The statistical chi-square test was applied and a probability value (p-value) of < 0.0001 was obtained, indicating that the difference between income categories was more than just a random pattern. (Note that any p-value of < 0.05 is considered statistically significant, i.e. an indication of an underlying consistent, non-random pattern.)

Food waste has negative impacts: it has environmental impacts such as climate change, it results in insecurity of food supply, and resources used during food production are wasted. Through questions asked during the actual weighing, it seems that CTMM households are not aware of the environmental impacts of food waste, and that is why they waste food. Households might continue to waste food and impact the environment if nothing is done to educate them about the impact caused by food waste. The study concludes that regardless of the National Waste Management Strategy's target to divert waste from landfills, there are no active and visible management practices in the CTMM that specifically focus on doing so.

5.4 Recommendations

The findings of this study reveal that for households to reduce the amount of food waste, several recommendations can be made which will lead to better management of households' food waste in the CTMM and possibly in all other municipalities in South Africa. The outcomes of this study have led to the following recommendations:

5.4.1 In the supermarket

Households must draft a shopping list before food shopping. This will help them to plan their meals and they will know what to purchase when they get to the supermarket instead of just buying unnecessary food that will end up generating unnecessary waste. They should be encouraged to use a shopping list and stick to it during shopping for food. This recommendation is strongly emphasised because of the high number of respondents (36%) who did not stick to their shopping list. By not sticking to the shopping list households end up trapped by Buy One Get One Free (BOGOF) special offers and end up buying too much food which is not planned. These offers encourage customers to purchase food items that end up unused and discarded as waste. It is also recommended that households buy less food and buy food that lasts longer.

5.4.2 In the kitchen

It is recommended that households prepare only the amount of food that they can consume and finish. This is caused by cooking too much food and throwing leftovers into the garbage bin. Households must take into consideration the size of the food portion when serving their family members. The study also found that there is a need to encourage households to store food properly as illustrated on the label of the product. Households should know which food stays in the cooling facility, freezer facility or at room temperature.

5.4.3 The use of leftovers

The findings of this study reveal that only 17% of respondents used leftovers. This means that 83% of respondents in this study just throw away their leftovers. This study recommends that households use leftovers either by eating them, using them for compost or feeding them to pets. Households must keep their leftovers in the freezer for another day or in the cooling facility and eat them the following day rather than throwing their leftovers in the household garbage bin. To reduce the amount of leftovers wasted in households, it is also recommended that the CTMM provide recipes using leftovers. There is a need to train households in food management skills to reduce food waste.

5.4.4 Disposal methods and separation

As indicated in this study, 83.3% of respondents relied on the household garbage bin for their food waste disposal method. This is an opportunity for CTMM to raise awareness on composting and provide separate bins for composting as an alternative to landfills. The CTMM may consider using food waste as a biofuel input material for biodigesters to generate gas such as electricity. The CTMM must prohibit food waste from being disposed of with general waste in the municipality bins because it ends up at the landfills which contributes to environmental pollution; household food waste should be stored and collected separately for the purpose of recycling. It is recommended that food waste separation at source be started in household kitchens.

Households must be provided with different buckets, barrels or bins for waste collection so that they can separate food waste generated. The buckets or barrels that will be used for food waste collection must be leakproof, waterproof and covered when not used. This is to reduce odour, insects and other pests that may be attracted by food waste. Households' food waste must be collected by recycling companies at the same frequency as garbage is removed by the municipality in that community area.

5.4.5 Food waste recycling and awareness

This is an opportunity for the CTMM to raise awareness of reducing household food waste and to educate people on the impacts of food waste. Additionally, the CTMM needs to raise awareness to encourage households to recycle food waste and the benefits of doing so. To reduce the amount of GHG emissions in the environment caused by food waste, the CTMM must create household awareness and educate people about food waste, separating food waste at source and recycling food waste. It is recommended that environmental education be used as a way to raise household food waste awareness in order to encourage households to recognise the need for recycling their food waste and the benefits of recycling. This recommendation is highlighted by the fact that only 2.4% of respondents composted their food waste while 83.3% of the households just threw away food waste into the garbage bin. Composting might not be the solution but it is also a way to minimise food waste. This shows that most households are not aware of impact of food wastage and there is a need for the CTMM to develop strategies that will focus on reducing food waste and to fund projects that aim at promoting a green environment. The study recommends

that food waste awareness campaigns be launched in communities, schools and companies. In order to reach as much of the population as possible, the study recommends media campaigns.

There should be ways to start composting in the community, e.g. by using Bokashi to compost food waste; this can reduce GHG emissions because it will keep food waste from rotting. There is also a need to educate households on what food waste is and its impact on the environment because many households do not consider themselves as food wasters. It is necessary to raise awareness on improving households' economics skills and the financial impacts of buying specials. If the food ends up being wasted, the households do not save any money, but perhaps even end up wasting money.

5.5 Suggestions for further research

Throughout the course of this study, it was found that there are opportunities for further research on assessing households' food waste. Further research is required on the assessment of household food waste to reduce food waste and divert it from landfills. Further areas for research are as follows:

i. There is a need to assess households' food waste and collect data in other municipalities in South Africa as this study data is only from one municipality.
ii. Food waste at all stages of the food supply chain in South Africa can be assessed in order to understand the drivers of food losses because households are not the only source of food waste.
iii. The amount of food waste disposed of down the sink, composted or fed to pets in the households could be quantified, as this study only focused on the food waste that ends up in the household garbage bin.
iv. The cost of food wasted in households could be determined, since this was not evaluated in this study.
v. There is a need to investigate how packaging influences food waste at household level and the food supply chain in South Africa.
vi. There is a need to evaluate household food wastage during different seasons so to compare data as seasonality of certain food products most definitely influences consumers' consumption and therefore their wastage.

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ANNEXURES

Annexure A: Questionnaire on food waste in English

Questionnaire No._____; Suburb/Location: Atteridgeville Ext 6, 16, and 17, Lyttelton, Montana Park, Olievenhoutbosch Ext 36 and Silver Lakes Golf Estate

(Please tick whichever is applicable)

GENERAL:

1. What is your gender? [ ] Male [ ] Female
2. How many persons live in your household? [ ] 1, [ ] 2, [ ] 3, [ ] 4, [ ] 5, [ ] 6, [ ] 7, [ ] 8
3. What kind of ownership (accommodation) are you living in? [ ] Rental or [ ] Own house
4. Which age group are you? [ ] 18-20, [ ] 21-30, [ ] 31-40, [ ] 41-50, [ ] 51-60, [ ] 61-70, [ ] 70+_____
5. What is your highest qualification? [ ] Unschooled, [ ] Matric, [ ] Diploma, [ ] Degree, [ ] Post Graduate
6. What is your source of income? [ ] Employed, [ ] self-employed, [ ] Retired, [ ] House wife/husband [ ] Student or [ ] other source of income [ ] _____
7. What is your monthly income? [ ] R500 – R5000, [ ] R6000- R9000, [ ] R10000+

HOUSEHOLD BEHAVIOUR:

8. Do you have a garden? [ ] Yes [ ] No
9. Do you grow own food? [ ] Yes [ ] No
10. How often do you go shopping for food? [ ]Every day, [ ] Weekly, [ ] Monthly
11. Do you find you are drawn to cheaply priced products or special offers? (Buy one get one free, 3 for 2, half price) [ ] Yes [ ] No
12. Do you generally use a shopping list? [ ] Yes [ ] No 12.1 If Yes do you stick to the shopping list?

EATING HABITS:

13. How often do you prepare food in your household? [ ] 0, [ ] 1, [ ] 2, or [ ] 3 times in a day
14. Do you think you do waste food? [ ] Yes [ ] No
15. What type of food do you waste the most in your house? _____
16. Is usually everything eaten up? [ ] Rarely, [ ] Sometimes, [ ] Frequently or [ ] Regularly

STORAGE:

17. Do you have fridge? [ ] Yes [ ] No
18. Do you have a Freezer? [ ] Yes [ ] No
19. What are your criteria to proof the edibility of food in your storage / fridge? _____
19.1 [ ] Date of expiry 19.2 [ ] Appearance 19.3 [ ] Smell 19.4 [ ] Taste

DISPOSAL:

20. Do you use leftovers in any way? [ ] Yes [ ] No
20.1 If Yes in Q20, How do you use leftovers? _____
21. When or why do you throw away food? _____
22. Amount of food waste weighed using a kitchen scale per week in selected households [ ] 1 ___ [ ] 2 ___ [ ] 3 ___

THE END

THANK YOU FOR YOUR PATIENCE

Annexure B: Permission to conduct study

CITY OF TSHWANE
IGNITING EXCELLENCE

Environmental Management Department
Waste Management Division

Room 16 | 1st Floor | Old Mercedes Benz Building | Francis Baard Street | Pretoria | 0002
PO Box 1454 | Pretoria | 0001
Tel: 012 358 0550 | Fax: 086 620 4533
Email: faithmab@tshwane.gov.za | www.tshwane.gov.za | www.facebook.com/CityOf Tshwane

My ref:
Your ref:
Contact person: Faith Mabindisa
Section/Unit: Waste Management

Tel: 012 358 0550
Fax:
Email: faithmab@tshwane.gov.za

To: Fhumulani Ruth Ramukhwatho

From: Executive Director: Waste Management
F Mabindisa

26 February 2014

RE:LETTER REQUESTING PERMISSION TO CONDUCT RESEARCH STUDY IN ATTERIDGEVILLE, CENTURION, OLIEVENHOUTBOSCH, MONTANA AND SAVANNAH

The Waste Management Division hereby acknowledges receipt of the letter requesting permission to conduct research study in City of Tshwane area dated, 04 February 2014.

The permission is therefore granted to conduct the research in the above mentioned areas and kindly advise that you inform the Regional Waste Management on the day you conduct research in their areas:

Attridgeville Area-Region 3
Solly Moatshe /Elsie Makinta
012 358 0549 /0824575993
SollyMoa@tshwane.gov.za
ElsieMa@tshwane.gov.za

Centurion and Olivenhoutbosch Area-Region 4
Mosidi Ngati
012 358 0277
MosidiN@tshwane.gov.za

Montana-Region 2
Nompumuza Maphosa
012 358 7957
NompumuzaMa@tshwane.gov.za

Savannah-Region 6
Joel Marumo
012 358 8787
JoelMar@tshwane.gov.za

Faith Mabindisa
EXECUTIVE DIRECTOR: WASTE MANAGEMENT DIVISION

Annexure C: Ethical approval

UNISA university of south africa

2014-03-20

Ref. Nr.: 2014/CAES/013

To:
Student: FR Ramukhwatho **Student nr: 49028464**
Supervisor: Mrs R Du Plessis
Department of Environmental Sciences
College of Agriculture and Environmental Sciences

Dear Mrs Du Plessis and Ms Ramukhwatho

Request for Ethical approval for the following research project:

Assessment of the household food wastage in a developing country: A case study of four areas in City of Tshwane Metropolitan Municipality (CTMM), Gauteng, South Africa

The application for ethical clearance in respect of the above mentioned research has been reviewed by the Research Ethics Review Committee of the College of Agriculture and Environmental Sciences, Unisa. Ethics clearance for the above mentioned project (Ref. Nr.: 2014/CAES/013) **is given for the duration of the research project.**

The researcher is requested to provide permission letters from the relevant churches from which the participants will be recruited. The researcher is also requested to provide the committee with sufficient information regarding the way the risk to the researcher and Unisa will be dealt with as waste handling does hold risk to both parties. This feedback should be provided to the ethics committee within two weeks, or the approval will be withdrawn.

Please be advised that should any part of the research methodology change in any way it is the responsibility of the researcher to inform the CAES Ethics committee of such changes. In this instance a memo should be submitted to the Ethics Committee in which the changes are identified and fully explained.

The Ethics Committee wishes you all the best with this research undertaking.

Kind regards,

Prof E Kempen,
CAES Ethics Review Committee Chair

MLi please note permission letters to be submitted

Prof MJ Linington
Executive Dean: College of Agriculture and Environmental Sciences

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 429 12 429 4150
www.unisa.ac.za

2014-04-10

Ref. Nr.: 2014/CAES/013

Student nr: 49028464

To:

Ethics Committee

Department of Environmental Sciences

College of Agriculture and Environmental Sciences

Dear Prof E Kempen

RE: Request for the ethical approval for the following research project:

Assessment of the household food wastage in a developing country: A case study of four areas in city of Tshwane Metropolitan Municipality (CTMM) Gauteng, South Africa

The researcher will be travelling using public transport, going house to house distributing the questionnaires. The risk is using public travel (taxis) but is often used by the

researcher. She is therefore familiar with it. The risk will be lessened by travelling only during the day time. The risk of visiting people will be lessened by restricting visits to day time and it will be where families stay together. The researcher will not visit or engage persons living alone. Whenever the need arises the researcher will wear an overall, gloves and a mask as Personal Protective Equipment when handling food waste.

Participants will be recruited house to house from different areas (not churches) of the city of Tshwane municipality wherein there are people whom I know. Participants will then answer the questionnaires and from those questionnaires, households will be selected randomly so that their food waste can be weighed.

Kind regards,

Ramukhwatho FR

Annexure D: Household food wastage consent form

CONSENT FORM

TITLE OF RESEARCH PROJECT

Household food wastage assessment in a developing Country: Tshwane, South Africa: A case study of Atteridgeville Ext 6, 16, and 17, Lyttelton, Montana Park, Olievenhoutbosch Ext 36 and Silver Lakes Golf Estate.

Dear Mr/Mrs/Miss/Ms _____ Date 15/08/2013

NATURE AND PURPOSE OF THE STUDY

Household food waste is likely to be only a small component of the overall food waste problem in South Africa, but the total costs to society of household food waste are estimated at approximately R21.7 billion per annum, or 0,82% of the annual South African GDP. Food waste has a triple negative impact, which includes environmental impacts of food waste disposed at landfill and consequent pollution, socio-economic impacts associated with food insecurity and atmospheric emissions derived during food production, processing and distribution to consumers contributing to climate change. Because there is no reliable source of data on household waste generation rates in South Africa. It is important to provide data on the types and causes of food waste in South African townships and suburbs so to suggest possible remedies for such wastage**.**

RESEARCH PROCESS

The study requires your participation in the following manner:

• +- 50 households are required to answer the Questionnaire such as when do they throw food away; what types of food are thrown away the most and the amount of food waste that are thrown away;

• Respondents may be representative of any ethnic group, age or gender;

• Basic demographic information will be required from you such as age, cell number, occupation, income and wellness;

• Food waste will be weighed for 3 weeks.

NOTIFICATION THAT PHOTOGRAPHIC MATERIAL, TAPE RECORDINGS WILL BE REQUIRED

Phone camera will be used to take pictures of food waste before weighing.

CONFIDENTIALITY

The opinions of the households regarding food waste are viewed as strictly confidential, and only supervisors of the research study will have access to the information. The identity of household will not be published in a dissertation or in journals when publishing the study data. Your anonymity is therefore ensured.

WITHDRAWAL CLAUSE

I understand that I may withdraw from participating in this study at any time. I therefore participate voluntarily until such time as I request otherwise.

POTENTIAL BENEFITS OF THE STUDY

The amount of food wasted and lost around the world is staggering and it is food that could be used to feed the world's growing population as well as those in hunger today. It is also an unnecessary waste of the land, water and energy resources that were used in the production, processing and distribution of this food. This study will provide data on the types and causes of food waste in South African townships and suburbs so to suggest possible remedies for such wastage, such as composting (wherein household will be able compost their food waste and provide a soil conditioner for their gardens). The study will have an impact for planning and execution of household food waste management in the City of Tshwane Metropolitan Municipality (CTMM). Participants will be educated on how to plan their meal and also on how to use a shopping list.

INFORMATION

If I have any questions concerning the study, I may contact the researcher, Miss Fhumulani Ramukhwatho, Unisa, Cell: 073 744 7244, supervisor, Mrs Roelien Du Plessis, at the Department of Environmental Sciences, Florida Campus, Unisa, Tel: 011 471 2584 or Dr Suzan Oelofse, at the Natural Resources and Environment, Pretoria, CSIR, Tel: 012 841 4333.

CONSENT

I, …… have read the above information relating to the project and have also heard the verbal version, and declare that I understand it. I have been afforded the opportunity to discuss relevant aspects of the project with the project leader, and hereby declare that I agree voluntarily to participate in the project.

I indemnify the university and any employee or student of the university against any liability that I may incur during the course of the project.

I further undertake to make no claim against the university in respect of damages to my person or reputation that may be incurred as a result of the project or through the fault of other participants, unless resulting from negligence on the part of the university, its employees or students.

I have received a signed copy of this consent form.

Signature of participant: .....

Signed at …… on ……

WITNESSES

1 .....

2 ……

Annexure E: Demographic profile of questionnaire respondents

		Atteridgeville Ext 6, 16 and 17	**Olievenhoutbosch Ext 36**	**Montana Park**	**Lyttelton**	**Silver Lakes Golf Estate**	**Total**
Variable	**Selection provided**	**% of respondents (n=50)**	**% of respondents (n=50)**	**% of respondents (n=40)**	**% of respondents (n=32)**	**% of respondents (n=38)**	**% of respondents (n=210)**
Gender	Male	36	42	42	34	55	42
	Female	64	58	58	66	45	58
Age	18-21	0	0	0	0	0	0
	21-30	54	56	17.5	47	37	43
	31-40	26	32	37.5	28	34	31
	41-50	8	6	28	22	13	14
	51-60	6	6	15	3	11	8
	61-70	2	0	2.5	0	5	2
	>70	4	0	0	0	0	1
Level of education	Unschooled	4	2	0	0	0	1
	Matric	48	46	10	34	11	31
	Diploma	30	32	25	28	34	30
	Degree	12	20	53	22	29	26
	Postgraduate	6	0	12.5	16	26	11
Household size	1	6	12	0	19	21	11
	2	8	34	30	31	39	28
	3	16	22	45	25	26	26
	4	36	18	17.5	16	11	20

	5 6 7 8	20 2 10 2	4 4 0 6	5 0 3 0	9 0 0 0	3 0 0 0	9 1 3 2
Monthly household income	R500-R5 000 R6 000-R9 000 >R10 000	56 18 26	44 22 34	3 3 95	0 41 59	3 24 74	25 20 55

Annexure F: Composting pamphlet

FOOD WASTE COMPOSTING

Composting is a simple free way of recycling organic materials to restores vitality to depleted soil. Compost is a dark, crumbly, and earthy smelling form of decomposing; it is organic material that can be used to mulches and soil amendments instead of commercial fertilizers. Compost is cheap and you can make it without spending a cent. Also it loosens clay soils and helps sandy soils retain water. Adding compost improves soil fertility and stimulates healthy root development in plants.

Healthy soil produces healthy plants and one of the best ways you can build healthy soil in your garden and lawn is by using compost. With a small investment in time, you can easily make compost with food scraps in your own yard and improve the health and appearance of your yard, save money on fertilizers and mulch, all while conserving natural resources and guarding the wellbeing of your family and pets.

Why Compost?

Composting is the most practical and convenient way to handle your yard and food wastes:

- **Good for the environment:** It saves money by reducing the need to buy chemical fertilizers or compost to add on your garden
- **Soil conditioner:** It improves soil structure and texture, increases the soil's ability to hold both water and air, improves soil fertility, and stimulates healthy root development in plants.
- **Introduces beneficial organisms to the soil:** It encourages the production of beneficial bacteria and fungi that break down organic matter to create humus, a rich nutrient-filled material.
- **Recycles kitchen and yard waste:** It reduces methane emissions from landfills and lowers your carbon footprint.
- **Reduces landfill waste:** Most landfills in South Africa are filling up; many have already closed down. One-third of landfill waste is made up of compostable materials.

Materials for Composting

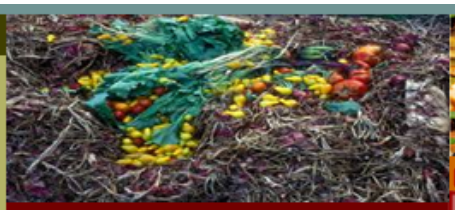
1. Bin or Pile? A pile works great for just leaves and grass clippings, but when you want to incorporate food waste; it's time to use a bin to prevent rodents. Closed-top bins include turning units, stacking bins, and bins with flip tops.
2. Space. Select a dry, shady, or partly shady spot near a water source and preferably out of sight for your compost pile or bin. Ideally, the compost area should be at least three feet wide by three feet deep by three feet tall (one cubic yard). This size provides enough food and insulation to keep the organisms in the compost warm and happy and working hard. However, piles can be larger or smaller and work just fine if managed well.
3. Browns such as dry leaves, small branches, and twigs, straw, sawdust, and used potting soil for carbon and greens such as fresh grass clippings, green leaves, soft garden pruning's, vegetable and fruit peels, coffee grounds, and tea bags for nitrogen, air for organisms, and water for moisture.

COMPOSTING METHOD

- Select a dry, shady spot near a water source for your compost pile or bin.
- Add brown and green materials as they are collected, making sure larger pieces are chopped or shredded.
- Moisten dry materials as they are added.
- Once your compost pile is established, mix grass clippings and green waste into the pile and bury fruit and vegetable waste under 10 inches of compost material.
- Optional: Cover top of compost with a tarp to keep it moist. When the material at the bottom is dark and rich in colour, your compost is ready to use.
- The resulting compost can be applied to lawns and gardens to help condition the soil and replenish nutrients. Compost should not be used as potting soil for house plants because it may still contain vegetable and grass seeds.

What not to compost

- Pet wastes, such as dog or cat faeces, soiled cat litter
- Meat or meat waste, such as bones, fat, gristle, skin.
- Sea food scraps e.g. Fish or fish waste, etc.
- Grease and oils of any kind
- Coal or charcoal ash
- Treated or painted wood
- Metals, plastic, glass
- Dairy products, such as cheese, butter, cottage etc.



What to add to Compost

Greens

- All Vegetable, fruits and food scraps
- Tea leaves and tea bags
- Grains (cooked or uncooked): rice, barley
- Coffee grounds, tea bags, filters
- Fruit or vegetable pulp from juicing
- Grass clippings
- Old bread, donuts, cookies, crackers, pizza crust, and noodles

Browns:

- Egg shells
- Nut shell
- Old newspapers (wet)
- Sawdust
- Fallen leaves
- Vacuum cleaner dust
- Human and animal hair
- Wood ash
- Outdated boxed foods from the pantry
- Corn stalks
- Cotton fabric
- Cow, horse, sheep, chicken and rabbit manures

Composting pile troubleshooting

Problem	Cause(s)	Solution(s)
The pile smells bad	Insufficient air or too much moisture	Turn the pile if not enough air Add dry materials if too moist
The pile does not heat up	Insufficient moisture OR Pile too small OR Lack of nitrogen-rich material OR Not enough air/ Cold weather	Add water if dry Build pile to at least 3' x 3' x 3' Mix in grass clippings or fruit/ vegetable scraps Chip or grind materials
The pile attracts flies, rodents, or pets	Pile contains bones, meat, fatty or starchy foods, or animal manure	Alter materials added to pile; bury fruit/ vegetable scraps in the middle of the pile, or under 8" to 10" inches of soil, or compost them in a worm bin.

For more information on composting: www.unisa.ac.za/

November 2014

Annexure G: Benefits of growing own organic food pamphlet

Some of the benefits of growing own organic food

1. Improve your health

many studies have shown that organically grown food has more minerals and nutrients that we need than food grown with synthetic pesticides. There's a good reason why many chefs use organic foods in their recipes—they taste better.

2. Save money

growing your own food can help cut the cost of the grocery bill. Instead of spending hundreds of Rand at the grocery store on foods that don't really nourish you, spend time in the garden, outside, exercising, learning to grow your own food.

3. Protect the planet

Growing food in your own garden is also incredibly beneficial to the environment. You will be growing your food organically without using harmful and toxic pesticides and herbicides which pollute the air and water. The average child receives four times more exposure than an adult to at least eight widely used cancer-causing pesticides in food. Food choices you make now will impact your child's future health.

5. Protect water quality

Water makes up two-thirds of our body mass and covers three-fourths of the planet. The Environmental Protection Agency estimates pesticides- some cancer causing- contaminate the groundwater, polluting the primary source of drinking water for more than half the country's population.