

# Understanding food waste management practices in the grocery retail sector in Durban, KwaZulu-Natal

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## **PREFACE AND ACKNOWLEDGEMENTS**

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## ABSTRACT

Food waste remains a global concern. This is attributed to its negative impacts on food security, water resources and climate change, to name a few. Throughout the food supply chain, food waste figures are generally based on estimates. The grocery retail sector is in a critical position to influence waste reduction and to contribute towards achieving the United Nation's Sustainable Development Goal to *halve the amount of global food waste by 2030*.

The purpose of this study was to understand how food waste is managed in the retail industry using a sample of three grocery retail stores in Durban, KwaZulu-Natal as a case study. This was achieved by assessing food waste types, determining food waste management in relation to waste- and food recovery hierarchies; exploring drivers behind food wastage; and lastly exploring motivators and opportunities for food wastage prevention and reduction in the grocery retail sector.

Quantitative and qualitative research methods were used to collect and analyze data from three grocery retail stores belonging to one retail group. Data collection included semi-structured interviews, secondary data in the form of archived waste monitoring and measurement records and on-site food waste assessment and characterization. Nvivo 12 and Microsoft 2010, were used to analyze data.

Similar to the results of other studies, this research has found that fruit and vegetables were the most wasted food items, followed by perishable products (such as dairy) and in-store bakery items. This study identified food waste drivers which include date labelling, food safety standards, shelf life, handling, quality standards, promotions and lack of diversion avenues. Store managers were exclusively motivated by financial gain to reduce food waste. Opportunities identified to prevent and reduce food waste include training and awareness, improved demand planning and forecasting, food redistribution and landfill ban legislation, and infrastructure investments. These findings are not unique to this study but relates to findings from studies conducted globally.

**Keywords:** Food waste, short shelf life, grocery retail, waste hierarchy, drivers

## ACRONYMS AND ABBREVIATIONS

AU	African Union
CGCSA	Consumer Goods Council of South Africa
CSIR	Council for Science and Industrial Research
DEA	Department of Environmental Affairs
DEFF	Department of Environment, Forestry & Fisheries
DST	Department of Science & Technology
DTI	Department of Trade Industry
EU	European Union
FAO	Food and Agriculture Organization
FUSIONS	Food Use for Social Innovation by Optimising Waste Prevention Strategies
KZN	KwaZulu-Natal
NEMWA	National Environmental Management Waste Act (59 of 2008)
NOWCS	National Organic Waste Composting Strategy
NWMS	National Waste Management Strategy
RSA	Republic of South Africa
SAWIS	South African Waste Information System
SDG	Sustainable Development Goal
SEMA	Specific Environmental Management Act
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Programme

UNEP	United Nations Environment Programme
USA	United State of America
WRAP	Waste and Resource Action Program
WRI	World Resource Institute
WWF	World Wide Fund for Nature

## **DEFINITIONS**

### ***Food security***

*A situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2015)*

### ***Food waste***

*any food, and inedible parts of food, removed from the food supply chain to be recovered or disposed (including composted, crops ploughed in/not harvested, anaerobic digestion, bio-energy production, co-generation, incineration, disposal to sewer, landfill or discarded to sea)” (Food Use for Social Innovation by Optimising Waste Prevention Strategies (FUSIONS), European Commission, 2014).*

### ***Waste***

*(a) any substance, material or object, that is unwanted, rejected, abandoned, discarded or disposed of, or that is intended or required to be discarded or disposed of, by the holder of that substance, material or object, whether or not such substance, material or object can be re-used, recycled or recovered and includes all wastes as defined in Schedule 3 to this Act; or (b) any other substance, material or object that is not included in Schedule 3 that may be defined as a waste by the Minister by notice in the Gazette, but any waste or portion of waste, referred to in paragraphs (a) and (b), ceases to be a waste—(i) once an application for its re-use, recycling or recovery has been approved or, after such approval, once it is, or has been re-used, recycled or recovered; (ii) where approval is not required, once a waste is, or has been re-used, recycled or recovered; (iii) where the Minister has, in terms of section 74, exempted any waste or a portion of waste generated by a particular process from the definition of waste; or (iv) where the Minister has, in the prescribed manner, excluded any waste stream or a portion of a waste stream from the definition of waste. (National Environmental Management Waste Act (59 of 2008), as amended) (Republic of South Africa, 2014)*

### ***Date of minimum durability***

*(‘best-before’/‘best before end’): the end of the period the product must remain under stated storage conditions for it to continue to be completely marketable and to retain specific qualities. The food may still be ‘perfectly satisfactory’ beyond this date (Department of Health (DoH), 2010).*

### ***Sell-by date***

*the last date that the product can be offered for sale to consumers. Beyond this date there is still a reasonable storage period in the home ((DoH, 2010).*

**Use-by date**

*(‘best consumed before’, ‘recommended last consumption date’, ‘expiry date’): the end of the period the product must remain under stated storage conditions. Beyond this the product will probably lose the quality expected by consumers and should be regarded as unmarketable (DoH, 2010).*

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# CHAPTER 1: INTRODUCTION

## 1.1 Background

The dire situation of food wastage has drawn significant attention globally due to inadequate food to feed the growing population. Globally, literature indicates that a third of food produced for human consumption, or about 1.3 billion tonnes per annum, get wasted whilst one in seven people is food insecure (Hall *et al.*, 2009:1). The United Nations Development Programme (UNDP) reports that, as of 2017, there are approximately 821 million people estimated to be chronically undernourished, mostly from developing countries (UNDP, 2020a). In the African context, food losses and waste are generated throughout the food supply chain, from initial agricultural production to final household consumption. In Nigeria, which follows Egypt as the largest tomato producer in Africa, 45 per cent (%) of the harvested tomatoes are lost (United Nations Environment Programme (UNEP), 2018).

According to the World Wide Fund for Nature (WWF, 2017), South Africa generates about 31 million tonnes of food per year and 10 million of those tonnages become waste. In a country where an estimated 14 million people go to bed hungry, the magnitude of food wasted is a concern. Adding to food security concerns is the loss of natural resources consumed during production of food that get wasted and also the negative effect on the environment and economy.

## 1.2 Problem statement and justification for the research

Although several studies on food waste and losses have been performed in the international and national perspectives, these mostly give estimates of an overall food supply chain perspective and do not provide accurate information about food waste in specific segments (Oelofse & Nahman, 2013: 85; Cicatiello *et al.*, 2016:96; Kliaugaitė & Kruopienė, 2018:7). Additionally, the research objectives have been diverse and specific with some researchers focusing on the entire food supply chain whilst others having interest on specific segments such as household only.

This study aims to focus on waste generated by the *grocery retail sector*. In South Africa, the grocery retail sector is one of the actors in the supply chain where there is a gap in data and information regarding the quantities of food waste generated and the main reasons for. The quantities of food waste generated and how these are managed have an element of commercial sensitivity to retailers and is generally not publicized. Kliaugaitė and Kruopienė (2018: 9) cite this as one of the explanations behind the shortage of data and information in this sector.

Secondly, even though food waste contribution by the grocery retail sector is relatively low when compared to other segments of the supply chain, literature identifies the position of the grocery retail sector to be of significance for food waste avoidance and reduction, both upstream and

downstream (of the retail/sales process). This is attributed to the notion that the retail sector is in a position to influence consumers, put pressure on suppliers, and redistribute surplus food (Hermsdorf *et al.*, 2017:2533; Mattsson *et al.*, 2018:119; Tonini *et al.*, 2018:744;). Food donation to charities is an example of a redistribution platform to absorb unsalable food for human consumption (Lebersorger & Schneider, 2014:1918; Teller *et al.*, 2018:982).

Therefore, there is an urgent necessity to evaluate the actual scale of the problem and to identify suitable measures to scale up the food waste hierarchy, in order to eventually avoid or minimize food wastage (Kliaugaitė & Kruopienė, 2018:7)

The subject of food waste is an evolving one in South Africa, with various stakeholders demonstrating an interest. Food waste is managed with most other waste types in terms of the National Environmental Management Waste Act (NEMWA) (Act 59 of 2008) and no specific South African legislation exists for the management of food waste. The country has, however, demonstrated a recognition of the challenges associated with food waste and a level of interest towards addressing this subject.

South Africa adopted Sustainable Development Goals (SDG) in 2015. These seventeen global development goals are interconnected and their objective is to “*end poverty, protect the planet and ensure that all people enjoy peace and prosperity*”. SDG 12.3 commits to 50% reduction of global food waste at the retail and consumer levels and reduction of food losses along production and supply chains, including post-harvest losses by year 2030 (UNDP, 2020b). Responding to this commitment, nations are developing and implementing initiatives to reduce and redirect food waste at retail level (Mattsson *et al.*, 2018:118).

Conversely, any effort to address food waste issues relies on reliable data of the magnitude of the problem. However, researchers express a significant concern regarding poor availability of food waste data across the food supply chain segments. Oelofse and Nahman (2013:85) recommend a thorough assessment of food waste throughout the food supply chain in order to react efficiently to the food waste crisis. The national waste reporting platform, the South African Waste Information System (SAWIS), has yet received a lukewarm response in terms of reporting waste data, and the organic waste category lacks quantification details of different types of organic waste on this platform (Department of Environmental Affairs (DEA) 2018:92).

Through the characterization of food waste, and semi-structured interviews with retail personnel to understand how food waste is managed at their premises, this research makes a contribution towards understanding the magnitude of food waste in the retail sector and associated drivers of food waste. Three grocery retail stores in Durban were used as a case example.



### 1.3 Delineation of the scope of the study

This study focused on the *grocery retail* sector “market stage” of the food supply chain. Three grocery retail stores (two supermarkets and one hypermarket) belonging to one retail group, located in Durban (eThekweni Municipality), a city located in the province of KwaZulu-Natal in South Africa participated in this study. The selection of this area was based on its geographical proximity which made it convenient for the researcher to reach the study sites, the shrinking landfill airspace in this municipality and the high level of food insecurity in the urban areas located in this province.

Four large retail chains were initially approached for inclusion in the study however, only one agreed to participate in the research.

Food categories included in the scope of the study were: fresh fruits and vegetables, dairy, bakery products, meat, poultry, seafood and prepared foods. Food waste was quantified per retail store department, which included: the butchery, cheese bar, cold deli, convenience meals, deli, deli prepared foods, fish shop, fresh produce, in-store and outsourced bakeries, perishable groceries, and poultry. Non-perishable products, such as canned foods, grains and pastas, dry foods and candies were not included in this study, mainly due to their relatively long shelf-lives, when compared to the fresh, perishable products included in this study. Food products with short lifespans make a significant contribution to the magnitude of food waste compared to long shelf life products, which are rarely found in food waste piles.

Data collection involved conducting semi-structured interviews, carrying out on-site food waste assessment and characterization, and retrieval of existing food waste quantification data presented in this study. Data on food waste types and quantities, for a period of 12 months (July 2018 to June 2019), were retrieved from the private archival documents and administrative records of all three grocery stores. These data were provided to the researcher, through an email, by the sustainability manager based at the head office.

Two visits were made to each of the three grocery stores between August and September 2019. The semi-structured interviews were conducted on the first visit whilst the second visit was dedicated to an on-site food waste assessment and characterization. Food waste quantification data obtained from an on-site food waste assessment and characterization exercise solely served to validate the quality of the existing quantification data retrieved from the historical store records and are not presented in the results of this study.

The Food Waste and Loss (FLW) inventory protocol template from the *Food Loss Waste Accounting and Reporting Standard* (World Resources Institute, 2016) was used to define scope for this study as presented in Figure 1-1. The figure delineates the time-, material type-, destination-, boundary and related issues scope of the research (Figure 1-1).

## Scope for food waste quantification (FLW inventory protocol)

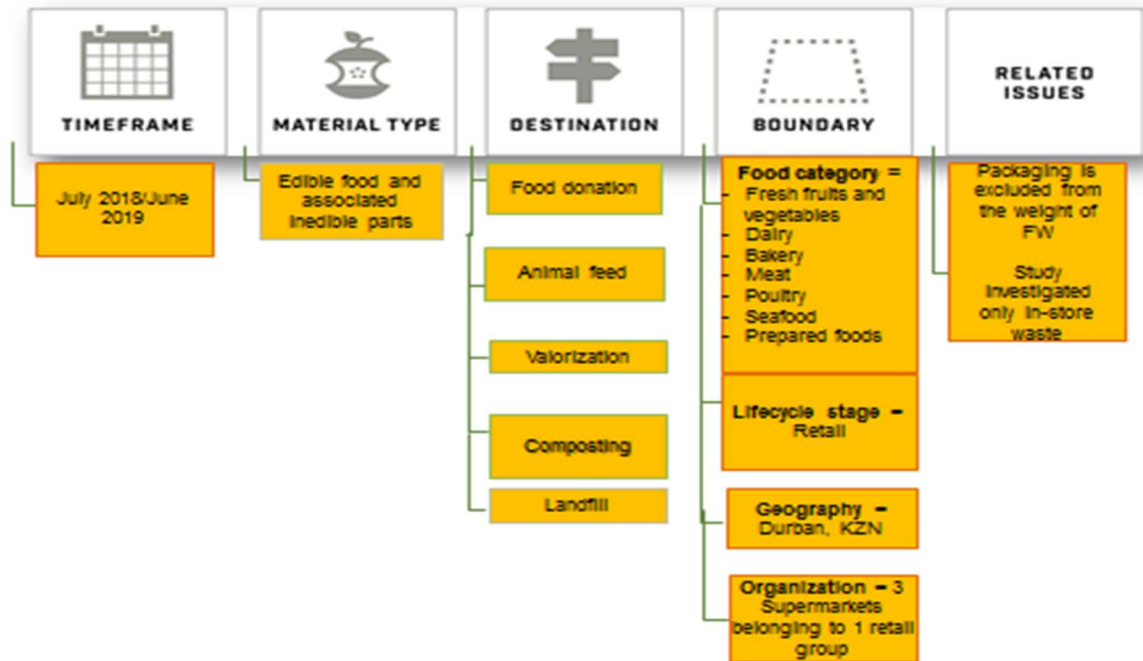


Figure 1-1: Scope of the research (Sourced from WRI, 2016)

### 1.4 Assumptions and limitations

Apart from the limitations related to the scope of the study (limited to three retail stores in Durban, belonging to one retail chain), the following additional assumptions and limitations should be noted:

- The research only focused on in-store food waste. No other phases of the food life cycle (up- or downstream) were included in the scope of the study.
- The research quantified food waste per store department.
- The findings of this study relate to food waste data gathered in one-year (from July 2018 to June 2019). It is assumed that these data are representative of what is reasonably expected to occur in a “normal year”. It should be noted that special circumstances, such as the COVID-19 restrictions, may influence food waste generation. These special circumstances are not provided for in this research.
- The results of this research aims to contribute to an expanded understanding of how food waste is currently managed at the grocery retail stores in Durban and does not necessary represent what could be expected from the grocery retail stores in South Africa.

- It is assumed that the views of respondents participating in interviews were truthful and that it is representative of the opportunities and problems related to food waste management in the South African (or developing world context) in general.

Methodological limitations are provided in chapter three of this dissertation.

## **1.5 Research aim and objectives**

The research aimed to understand how food waste is managed in the retail industry using three grocery retail stores in Durban, KwaZulu-Natal as a case study.

The research objectives

were to:

1. Assess (identify, categorize and quantify) *food waste types* from selected grocery retail stores;
2. Determine *how food waste is managed* in relation to the waste- and food waste management hierarchies;
3. Explore the *drivers* behind food wastage in the grocery retail sector; and
4. Explore *motivators and opportunities* for food wastage prevention and reduction in the grocery retail sector.

## **1.6 Structure of the mini-dissertation**

This mini-dissertation comprises of five chapters.

Chapter one sets out an introduction to the research study, background to the study, the problem statement, substantiation, and research aim and objectives of this study. The delineated scope, assumptions and limitations of the study are also included in this chapter. The structure of the study is part of this chapter as well.

Chapter two provides a literature review on food waste from farm-to- fork with more emphasis on the retail sector which forms the basis of this study. The reviewed literature includes academic publications, scholarly articles and the applicable legal framework. The chapter also defines food waste, gives a brief on the impacts of food waste, quantification studies conducted, food waste categories investigated, management options, the drivers of retail food waste, the strategic context and food waste management instruments being adopted internationally.

Chapter three provides details of the research methodology used to address the objectives of this study, and motivates the methodological choices made. Included in this chapter are: the type of

methodology that was used, data collection procedures and the process of data analysis. This section also and limitations of this study.

Chapter four builds from the methods described in chapter three and presents the findings and discussion of this research study in line with the research objectives instituted in chapter one, whilst

Chapter five concludes the research findings presented in chapter four in relation to the research objectives and the research question on how food waste is managed in the retail sector against the waste management hierarchy. The chapter also provides recommendations and implications for further research.

## **1.7 Chapter summary**

This chapter provided the introduction and background information on food waste and related issues. It outlined the problem statement, substantiation for the study, research question, and the aim and objectives of the study. The delineated scope, assumptions and limitations of the study are also included in this chapter. The chapter ended with an outline of the study structure. Chapter two provides the literature review for the purposes to outline the context of the study, and to address certain research objectives.

## CHAPTER 2: LITERATURE REVIEW

### 2.1 Introduction

Food waste research objectives are usually diverse or specific in terms of commodities to be investigated, geographic distributions, food supply chain segment, and data collection methodology (Sheahan & Barret, 2017:2). Some researchers have investigated food waste at global level, whilst other studies are country or area specific (Gustavsson *et al.*, 2011:2; Oelofse & Nahman, 2013:85). Conversely, some studies have focused on specific food commodities whilst others focus on all food types (Goodman-Smith, 2018:6). The research by Gustavsson *et al.* (2011: 2); Oelofse and Nahman (2013: 85) and Alexander *et al.* (2017:191) are examples of studies that have looked at the entire food supply chain, whilst other have focused on specific food segments of the food supply chain. The methodology employed during food waste studies also varies amongst the researchers.

Building on the chapter one, this chapter provides context to the study by providing a review of literature on food waste studies in the retail sector. The literature reviewed also supported specific research objectives, i.e. *Research objective 3: Explore the drivers behind food wastage in the retail sector; and Research objective 4: Explore motivators and opportunities for food wastage prevention and reduction in the retail sector.* The reviewed literature mainly focused on exploring: the definition of food waste; food waste impacts; the magnitude of food waste occurring across the food supply chain; and more specifically, food waste occurring within the grocery retail sector and associated drivers. The chapter also provides the strategic context of food waste in South Africa, the waste management- and food waste recovery hierarchies, as well as food waste management instruments, and closes out with a chapter summary.

### 2.2 Defining food waste

The definition of *food waste* varies amongst researchers as an accepted universal definition does not exist. However, the terms “food loss” and “food waste” are popular in scholarly publications and the context of utilization of the term depends on the research interest of the researcher (Cicatiello *et al.*, 2016:97; Kliaugaitė & Kruopienė, 2018:982). According to Gustavsson *et al.* (2011:2) any food product initially intended for human consumption, but wasted or lost in some areas of the food supply chain is defined as *food waste or loss* even if redirected to other stages of the food waste hierarchy, such as animal feed or energy generation.

Authors distinguish between *food waste* and *food loss*, where *food waste* occurs at the last stages of the food supply chain (i.e. retail and consumer level), whilst *food loss* occurs in production, handling and storage, processing and packaging of the food supply chain. This implies that food waste represents a part of total food losses. Additionally, consumer and retailer behaviour

influences food waste generation (Cicatiello *et al.*, 2016:98; Goodman-Smith, 2018:6; Gustavsson *et al.*, 2011:2).

Food waste can further be classified as *avoidable* which is food that was edible at some stage, such as expired food, *possible avoidable* and *unavoidable*. Possible avoidable refers to food that can be viewed as eatable by only a fraction of individuals (such as bread crumbs), whilst unavoidable food cannot be eaten e. g. seafood shells and onion skin (Filimonau & Gherbin, 2017:1185; Goodman-Smith, 2018:8).

A generally acceptable definition of food waste, which has also been adopted in South Africa, is the definition developed by the European Union as part of their “Food Use for Social Innovation by Optimising Waste Prevention Strategies” (FUSIONS) project. The FUSIONS definition of food waste includes inedible parts of food portions in order to support the use of these as by-products for creation of new products. The idea is to sustain food systems, promote efficient utilization of resources and circular economy. This coherent definition states that “*food waste is any food, and inedible parts of food, removed from the food supply chain to be recovered or disposed (including composted, crops ploughed in/not harvested, anaerobic digestion, bio-energy production, co-generation, incineration, disposal to sewer, landfill or discarded to sea)*” (FUSIONS, 2014).

It is evident that there are variations within the context of food waste definition and this demonstrates a need for a harmonised definition. This ambiguity is one of the reasons behind a problem in evaluating the volume of food waste generated globally (Garrone *et al.*, 2014:1463). For the purpose of this research, the FUSIONS definition of food waste was used to understand the management practices of food waste at the grocery retail level.

## **2.3 Food waste impacts**

Food waste has several negative impacts, including social-, environmental- and economic impacts. These impacts are discussed in the sub-sections below.

### **2.3.1 Social impacts**

The magnitude of food insecurity does not justify the magnitude of food that gets wasted globally. In South Africa, about 30 % of produced food gets wasted whilst an estimated 14 million people go to bed hungry (WWF, 2017). The South African Constitution provides for access to food and sufficient nutrition yet food poverty, hunger and malnutrition in various forms remains a challenge (WWF, 2019). In Africa, the malnutrition rate is about 20% even though considerable improvements have been made to fight hunger. This figure raises a concern because it is far beyond the global average which is about 10% (FAO, 2015). Improved efficiency levels through food waste reduction within the food supply chain would contribute towards enhanced food

security. For this to materialise, efforts need to be directed towards understanding the underlying factors of food waste (Irani & Sharif, 2016:177).

The changing environment is also a problem for sustainable food systems. Climate change impacts will make it difficult to produce the amount of food currently being produced in the future. Globally, it is projected that food production will have to double to feed the growing population by 2050. In South Africa as well, there's a concern about the ability to feed the expected population growth of 73 million people by 2050 (WWF, 2019).

### **2.3.2 Environmental impacts**

Throughout the food supply chain greenhouse gases (GHG) are emitted. These are climate change precursors which present a significant environmental challenge. Throughout the lifecycle of food that gets wasted, an estimated 4.4 Giga tonnes (Gt) of carbon dioxide equivalent (CO<sub>2eq.</sub>) is produced annually. Munhuweyi (2012: 132) study findings indicate that for South Africa's cabbages, carrots and tomatoes alone, post-harvest losses contributed to between 1.37 and 13.77 million tonnes CO<sub>2eq.</sub>. Approximately 3.74 to 4.35 million m<sup>3</sup> of fresh water as well as 14.79 to 111.63 MJ of fossil energy were also wasted along with these post-harvest losses. WWF (2017) estimates that GHG emissions could rise to 5.7 to 7.9 Gt CO<sub>2eq.</sub> annually.

Organic material produces methane when it decomposes and this is the resulting environmental negative impact when food waste is landfilled. Countries such as Germany, Sweden, and Canada have resorted into diverting organic waste (including food waste) by outlawing its disposal to landfills. A concerning case with South Africa is that land disposal is still the most practical and the cheapest option for waste management. About 90% of municipal waste is being landfilled and the component (including food waste) is estimated to contribute about 4.3% to the country's greenhouse gas emissions (GreenCape, 2019).

Another issue relating to landfill disposal is that landfill sites are filling up rapidly in South Africa whilst some are challenged with compliance to the environmental legislation. According to the South African Cities Network (SACN) (2014) model, landfill airspace in the City of Johannesburg will diminish by the year 2025 whilst the eThekwin's landfill airspace will shrink to 3.7 million m<sup>3</sup> as of the year 2030. This calls for an urgent need to implement the waste hierarchy options to divert waste from landfilling. In this momentum, the provincial organic waste diversion plan implemented by Western Cape's Department of Environmental Affairs and Development Planning (DEA&DP) aims to divert 50 % of organic waste from landfill by 2022, and 100% by 2027 (GreenCape, 2019).

In a water-scarce region like South Africa, food waste is also a concern for water sustainability. Water wasted as a result of food waste could fill over 600 000 Olympic swimming pools (WWF, 2017). According to Oelofse (2013), total water loss as a result of food waste in South Africa is

equivalent to nearly 22% of the country's total water footprint, of which 12.8 million m<sup>3</sup> is lost through food loss on-farm. Water loss per food type and associated food loss is: cereals (4,168 million m<sup>3</sup> or 32% of total contribution to water loss), meat (3,334 million m<sup>3</sup> or 26%) and fruits & vegetables (3,076 million m<sup>3</sup> or 24%). Lastly, the energy wasted along with food waste could power the City of Johannesburg for 16 weeks (WWF, 2017).

### **2.3.3 Economic impacts**

Unsustainable food systems present a significant economic impact in developing countries. The cost of edible food waste throughout the food supply chain is valued at R61.5 billion per annum (approximately US\$7.7 billion). On per capita basis, this cost is quite low (US\$148) when compared to developed countries such as the United States of America (USA) which ranges between US\$285 and US\$628. However, it constitutes 2.1% of the country's Gross Domestic Product (GDP) which is quite significant when compared to 0.6-1.3% GDP in the USA (Nahman & de Lange 2013: 15).

The 2012 study into vegetable losses in South Africa, found that 21% of cabbages, 18% of carrots and 15% of tomatoes were lost before retailer purchase, equating to an annual loss to the national economy of R33.7 million (Munhuweyi, 2012: 64). It also found that mechanical damage accounted for between 50% and 70% of the losses whilst the remainder was due to insect damage and decay.

## **2.4 Food waste in the food supply chain context**

The magnitude of food that gets wasted along the food supply chain, from farm-to fork, (i.e. agricultural production, food storage, transportation, food processing, retail, and in the kitchens of restaurants, hotels and households) is distinct at each stage. This indicates a loss of food that should feed the growing population, loss of resources used to produce this food and the generation of the greenhouse gases when this food is being transported and disposed.

The magnitude of waste and loss occurring along the supply chain was estimated by Gustavsson *et al.*, (2011:4). According to the results of this study, approximately a third of produced food is lost or wasted worldwide and this translates to about 1.3 billion tonnes annually. Table 2-1 below demonstrates the magnitude of FLW in the food supply chain in the sub-Saharan Africa. A mass flow model based on food production and food waste data from the FAO was used for deriving these estimates (Nahman & de Lange 2013: 7).



**Table 2-1: Proportion (by mass) of food entering each stage of the value chain that is lost/wasted (Source: Gustavsson *et al.*, 2011). (This research focused on the “market” phase, which is highlighted in grey)**

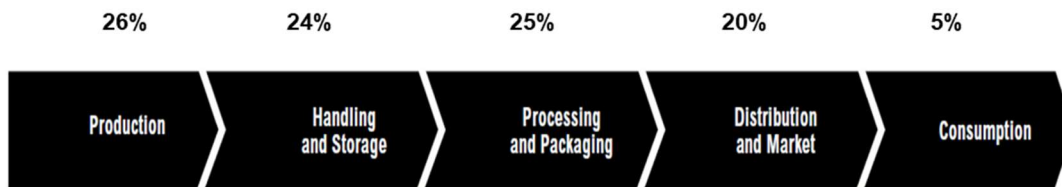
Commodity group	Agricultural production	Post-harvest handling and storage	Processing and packaging	Distribution and market	Consumption
Roots and tubers	14.0%	18.0%	15.0%	5.0%	2.0%
Oil seeds & Pulses	12.0%	8.0%	8.0%	2.0%	1.0%
Fruits and vegetables	10.0%	9.0%	25.0%	17.0%	5.0%
Meat	15.0%	0.7%	5.0%	7.0%	2.0%
Fish and seafood	5.7%	6.0%	9.0%	15.0%	2.0%
Milk	6.0%	11.0%	0.1%	10.0%	0.1%

The quantity of food waste generation also varies by food product and geographic distribution. Findings from a study conducted by Gustavsson *et al.*, (2011: 5) indicate that developing countries experience more food waste at the earlier stages of the food supply chain whilst developed countries experience more food waste at the latter stages of the food supply chain. In Sub-Saharan Africa, a proportion of approximately 39% wasted calories is generated during the production stage of the food supply chain, whilst North America/ Oceania waste 61% during the consumption stage of the food supply chain.

Developing countries often lack suitable infrastructure such as advanced harvesting technologies, transport and storage facilities. This coupled with weather conditions may contribute to more food waste being generated at the initial stages of the food supply chain.

Oelofse and Nahman (2013:83) estimated the magnitude of food waste at each level of the food supply chain in South Africa. This study demonstrated that the main categories of food that are wasted in South Africa are fruit and vegetables, which constitute 4.4 million tonnes or 47% of total food waste, and cereals, which constitute 2.5 million tonnes or 27% of total food waste.

Figure 2-1 depicts the percentage of food waste (by mass) that is generated at each stage of the food supply chain in South Africa which is 26% at production stage, 24% during handling and storage, 25% during processing and packaging, 20% at distribution and market, and 5% at consumption stage.



**Figure 2-1: Percentage of food waste (by mass) that is generated at each stage of the food supply chain in South Africa. (Sourced from WWF, 2018)**

Distribution and market stage represents food waste occurring during distribution to markets, including losses at wholesale and retail markets. This study focused on the “market” phase of the food supply chain, focusing on food waste from the grocery retail sector.

The grocery retail sector encompasses of food sold to consumers for consumption off site. It is diverse in nature, consisting of a mix of store formats such as convenience stores (stores with sales area of less than 280 m<sup>2</sup>), supermarkets (with a sales area of 280 to 2 300 m<sup>2</sup>), superstores (with a sales area above 2 300 m<sup>2</sup>) and hypermarkets (which are over 5500 m<sup>2</sup>) (UKEssays, 2018).

The retail sector in this study is defined as “store formats” (hypermarkets and supermarkets) selling food products for the purpose of off store consumption. This research specifically focuses on food waste from a specific chain of grocery stores, which sell a general range of fresh and packaged food products.

## **2.5 Grocery retail food waste**

While food waste occurring at household level is well documented, the research on food waste occurring at retail (or “market”) segment of the food supply chain is at infancy stage. Even though food waste contribution by the grocery retail sector is relatively low when compared to other segments of the supply chain, literature identifies the position of the grocery retail sector to be of significance for food waste avoidance and reduction, both upstream and downstream. This is attributed to the notion that the retail sector is in a position to influence consumers, put pressure on suppliers, and redistribute surplus food (Hermsdorf *et al.*, 2017:2533; Mattsson *et al.*, 2018:119 Tonini *et al.*, 2018:744). This section of the literature review explores grocery retail food waste in terms of classification (2.5.1) and delves into the previous studies conducted globally (2.5.2).

### **2.5.1 Classification of grocery retail food waste**

Eriksson *et al.* (2012:26) grouped retail food waste into four categories (i.e. pre-store waste, recorded in-store waste, unrecorded in-store waste, and missing quantities). Pre-store was defined as waste that occurs when a grocery retail outlet does not accept the foodstuffs delivered

from suppliers because they are damaged or do not pass internal quality control. Although, technically, this food waste occurs outside grocery outlets, it is usually assigned to the supermarket operations. Recorded in-store waste was generated when grocery retailers sorted out and discarded food which had low chances to be sold; this may have been due to poor aesthetics, structural damage or surpass of the “best-before” or “use-by” dates.

Food waste discarded but not recorded was classified as unrecorded in-store waste and it resulted from quantification errors of unpackaged food waste and non-recording of food waste items. This waste could have been pre-store or in-store waste if recorded. Although the bins of the participated stores were filled with pre-store, in-store and unrecorded food waste, pre-store and recorded in-store waste hold the largest share of the grocery retail food waste. The last category identified during this study were the missing quantities which were attributed to “*loss of mass between outgoing and ingoing flows*” which could have resulted from theft and mass loss related to evaporation.

This study exclusively investigated in-store food waste within the grocery retail sector, i.e. category two of the grocery retail food waste.

### **2.5.2 Examples of grocery retail food waste studies and methods used**

It is often difficult to compare retail food waste data because researchers employ different methodologies to collect and analyse data. Some studies have used delivery records and store sales data. Some have used interviews with retail staff as a platform to obtain data on food waste quantities (Mena *et al.* 2011:651; Eriksson 2012: 25; Lebersorger & Schneider 2014: 1912; Filimonau and Gherbin 2017: 1188; Le Roux 2017: 30; Goodman-Smith *et al.*, 2020:3).

Lebersorger and Schneider (2014: 1912) quantified one-year data received from 612 retail outlets in Austria. Food loss data in mass units were obtained from the database of the stores and it consisted of store sales data and mass donated to social services.

Mena *et al.* (2011:651) used convenience sampling and conducted 43 semi-structured interviews with retailers and suppliers in Spain and the UK. Historical records and observations were used as secondary data collection methods in some cases. The information obtained from these sources of data was then used to estimate both the quantities and the destination of food waste for different food commodities. Underlying causes for food waste and opportunities for reduction were identified.

Eriksson (2012: 25) quantified specific food commodities using existing store database data from six supermarkets located in the Uppsala Stockholm region in Sweden through convenience sampling. The quantities for selected commodities were recorded over a one-year period from 2010 to 2011. According to Eriksson (2012: 27) stores had existing procedures in place where food to be discarded was recorded by the retail staff in each store. Barcoded food products were

scanned into the store's database and for the non-barcoded products, the store manager did manual recording. The study focused on fruit and vegetables, dairy, cheese, meat and deli departments, with bread being excluded because it was managed separately by a supplier. The idea behind selecting only a few stores was that the results will present a representative view of the performance of the entire retail chain with regards to the magnitude of food waste.

In South Africa, Le Roux (2017: 30) used data from store databases, delivery records, and store sales data provided by retailers to study the extent and drivers of perishable food waste in the retail supply chain industry. The study focused on the fruit and vegetable category of the perishable products and used quantitative research methods to test hypotheses related to the extent of food waste and its relationship with specific food waste drivers.

In Nordic countries, Stenmarck *et al.*, (2011) attempted to quantify food waste by reviewing existing estimates in the literature. The important point to note from this study is that accessing data on food waste quantities from the grocery retail industry is not easy due to commercial sensitivity. Retailers in Finland were not willing to share the exact data, and some of the study participants presented data for in-store food waste in approximate figures. This affirmed the experience of Mena *et al.* (2011:651) where some retailers were not willing to share waste records, citing confidentiality concerns.

To understand how, grocery retail store managers, address the problem of food waste in their operations, Filimonau and Gherbin (2017:1188) conducted a series of twelve in-depth semi-structured interviews with retail manager's. The context of the questions related to the manager's awareness of the magnitude of food waste, food waste management interventions and the role of policy and key stakeholders in preventing and reducing food waste.

## **2.6 Food waste drivers in the grocery retail sector**

Food waste generation is driven by various factors. Enterprises need to identify underlying drivers of food waste in order to develop and execute interventions to mitigate food waste generation (Irani & Sharif, 2016:176). The results of the study conducted by Le Roux (2017) show that there is a fluctuation of food waste driven by specific circumstances and factors. When supply chain managers focus on specific drivers of food waste, they can reduce the extent of food waste in the food supply chain. The following sub-sections explores the drivers of food waste found in literature, with emphasis on the drivers relating to food waste occurring at the grocery retail level.

### **2.6.1 Forecast/ordering systems**

Poor product forecasting and ordering is cited as one of the drivers of food waste. This is due to problems in predicting product demand, especially for perishables and fresh food. This is because what customers buy depends on a number of factors such as promotions, season, weather, and

the mood of the customer (Mena *et al.*, 2011:652; FUSIONS, 2014). In a study conducted by Mena *et al.* (2014:152), participants indicated that they planned their promotions in relation to specific events such as Christmas and public holidays. However, the success of this depended on accurate forecasting. An example made was that they prepared additional meat products in anticipation of a “barbecue summer”. If this does not happen, it resulted in the application of price reduction or food waste.

Organic products have shorter lifespans and lower turnover compared to conventional products and this leads to premature discarding of these products. In a study conducted by Eriksson (2012: 36) organic products within the cheese, dairy, deli and meat departments were found to have higher percentage of waste than conventional products and this was attributed the lower mass sold per article, of organic products. Eriksson (2012: 47) and FUSIONS (2014) recommended better order forecasting as one of the potential waste reduction measures for organic products.

### **2.6.2 Shelf life**

Product shelf life has been identified as one of the causes of food waste generation and it varies amongst products depending on factors such as product type, packaging used and the quality of refrigeration (Mena *et al.*, 2014:154). Short shelf life products are often discarded due to decay attributed to too much time spent moving throughout the food supply chain (Mena *et al.*, 2011:657; Teller *et al.*, 2018: 988). During long trips, the shelf life of fresh produce may already be compromised when they reach the retailers (de Moraes *et al.*, 2020:13).

Perishable products have a limited shelf-lives, findings from Mena *et al.* (2014:154) demonstrate that the main reason for wastage of fruits and vegetables was due to deterioration, softening or sprouting. Conversely, this study also discovered that some long shelf life products such as potatoes were wasted more than shorter shelf life products i.e. strawberries. FUSIONS (2014) add that seasonal products, especially fresh produce, are in surplus during their harvesting season and get spoiled if not sold fast.

According to Aschemann-witzel *et al.* (2015:6462) the buying patterns of perishable products are influenced by the product shelf life, “the willingness to pay for a perishable product decreases throughout its shelf life”.

### **2.6.3 Cosmetic perfection**

Food waste generated due to concerns around freshness and cosmetic perfection in terms of weight, shape, size and appearance of fresh produce is a critical issue. Consumers are often reluctant to purchase “imperfect” produce and select stores based on the fresh produce quality they provide (FUSIONS, 2014; Filimonau & Gherbin, 2017:1191; Kliaugaitė & Kruopienė, 2018:17). This behaviour results in the elimination of good food and subsequent generation of

unnecessary food waste. Even though poor quality fresh produce is mostly rejected at farm gate, retailers are in a perfect position to implement measures for reducing this kind of wastage (FUSIONS, 2014). The results from Topolansky *et al.* (2017:775) indicate that German consumers demonstrated a positive attitude towards cosmetic flawed products and willingness to purchase misshaped vegetables and fruits depending on the price and flaw type of the product. Hence retailers may decide to ease their aesthetic standards and offer these “imperfect” products at a reduced price as part of their Corporate Social Responsibility initiatives.

#### **2.6.4 Packaging and handling**

FUSIONS (2014) mention that limited buyer flexibility and over-purchasing attributed to packaging size as another driver for food waste generation, both at retail and consumer level. For example, customers may avoid products that are sold only according to a specific case size and those who buy may end up not using the entire stock within an expiry date. Further, packed products cannot be sold if one item in the package is damaged for example, if one fruit is spoiled in a pack, the customer avoids buying that particular pack.

Product packaging may be damaged due to poor handling by retail employees and sometimes by customers. According to Lebersorger and Schneider (2014: 1916) and Holweg *et al.* (2016:643) packaging faults due to poor handling by employees and consumers when shopping was cited as one of the main causes of food waste generation in their studies.

#### **2.6.5 Lack of training and awareness**

According to published literature, a lack of training and awareness on food waste prevention and reduction interventions (such as proper handling and efficient rotation of food items) is one of the drivers for generation of food waste in the grocery retail sector (Gruber *et al.*, 2016: 15; Filimonau & Gherbin, 2017:1192; de Moraes *et al.*, 2020:11; Goodman-Smith *et al.*, 2020:6). FUSIONS (2014) and Gruber *et al.* (2016: 15) indicate that high staff turnover and a high number of part-time employees in the retail industry indicates that skilled staff may be lacking. In this context, cost associated with throwing food away may be less than the cost of training employees in procedures relating to efficient waste management.

Respondents from Filimonau and Gherbin (2017: 1192) cited problems with staff attitudes towards food waste reduction practices, where employees had no interest in these initiatives. However, the majority of these participants demonstrated confidence in training as an opportunity to change behaviour of these employees to, subsequently, reduce food waste. This confidence in training was also affirmed by Goodman-Smith *et al.* (2020:6) where the retail compliance manager suggested continuous training to effect positive response towards waste management practices by employees.

The lack of customer knowledge about technical aspects of a product such as when a fruit or vegetable is ripe, how to prepare it, and how to use it as an ingredient may lead to further food waste generation (FUSIONS, 2014).

### **2.6.6 Promotions**

There is consensus in literature around promotional activities playing a significant role in the generation of food waste, both at retail and consumer stage. According to Gruber *et al.* (2016: 21), promotions encourage the purchasing of excess food by consumers. Such an example is the “buy one get one free” regime and large package offers. In a study conducted by Lee (2018:330) 75% of the participants over-purchased during the previous three months because they wanted to take advantage of promotion and some pointed out portion/packaging being larger than needed.

According to Mena *et al.* (2014:152) poor forecasting and inadequate information sharing between grocery retailers and their suppliers contributes in the generation of food waste. Promotion-related food waste also occurs at the grocery retail sector due to too many items being allocated to stores during promotions (Gruber *et al.*, 2016:8; Teller *et al.*, 2018:987). However, emerging data management technology such as blockchain can improve order forecasting by minimizing the gap between predicted and actual sales. Such technology tracks and trace products information throughout the food supply chain and improves inventory monitoring (Marin *et al.*, 2019:3275; Annosi *et al.*, 2021:218).

### **2.6.7 Policy and legislation**

Policy and legislation are cited to be a major instrument for effecting food waste reduction in the retail sector. This is because issues around date labelling impede the redistribution of food for re-use-by those in need. While some countries have developed legislation to enable the donation of food affected by date labelling, such policy and legislation is absent in most countries.

#### **2.6.7.1 Date labelling**

Date labelling is a crucial merchandising aspect of the retailing process. The purpose of date labels such as “sell-by” or “best-before” is to ensure product freshness to the consumers and to assist the retail stores with stock rotation (Le Roux, 2017:21)

Date labelling is cited as one of the prominent drivers of food waste globally, at the latter stages (market and consumer) of the food supply chain. This is mostly attributed to misinterpretation of “sell-by”, “use-by” and “best-before” dates (Venter, 2017: 90). Items about to or that have reached their “sell-by” and “best-before” dates are often removed from sales and thrown away by grocery retailers (Gruber *et al.*, 2016:15).

In the grocery retail sector, literature demonstrates that food that is still in good condition get discarded instead of being donated because the retailers are worried about corporate image implications and prosecution should the subsequent consumer become ill after eating that food (Gruber *et al.*, 2016:19; Patra *et al.*, 2020:2).

A study conducted by (Venter, 2017: 86) on the “*consumer’s knowledge of date labelling and the influence thereof on household fresh produce waste practices in Gauteng*”, it was concluded that “consumers’ knowledge of date labelling does contribute to household waste practices in Gauteng”. Although this did not feature as one of the three top reasons for wastage of fresh produce at the household level, it did feature on the top five list.

To curb food waste generation driven by misinterpretation of “sell-by” and “best-before” dates at household level, retailers have a key role in providing guidance and awareness to consumers. Many foods can be safely consumed after their “sell-by” and “use-by” dates (FUSIONS, 2014).

Date labelling of food products is governed by law in many countries. In South Africa, it is governed by Regulation 146 of March 2010 in terms of the Foodstuffs, Cosmetics and Disinfectants Act (54 of 1972), which provides for mandatory date stamping on food with exception of few items such as unprocessed honey, unpacked meat, vinegar, sweets, and fresh produce (DoH, 2010). In essence, all perishable pre-packaged food products must have a “sell-by” or “best-before” date (Venter, 2017: 26).

#### **2.6.7.2 Lack of policies to encourage redistribution**

Retailers within the countries that do not have legislation to encourage food redistribution are reluctant to donate products to charity organizations that have passed their “best-before” date. Even though these products are still fit for consumption, retailers fear law action should the charity recipients fall ill (Gruber *et al.*, 2016:19; Hermsdorf *et al.*, 2017:2541; Patra *et al.*, 2020:2)

Some developed countries have developed legislation to encourage redistribution of products that have passed their “best-before” dates, under specific conditions. However, it is still a problem to implement this in practice because clarity in terms of how to correctly handle such products is absent as authorities do not provide detailed official guidance about that subject. As a result, retailers are sceptical of donating these product because of problems that may arise (FUSIONS, 2014; Baglioni *et al.*, 2016:2039).

In South Africa, legislation that would encourage donation of surplus food “food waste” to the hungry, the “UBUNTU SURPLUS FOOD DONATIONS BILL”, is being proposed through a draft bill. This legislation mimics food waste legislation developments in the developed countries such as Italy and France (Southern Africa Food Lab (SAFL), 2017). It is hoped that it would facilitate the donation of surplus food “food waste” to the hungry by:



- “protecting farmers who allow gleaners to collect surplus food on the land post harvesting for distribution to the needy;
- protecting good faith donors of surplus but wholesome food to Non-Government Organizations (“NGO”) for distribution to the needy; and
- protecting good faith donors of food that may be deficient in one form or another (e.g. it has reached its “use-by” date) to a responsible NGO that can test that the donated food is still wholesome and fit for human consumption, and if necessary recondition it (where possible) prior to distribution to the needy” (SAFL, 2017).

## 2.7 Management of food waste

This chapter reviews the management of food waste at the grocery retail level in relation to the strategic direction (2.7.1), the waste management hierarchy (2.7.2), and the governance instruments (2.7.3).

### 2.7.1 Strategic context

As a member of the United Nations (UN), South Africa participated in the development of the SDGs. These seventeen interconnected goals are the main mechanism for guiding development globally and they consist of 169 targets to be achieved by year 2030. SDG 1 aims to end poverty in all its forms and everywhere, whilst SDG 2 aims to end hunger, achieve food security and improved nutrition and promote sustainable agriculture and focuses on addressing issues of world hunger through, *inter alia*, minimizing food losses and food wastage. SDG 12 focuses on sustainable consumption and production with target SDG 12.3 established to drive 50% reduction of global food waste at the retail and consumer levels and reduction of food losses along production and supply chains, including post-harvest losses. Target 12.3 gave birth to a collaborative group known as *Champions 12.3* which comprises of various food waste stakeholders globally. *Champions 12.3*’s objective is to implement and achieve target 12.3 through specific, targeted approaches, including implementation and measurement (UNDP, 2020b).

At regional level, commitments to reduce food waste are enshrined in the Malabo Declaration. The objective of this declaration is to end hunger by the year 2025 in Africa through *inter alia*, halving the post-harvest losses by 2025 (African Union (AU), 2014).

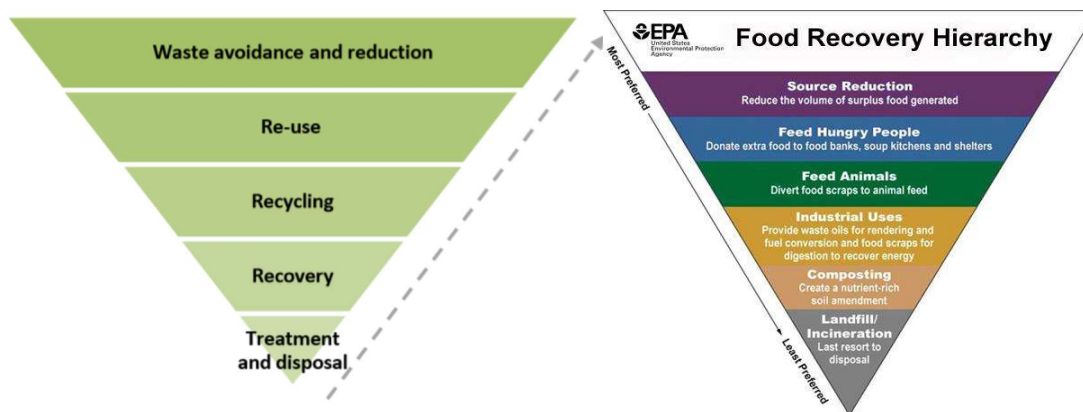
Pertinent to the issue of the SDGs, is the National Development Plan (NDP) which is a long term roadmap plan towards achievement of the South Africa’s strategic goals by the year 2030 (NPC, 2012). Chapter 11 (Social protection) of the NDP addresses food security and nutrition as one of the government priorities. It states that “*problems such as hunger, malnutrition and micronutrient deficiencies that affect physical growth and cognitive development, especially among children,*

*should be addressed and no one should suffer poverty induced hunger, thus no individual should live below the poverty line of R419 (2009)”* (NPC, 2012:363). The NDP and Medium Term Strategic Framework (MTSF) (which is the NDP’s 5-year implementation plan) are broadly aligned with the SDGs. Hence, the implementation and achievement of the MTSF’s objectives will subsequently contribute towards the achievement of SDG targets (CSIR, 2017).

The NEMWA is a specific environmental management Act (SEMA) for waste management and a backbone of integrated waste management regime in South Africa. The National Waste Management Strategy (NWMS), which was established in 2012 to facilitate the achievement of NEMWA objectives, comprises of key goals accompanied by targets to be achieved within specific timeframes which among others are the targets to improve waste data quantification, and reporting and improve diversion of waste from landfilling to reduction, repurposing, recycling and recovery. The waste management hierarchy is prescribed by the NWMS as a tool to improve waste management. Additionally, composting of organic waste is one of the initiatives promoted by the NWMS to achieve the objectives of the waste management hierarchy (DEA, 2012). To this end, the National Organic Waste Composting Strategy (NOWCS) was initiated for the purpose of prioritizing composting organic waste over landfilling in 2013.

### **2.7.2 The waste management hierarchy**

Integral to the policy direction of waste management is the waste management hierarchy. Globally, countries including South Africa have adopted the waste management hierarchy as a platform to address waste challenges in an integrated manner (DEA, 2012; Giordano *et al.*, 2020: 2; Redlingshöfer *et al.*, 2020:3). The NWMS advocates that the waste management solutions should follow the priority steps set on this hierarchy. Source reduction is the priority step in the waste management hierarchy, followed by re-use, recovery and disposal as the last resort (DEA, 2012). Figure 2-2 below demonstrate the waste management hierarchy with waste management options according to their level of priority, as well as the food recovery hierarchy. The similarities in priorities of these hierarchies, with avoidance and reduction as the most preferable option, and landfilling as a last resort, are clear.



**Figure 2-2: The waste management hierarchy (left) (from the DEA, 2012) and the food recovery hierarchy (right) (from US EPA, 2017)**

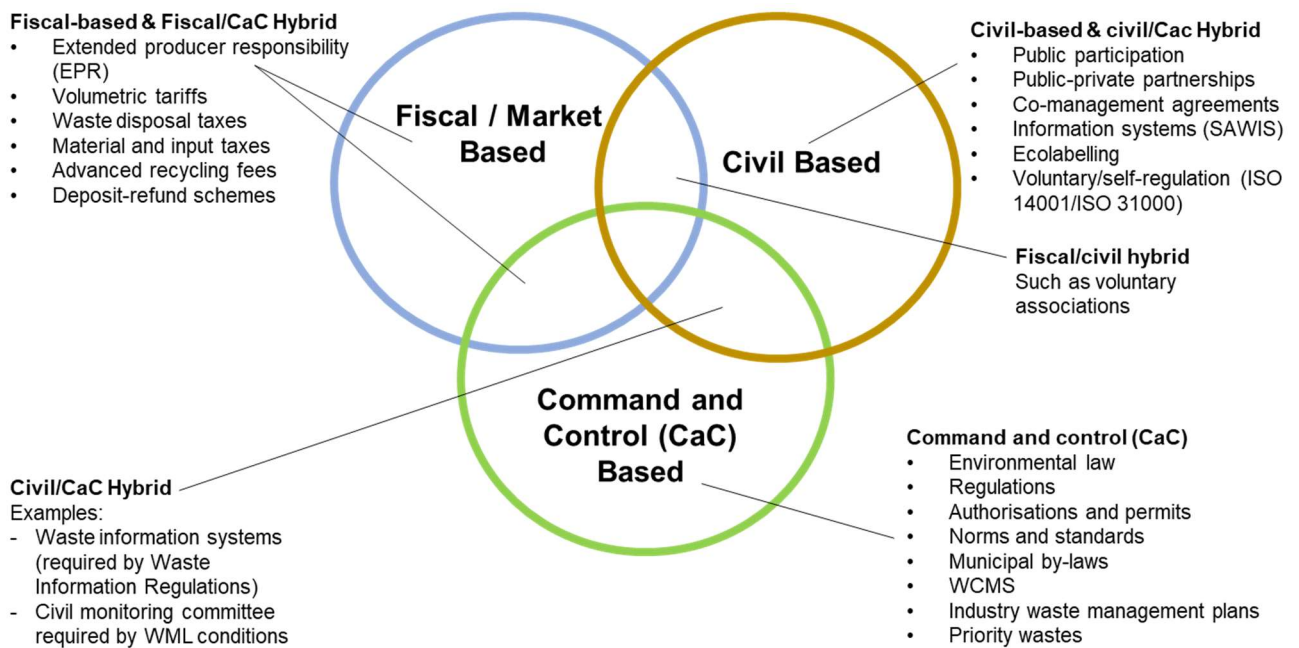
In the context of food waste at grocery retail level, priority on avoidance and reduction relates to the prevention of food waste generation and volume reduction, whilst the re-use tier relates to the donation of food waste for the purpose of feeding people and animals. Recycling relates to the production of compost, with the recovery tier encouraging the use of food waste for industrial purposes such as energy recovery. Landfill disposal remains as the last option for managing food waste (Papargyropoulou *et al.*, 2014:113).

With the growing attention on food waste, some countries have developed waste management hierarchies specific to food waste which resemble the generic hierarchy. Such examples include the food and drink material hierarchy published by the Waste and Resources Action Programme (WRAP) in the UK in 2013; and the food recovery hierarchy developed by the United States Environmental Protection Agency (USEPA) in the United States (USEPA, 2017; Goodman-Smith, 2018:12) (Figure 2-2).

### **2.7.3 Food waste management approaches and governance instruments**

Environmental or waste governance instruments are a critical component for effective environmental governance. These can be “*anything that can be used to achieve an environmental, waste, or sustainability-related outcome*”, they come in different shapes and forms and they serve different purpose. Each approach presents unique opportunities and challenges, and can be used alone or in combination with another.

This section discusses governance instruments (i.e. fiscal, command-and-control, civil based and voluntary instruments) in the context of food waste at the grocery retail level of the food supply chain. Figure 2-3 below demonstrates policy approach instruments for food waste management in South Africa.



**Figure 2-3: Governance approaches for (food) waste management in South Africa  
(Adapted from North-West University, 2018)**

### 2.7.3.1 Command-and-control approach

The command-and-control approach provides for legislative and regulatory instruments, which involve setting compliance conditions and requirements to influence human behaviour and the application of strict laws (such as criminal sanctions imposed to those who breach the law or the set conditions and requirements). Administrators then monitor performance against the prescribed conditions and action enforcement for non-compliances (Bosman & Kidd, 2009: 647).

Law promulgated by France in 2016 that bans stores that are bigger than 400m<sup>2</sup> from throwing away food that is still edible and oblige them to redistribute to food banks is an example of a command-and-control instrument. This law clarifies the waste management hierarchy in the context of food waste and also obliges retailers to sign an agreement with charity organizations to donate food that would have been wasted and introduces fines for non-compliance (Luis González 2017:227). Apart from legislation applicable to waste in general (such as the waste management hierarchy, requirements for landfill disposal, etc.), no specific law exists for the management of food waste in South Africa.

### 2.7.3.2 Fiscal approaches

Fiscal approaches take advantage of financial mechanisms such as incentives and disincentives to influence societal behaviour (Bosman & Kidd, 2009: 647). In the context of waste management, a suggestion was raised that fiscal measures can facilitate the reduction of waste and also divert it from landfill (Nahman & Godfrey, 2010:521).

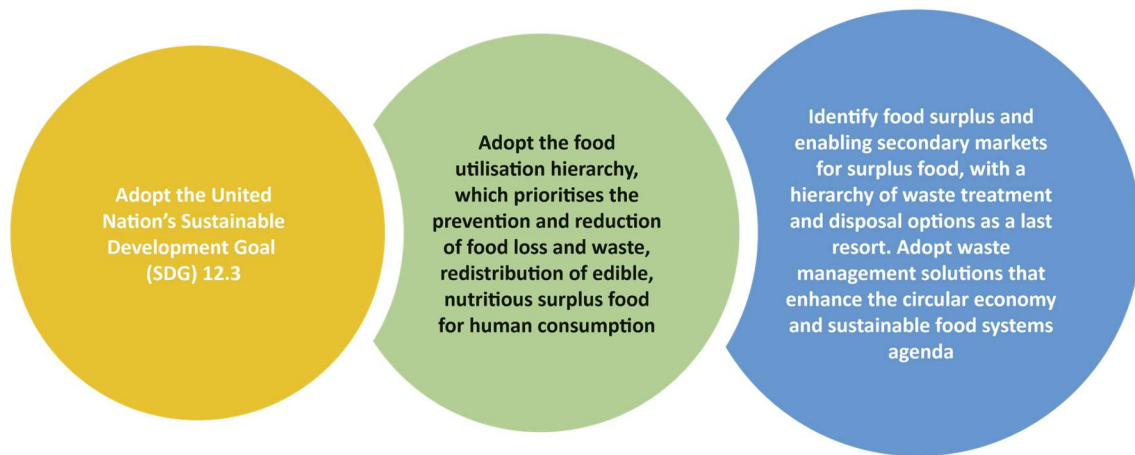
Italy is an example of a country where fiscal measures to reduce food waste were initiated (Giordano *et al.*, 2020:1). This country passed a law in 2016 with the intention to reduce 1 million of 5 million tonnes of food wasted per year. In this law, businesses will not be sanctioned if they donate food that have passed “sell-by” or “best-before” date and they will get tax cuts equivalent to the amount of food given away (Luis González 2017:229). This instrument demonstrates a hybridism of command-and-control and fiscal instruments.

### **2.7.3.3 Civil and agreement-based approaches**

This is an inclusive approach which involves engagement with stakeholders by capacitating them in terms of knowledge and awareness. The purpose is to encourage stakeholders to take responsibility for the environment and put pressure on industries and municipalities to improve environmental performance. It can be done through platforms such as environmental education, public participation and media exposure (Bosman & Kidd, 2009:647).

In the context of food waste, such initiatives include the *WWF SA Market Institute food waste programme* which convenes with key stakeholders across the hospitality, retail and food service sector to promote data transparency and understanding of how to accelerate the adoption of strategies to measure and reduce waste (WWF, 2020). The South African *think-eat-save (TES) Food Waste Prevention Programme* launched by the UNEP in 2015 is another example. In 2013, TESCO made a commitment to be a global leader in food waste reduction. They measure and publish food waste data to identify hotspots for action where surplus food is donated to charities, community groups and animal feed (TESCO, 2013).

*Agreement-based approaches relate to actions such as self-regulations developed by the industry generally aimed to deliver the policy objectives faster and/or in a more cost effective manner compared to mandatory requirements* (FUSIONS, 2016). In South Africa, the Consumer Goods Council of South Africa (CGCSA), in partnership with the Department of Trade, Industry and Competition (DTIC), and the Department of Environment, Forestry and Fisheries (DEFF) has developed a voluntary agreement (VA) reduce food loss and waste. This initiative was co-funded by the European Union (SA-EU Dialogue Facility). The VA was launched on the 29<sup>th</sup> of September 2020 and has received massive support from businesses and stakeholders within South Africa’s food sector which include amongst others, Woolworths, Spar, Pick n Pay, Danone, Massmart, Checkers and Shoprite, Tiger brands, Distell, and Nestle. These businesses have become core signatories of the VA, signalling their commitment to initiatives to reduce food waste in their businesses in line with the SDG. 12.3 (CGCSA, 2020). Figure 2-4 depicts the vision of the VA.



**Figure 2-4: VA vision (Adapted from CGCSA, 2020)**

## **2.8 Chapter summary**

This chapter discussed food waste by highlighting the definition found in literature and associated challenges caused by inconsistencies in the definition. It also highlighted diversity of methods used in food waste studies. Food waste occurring at the grocery retail level was also reviewed by looking at different classes defined by literature, quantification studies conducted and management options used. This revealed that a variety of methodologies are used to understand food waste, globally.

The literature review has indicated that fresh produce, followed by dairy and bakery products are the most dominant food waste categories identified by literature. Food waste drivers were also discussed with shelf life and issues around date labelling being the most prominent drivers of food waste production.

The last section of the literature review discussed food waste management from South Africa's strategic direction focusing on governance/management approaches, such as command-and-control, fiscal and civil/agreement-based approaches.

## CHAPTER 3: RESEARCH METHODOLOGY

### 3.1 Introduction

This chapter outlines the research methodology to address the research objectives of this study, and motivate the methodological choices made. This chapter needs to be considered in the context of the inclusions and exclusions of the research scope (Chapter one, Section 1.4).

### 3.2 Research design

The research, aimed at understanding food waste management practices in the grocery retail sector (using grocery retail stores in Durban as a case study), followed a mixed-method approach by gathering qualitative and quantitative data. This method is similar to an approach used by Goodman-Smith (2018: 38) who quantitatively and qualitatively characterized retail food waste in New Zealand. The research by Goodman-Smith (2018), adapted a three-component method used by the WRAP UK, developed in line with FUSIONS quantification manual guidelines. This model involves on-site food waste characterization, interviews with key retail stakeholders, as well as analysis of existing food waste data. The research design of this study was supported by similar studies done by other authors, and is provided in Table 3-1.

**Table 3-1: Research design and methodology**

Research objective (RO)	Methodology	Author reference
RO1: Assess (identify, categorize and quantify) food waste types from selected grocery retail stores	Analysis of existing (secondary) food waste quantification data  On-site food waste evaluation and characterization	Eriksson 2012:25; Brancoli <i>et al.</i> , 2017: 40; Goodman-Smith <i>et al.</i> , 2020:3  Lebersorger & Schneider, 2014: 1913; Goodman-Smith <i>et al.</i> , 2020:3
RO2: Determine how food waste is managed in relation to the waste- and food waste management hierarchies	Semi- structured interviews with store manager and waste manager  On-site food waste food waste evaluation and characterization	Gruber <i>et al.</i> , 2016: 5; Filimonau & Gherbin, 2017: 1188; Kiaugaitė & Kruopienė, 2018:11; Goodman-Smith <i>et al.</i> , 2020:3  Lebersorger & Schneider, 2014: 1913; Goodman-Smith <i>et al.</i> , 2020:3

Research objective (RO)	Methodology	Author reference
RO3: Explore the drivers behind food wastage in the grocery retail sector	Semi-structured interview with store manager and waste manager	Gruber <i>et al.</i> , 2016: 5; Filimonau & Gherbin, 2017: 1188; Kliaugaitė & Kruopienė, 2018:11; Goodman-Smith <i>et al.</i> , 2020:3
RO4: Explore motivators and opportunities for food wastage prevention and reduction in the grocery retail sector	Semi- structured interview with store manager and waste manager supported by literature review	Gruber <i>et al.</i> , 2016: 5; Filimonau & Gherbin, 2017: 1188; Kliaugaitė & Kruopienė, 2018:11; Goodman-Smith <i>et al.</i> , 2020:3

### 3.3 Study area selection and description

The study was conducted in Durban (eThekweni Municipality), a city in the province of KwaZulu-Natal situated within the east coast of South Africa. It is the third largest city in South Africa and covers an area of about 2,297 km<sup>2</sup> with a population of approximately 3.7 million people growing at a rate of 1.1% per annum that includes rural and urban landscapes (Moodley *et al.*, 2019: 2).

The selection of this area was based on its geographical proximity which made it convenient for the researcher to reach the study sites. Another reason was the shrinking landfill airspace in this municipality and the high level of food insecurity in the urban areas within this.

The city has four landfill sites: Bisasar landfill site, Mariannahill landfill conservancy site, Buffelsdraai landfill conservancy and the Lovu landfill site. These landfills accommodate approximately 1.4million tons of general waste, including food waste, per year. Bisasar landfill has reached its full capacity and only accepting separated garden waste, building rubble and covering material for site rehabilitation purposes. Mariannahill landfill conservancy site is left with just over a year lifespan, the downsizing of the Bisasar landfill site added tonnages of waste to be accommodated by the Mariannahill site. The landfill security at the Buffelsdraai landfill conservancy site and the Lovu landfill site is 70 and 35 years respectively. However, pressure from waste tonnages that should be accommodated by the closed landfills will reduce the lifespan of these sites (Moodley *et al.*, 2019:2).

Shortage of food and hunger remains a problem in South Africa. In 2017, households with children aged five years or younger experienced hunger. The highest proportion of households that experienced hunger were from KwaZulu-Natal and more than half of these, with young children, were in urban areas (Stats SA, 2019).



Food waste that is being landfilled in Durban needs to be diverted to feed the hungry. It therefore makes sense for this city to be the main focus of this research.

### **3.4 Sampling method and sampling size**

Prior to the commencement of this study, the sampling size was determined based on the study timeframe, resources available and the aim of the study.

Non-probability sampling method involves selection of the participants that will provide rich information to the study. Convenience sampling is when participants are selected based on their availability and willingness to participate (Creswell, 2014).

Four large retail chains were initially approached for inclusion in the study, but only one agreed to participate in the research. Eriksson (2012:25) and Goodman-Smith *et al.* (2020:4) also used convenience sampling during their studies. Furthermore, Eriksson (2012:25), Cicatiello *et al.* (2016: 100) and Brancoli *et al.* (2017:40) studies demonstrate that small sample sizes are typical in research focusing on food waste in the retail sector.

The purpose of this study was to gain a rich understanding of how food waste is managed in the retail industry using three grocery retail stores in Durban using non-probability convenience sampling methods. The sample size, two supermarkets and one hypermarket belonging to the same retail chain, was considered to be adequate for the purposes of this research.

### **3.5 Selection of stores**

Stores were selected based on their geographical proximity to the researcher and their willingness to participate. A hypermarket and two supermarkets were selected to participate in this study.

### **3.6 Recruitment of stores**

The required authorization process from the relevant grocery retailers was followed to obtain the research data. Four large retail chain groups were approached in order to access data from individual stores and only one group agreed to take part in the study. This process followed a negotiating process recommended by Lewis (2003:62) where the retail groups “gatekeepers” must be approached for obtaining clearance. Three grocery stores (belonging to the one retail chain) were selected to participate in the study. Upon approval, a non-disclosure agreement (NDA) from the retail group was signed by the retail group representative from head office and the researcher. This was to ensure that all store identification information was kept anonymous due to the commercial sensitivity of this type of data. The retail store representative also provided the historical food waste quantification data and issued an approval letter, which was used when approaching stores for data access.

### **3.7 Pilot study on data collection methods**

A pilot study was conducted at a local supermarket to test the methods developed for data collection including time and resources that will be needed to execute the main research.

This supermarket presented similar characteristics as the final selected store formats in terms of, *inter alia*, departments offering various food products, screening of shelves and withdrawal of food items that have passed or are close to pass their “best-before” or “use-by” date, donation of these items to the local charity and the disposal of food waste to the municipal landfill.

Data were collected on a single day in July 2019 and involved a semi-structured interview with the store manager and back-of-store tour to observe how food waste was dispatched from the store, stored at the storage facility and collected for landfilling.

This pilot study assisted the researcher to prepare better with regards to time and resources needed to collect data at the stores. Informed by the results of the pilot study, it was decided that the site visits to each store must be done for two days, the first day for semi-structured interviews and the second day for on-site characterization and assessment exercise.

Feedback from the respondent of the pilot study was used to review and revise data collection methods. Semi-structured questionnaires with interview questions were adjusted in order to clarify the areas, which were unclear during the pilot exercise. The information obtained during the pilot study is not reported in this dissertation. The pilot study was merely conducted to test and improve data collection methods.

### **3.8 Data collection**

Primary and secondary data were collected for the purposes of the research. The primary data were gathered from the on-site food waste characterization, as well as interviews, whilst the secondary data included archival documents and administrative records on quantities of food waste generated. Data collection was also supported by the review of existing literature on similar research. Table 3-2 provides information of the store departments and their food categories for which food waste data were collected and presented in this study.

**Table 3-2: Store departments and their food categories (Source: Own research)**

Store department	Food categories
Butchery	Meat and related products such as mince
Cheese bar,	Various cheese categories
Cold deli,	Desserts
Convenience meals	Prepared meals
Deli	Platters
Deli prepared foods	Fine prepared foods such as sandwiches and salads
Fish shop	Frozen fish products
Fresh produce	Vegetables and fruits
In-store	Bakery items baked in-store
Outsourced bakeries	Bakery items sourced from the external service provider
Perishable groceries	Dairy products, such as milk, yogurt and other dairy products
Poultry	Chicken

### **3.8.1 Analysis of existing (secondary) food waste quantification data**

Raw (secondary) data from the private archival documents and administrative records for a period of 12 months (July 2018 to June 2019) were collected from all three grocery stores and analysed. Raw data were retrieved from the waste recording system of each store (in Microsoft Excel format) and emailed to the researcher by the store representative based at head office. This data was used to address RO1, i.e. *assess (identify, categorize and quantify) food waste types from selected grocery retail stores.*

The data provided were arranged in monthly column series, store information and different categories of food waste.

No secondary data existed on food quantities and their destination (i.e. how much food waste was actually collected by the foodbank and how much was disposed to landfill).

### 3.8.2 On-site food waste assessment and characterization

The retail group had an external service provider responsible for waste management activities at most of their individual stores. This waste manager provides on-site waste minimization services by extracting recyclables to reduce to the amount of waste sent to landfill however; no recycling or recovery was being implemented for food waste. The retail group had an established system in place for recording food waste at their stores. This was a standard procedure and the routine involved screening of shelves by each department in the store every afternoon and the withdrawal of food items that have passed or are close to pass their “best-before” or “use-by” date, damaged items, and items declared unsaleable by staff due to any other reason. Once items were removed from shelves, their barcodes were scanned prior to placing the items into a wheelie bin and sending it to the receiving department every morning.

Two visits were made to each of the three grocery stores. The site visits were conducted between August and September 2019.

On-site visits involved back-of-store tours with the waste manager to observe how waste was dispatched from the store, stored at the storage facility and collected for re-use and landfilling. The receiving department (RD) manager also assisted with the characterization exercise in terms of how waste is received from the store to the RD, and how waste is dispatched from RD to different destinations. Upon arrival, the researcher was given a waste record from the store, which was verified by the RD and then directed to the location for collection by the foodbank and the municipal waste removal truck for landfill disposal.

Food waste was separated into different categories (bakery, fresh produce, dairy, meat, and prepared meals) weighed and recorded on the formulated record sheet (Appendix D). During the time of the assessment and characterization exercise, these categories (bakery, fresh produce, dairy, meat, and prepared meals) were the only food items found in the waste pile. Each time, the scale was tared to zero, the weight and quantity were verified against the RD's record.

Where food redistribution was being implemented, the researcher developed two sets of data (quantity collected by the food bank and quantity destined for landfill disposal). As mentioned earlier, no secondary data existed on food quantities and their destination (i.e. how much food waste was actually collected by the foodbank and how much was disposed to landfill). This is because the RD only measured how much food waste products they received from the store against how much they dispatched, not considering to which destinations they were dispatched to.

Only the process flow observation and waste separation data of the on-site food waste assessment and characterization exercise are presented in the results of this study. Together with the secondary quantification data, were used to respond to the RO1: *assess (identify, categorize*

and quantify) food waste types from selected grocery retail stores. Quantitative data from this exercise was solely used to verify the accuracy of the secondary data.

**3.9 Semi-structured interviews**

In order to obtain a broader insight on how food waste is managed against the waste management hierarchy, to identify related challenges, and to identify opportunities for food waste reduction in the future, semi-structured interviews were conducted. Interviews were pre-arranged with the store representative. The total sample of four people was interviewed and this included each facility’s management representative and the retail group’s external service provider responsible for waste management.

Table 3-3 provides a summary of the interview question categories posed to participants. Appendices B and C provide the full set of questions.

**Table 3-3: Summary of interview question themes**

Area of investigation	Question themes
RO2: Food waste management measures.	Measures to prevent or reduce food waste Measures to re-use food waste Measures to recover food waste Disposal of food waste
RO2: Drivers for food waste.	Barriers for food waste reduction in-store Why other waste diversion avenues are not used
RO4: Motivators and opportunities for food waste reduction.	Key benefits for food waste reduction What can be done to encourage future food waste reduction initiatives in the grocery retail industry

Consent forms (Appendix A) were presented to interviewees prior to the interviews and the on-site characterization exercise. Interviews were between 20 and 30 minutes long, and the researcher recorded the responses to interview questions by hand (Appendix B for store managers and Appendix C for the waste manager). No recording device was used during interviews. The questionnaire (Appendix B & C) consisted of open-ended questions around food waste occurring at the store and semi-structured questions around food waste drivers, management options being implemented and the areas of improvement (Appendix B & C).

### **3.10 Literature review**

A review of international, published literature formed the basis of this study. Scopus and Google Scholar were used to search for similar studies, using search words such as *“food waste”, “food waste from the retail sector”, “food waste from grocery stores”, “food waste drivers”, “food waste reduction opportunities”, etc.*

The literature review was used to gather background information on food waste in the grocery retail sector in terms of: food waste drivers, management options, preventative and reduction measures, and the food categories that are frequently wasted. This information informed data collection (on-site assessment and evaluation) and provided guidance for structuring the questionnaires for semi-structured interviews. The literature review, further, provided data and information related to food waste from the grocery retail industry to provide for comparison to the results of this study.

### **3.11 Data entry and cleaning**

This section discusses how data from existing, historical quantification records, on-site assessment, and semi-structured interviews was entered and cleaned prior detailed analyses.

#### **3.11.1 Existing quantification data**

The existing quantification data provided for this study were presented in a Microsoft Excel spreadsheet with monthly column series, store information and different categories of food waste. Data from on-site assessment was used to verify the accuracy of this data. No inconsistencies were identified.

#### **3.11.2 On-site assessment and characterization**

The researcher used the recording sheet (Appendix D) to record food waste quantities and types during the on-site assessment and characterization exercise. This information was then entered into Microsoft Excel on a password protected computer. Each store was assigned a unique ID number. Data were entered into a separate spreadsheet for each store and triple checked by the researcher against raw data collected during the on-site assessment exercise. Quantitative data from this exercise were solely used to verify the accuracy of existing quantification data extracted from the retail group archives. Data entry and cleaning process was conducted by the researcher a day after collecting on-site characterization data.

### **3.11.3 Semi-structured interviews**

Microsoft Word was used to type out the information on interview sheets which were manually written. This raw data consisted of multiple responses from four participants (three from the retail stores and one from the retail group waste manager who was an external service provider). Where responses were unclear, the participants were contacted telephonically to verify their responses. The typed responses were imported into Nvivo-12 statistical software for subsequent detailed analysis.

### **3.12 Data analysis**

Mouton (2001:159) states that utilization of statistical methods is suitable for processing and presenting quantitative data in the form of graphs, write-ups and tables. The quantitative data were processed and analysed using spreadsheet calculations. The results were then presented in a table which illustrates the weights of food waste in kilograms, pie charts which presents the percentage of food waste per stream, and the discussion around the quantity of waste in relation to literature. Prior to detailed analysis of the existing, historical data, the quantification data obtained from on-site assessments were used to check errors and inconsistencies of the historical quantification data.

Statistical software Nvivo version 12 was used to analyse qualitative data. Thematic analysis was used to identify patterns in the interview data through deductive reasoning which was informed by literature review. The deductive approach entails using pre-determined themes expected to reflect on the dataset. Coding, which uses labels to group data according to specific patterns (Saldana, 2015:6) was employed. This process involved familiarisation with the data, generation of initial codes, collating of codes into themes, reviewing themes, naming and defining themes, and finally the generation of the report to present results (Braun and Clarke, 2006:79). Themes were generated by extracting sections of the interview data and developed codes under nodes library. After this activity, a codebook (Appendix E) illustrating the results of the analysis was generated. The codebook includes the identified themes, frequency (number of times the theme appears in the dataset) and reference (the number of responses that mentioned the theme). Figure 3-1 demonstrates the word frequency the most frequent words identified during the coding process.





### **3.14 Ethical considerations**

According to Lewis (2013:66), ethical considerations should be acknowledged and taken into consideration during any research. The nature of this research does not include any animal or vulnerable human participants. The research proposal for this study was reviewed by the Scientific Committee of the Environmental Management Research Group (EMRG) in the Unit for Environmental Sciences and Management and was exempted from full review by the Faculty of Natural and Agricultural Science's Research Ethics Committee (REC), because the methodology followed was considered to be a minimal ethical risk. Ethical clearance was obtained (ethics number: NWU-01389-20-A9).

The required authorization process from the relevant grocery retail group was followed to obtain the research data. Upon approval, a NDA from the retail group was signed by the retail group representative from head office and the researcher. This was to ensure that the store identification information and the research participants details are protected and remain anonymous. Consent forms (Appendix A) were presented to interviewees prior to the interviews and the on-site characterization exercise.

### **3.15 Chapter summary**

This chapter provided a detailed description of the methodology used in this research. A mixed-method approach was used, where quantitative research methods were used to analyse quantitative data both from on-site audit and historical records. Qualitative methods were used to analyse semi-structured interviews. Methodological limitations and ethical considerations were also addressed in this chapter. The following chapter gives a detailed account of the analysis of the data and the results of this study.

## CHAPTER 4: RESULTS AND DISCUSSION

### 4.1 Introduction

Existing food waste quantification data, in-store food waste characterization data and interview responses were obtained from all three participating stores. This chapter presents and discusses the results related to the four research objectives:

- *RO1: Assessing (identify, categorize and quantify) food waste types from selected grocery retail stores;*
- *RO2: Determining how food waste is managed in relation to the waste- and food waste management hierarchies;*
- *RO3: Exploring the drivers behind food wastage in the grocery retail sector; and*
- *RO4: Exploring the motivators and opportunities for food wastage prevention and reduction in the grocery retail sector.*

### 4.2 Results related to RO 1: Assessing the food waste types from selected stores

Different categories of food waste produced by the selected stores were observed and assessed during the on-site food waste characterization exercise and waste management process flow observation as explained in chapter three.

Data quantified from historical waste records demonstrated that the investigated departments within the three selected stores produced a total of approximately 218.5 tonnes of food waste during 1 year, from July 2018 to June 2019. Waste records per store indicated that:

- Store 1 produced approximately 58.7 tonnes of food waste per year,
- Store 2 produced approximately 73.7 tonnes of food waste per year, and
- Store 3 produced approximately 86 tonnes of food waste per year.

The slightly higher quantities of food waste produced by store 3 may be ascribed to the fact that store 3 is a hypermarket, which is larger and stocks more food products, when compared to supermarkets (store 1 and store 2). It was not an objective of this study to compare the food waste quantities per store, but rather to understand food waste types or categories overall, as represented by the three stores, therefore, no further analysis was done to explain the differences in waste quantities among the three stores.

Table 4-1 below outlines the amount of food waste produced in kilograms (kgs) per food waste category (as represented by the different store departments), and Figure 4-1 demonstrates the percentages of food waste categories from store departments. The food waste produced per

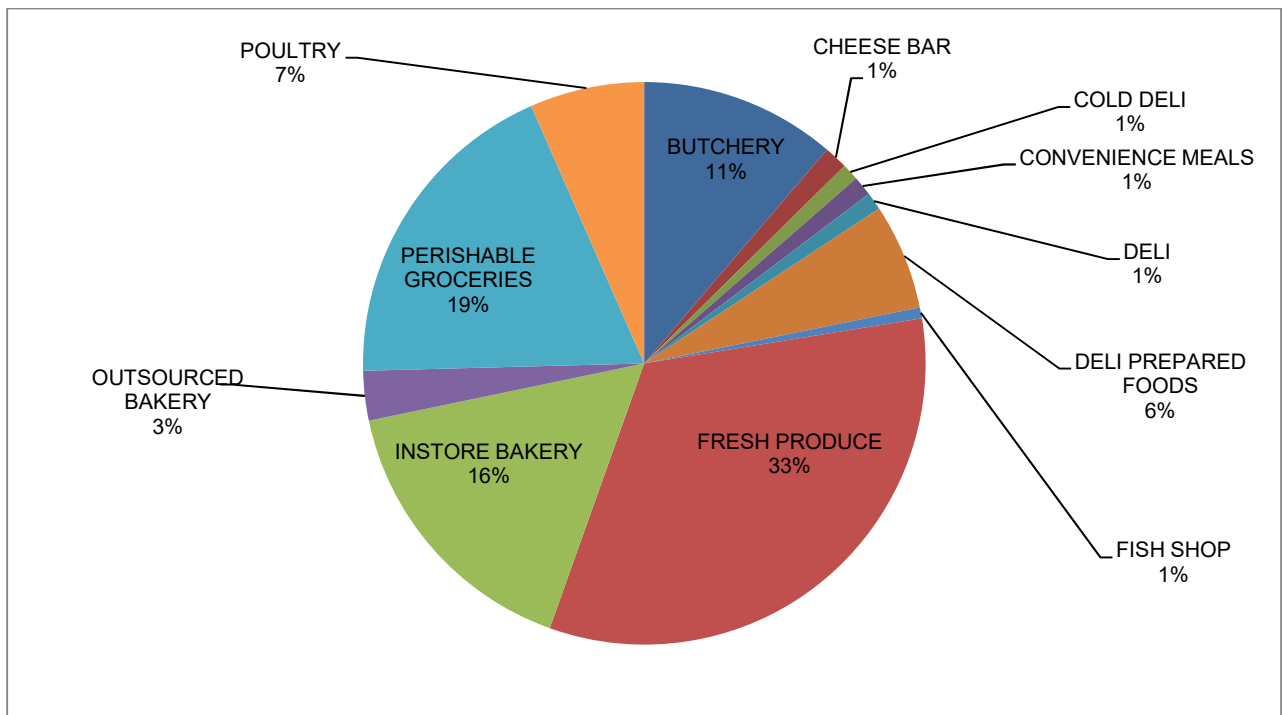
department was considered jointly, to provide the total amount of waste produced per department (combined for the three stores).

**Table 4-1: The amount (kilogrammes) of food waste produced**

Store Department	Store 1 (Supermarket)	Store 2 (Supermarket)	Store 3 (Hypermarket)	Departmental Total
	Kg	Kg	Kg	Kg
Fresh produce	19 006	22 349	30 786	<b>72 141</b>
Perishable groceries	11 891	14 312	14 926	<b>41 129</b>
In-store bakery	7 616	19 698	8 236	<b>35 550</b>
Butchery	8 488	4 351	11 767	<b>24 606</b>
Poultry	2 309	3 103	8 991	<b>14 403</b>
Deli prepared foods	4 055	5 723	3 529	<b>13 307</b>
Outsourced bakery	1 870	2 031	2 338	<b>6 239</b>
Cheese bar	1 224	420	1 284	<b>2 928</b>
Convenience meals	462	2	2 019	<b>2 483</b>
Deli	822	532	852	<b>2 206</b>
Cold deli	610	1 001	501	<b>2 112</b>
Fish shop	340	186	857	<b>1 383</b>
<b>Store Total</b>	<b>58 693</b>	<b>73 708</b>	<b>86 086</b>	<b>218 487</b>

#### 4.2.1 Quantities of food waste per retail store department

Figure 4-1 provides the food waste quantities per store department for the three stores combined.



**Figure 4-1: Percentage of food waste per retail store department for three stores (combined)**

The fresh produce department generated approximately 72.1 tonnes of waste, which makes up 33% of the total waste generated by the stores. This department represents fruits and vegetables, which were amongst the most wasted food items. These results are consistent with results reported in previous literature where fruit and vegetables are usually accounted as the largest quota of food waste stream (Eriksson, 2012:31; Lebersorger & Schneider, 2014:1916; Cicatiello *et al.*, 2017:278; Kliaugaitė & Kruopienė 2017:12).

Perishable groceries, which mostly include dairy products, such as milk, yogurt and other dairy products (but not cheese – which is included in the cheese bar) were the second most wasted food category at 41.1 tonnes (19%). The magnitude of dairy products waste is in line with the findings from Kliaugaitė and Kruopienė (2017:12) who found that dairy products constituted 20% of the total studied food waste stream generated in the Lithuanian retail sector. This category also contributed the highest percentage to the total waste sent to landfill in a study conducted by (Goodman-Smith *et al.*, 2020:6), usually because it may be unfit for human consumption.

The bakery department contributed to a total of 19% of the total food waste, where the in-store bakery produced more waste (16%) compared to the outsourced bakers (3%). Similar findings are evident in literature. Brancoli *et al.* (2017: 43) and Cicatiello *et al.* (2017:277) discovered that most of the waste produced by the bakery department was made up of bread baked at the store. Cicatiello *et al.* (2017:277) reported that the magnitude of in-store bread wastage could be associated with the low retail cost of this product on behalf of the retail stores (i.e. profit margins

lost by the retail store is relatively low when in-store bread becomes waste). Take-back agreements between the retail group and bakery supplier were in place at the investigated stores and this justifies the relatively low volume of bakery products wasted from the outsourced bakery. Take-back agreements place the responsibility of waste from unsold products on the supplier. Lebersorger and Schneider (2014:1918) suggest that shifting this responsibility to the retailer would drive retailers to reduce the volumes of this waste stream. The final destination of bakery products that are taken back by the suppliers is unknown, and it should be noted that these products may still end up in landfill sites, which is not necessarily desirable.

The butchery (meat products) generated approximately 24.6 tonnes (11%) of waste, whilst the poultry contributed to 7% (approximately 14.4 tonnes) of the total amount of food waste. Deli prepared foods, convenience prepared meals, deli- and cold deli products contributed to 6% (13.3 tonnes), 1% (2.4 tonnes), 1% (2.2 tonnes) and 1% (2.1 tonnes), respectively. The cheese bar (variety of cheeses) contributed to 1% (2.9 tonnes), whilst the fish shop also represented less than 1% of the total amount of waste generated (1.3 tonnes).

Research done by others demonstrate similar findings to the results of this study. Results of a study by Lebersorger and Schneider (2014:1916) demonstrated that fruits and vegetables were a leading wasted commodity at 68%, with dairy products at 6%, bread and pastry 7%, with the remaining 19% accounted for by beverages, meat, instant meals and candies. Related results were discovered by Kliaugaitė and Kruopienė (2018:12).

The results of this research, demonstrating that fruit and vegetables contributed to more than 33% of the total amount of food waste generated highlights the importance of implementing food waste reduction strategies. Oelofse and Nahman (2013:83) suggest that such focus would have a significant impact on the reduction of food waste generation rates in South Africa. The results from their study demonstrated that fruits and vegetables, combined with roots and tubers, contributed to 57% of the investigated waste stream, whilst 6% comprised of fish, seafood and meat. They further suggest that reduction of meat waste is crucial to reduce the environmental impacts of food waste. This suggestion relates to the findings from the study conducted by Brancoli *et al.* (2017:43) where beef waste was discovered to have contributed the largest share of emissions under the climate change category despite its low mass fraction in the investigated waste stream.

#### **4.3 Results related to RO 2: Determine how food waste is managed in relation to the waste- and food recovery hierarchies**

The final destination of food waste may vary and normally includes re-use, recovery and land disposal. In a study conducted by Holweg *et al.* (2016:649), landfill disposal was a default option for several food waste products. This was also the case in a study conducted by Goodman-Smith

*et al.*, (2020:4), however, diversion to charities, re-use as animal feed, and recovery by means of biogas production were prioritized over land disposal. In South Africa, waste disposal to landfill is still common practice.

The results of the thematic analysis of interviews, supported by on-site food waste evaluation and observations are provided in Table 4-2 and discussed in this section to address research objective two – *determining how food waste is managed in relation to the waste- and food waste management hierarchies* (as presented in Figure 2-2 of this dissertation).

**Table 4-2: Summary of interview responses related to how food waste is managed in relation to the waste- and food recovery in respect of mentioned themes and frequency of appearance**

Theme	Mentioned phrases	Frequency of appearance (Number of times mentioned)
Food waste prevention and reduction	“avoid”, “avoidance”, “prevent”, “prevention”	10
<ul style="list-style-type: none"> <li>• Price mark down</li> </ul>	“price markdown”, “price reduction”	2
<ul style="list-style-type: none"> <li>• Demand planning and forecasting</li> </ul>	“demand planning”, “forecasting”	5
<ul style="list-style-type: none"> <li>• Waste monitoring and measurement</li> </ul>	“waste measurement”, “waste monitoring”	3
Re-use of food waste		9
<ul style="list-style-type: none"> <li>• Social redistribution</li> </ul>	“donation”, “redistribution”, “charities”	7
<ul style="list-style-type: none"> <li>• Internal repurposing and redistribution</li> </ul>	“In-house use at the deli”, “internal repurposing”	2
Recovery	None	0
Composting	None	0
Landfill disposal	“Land disposal”, “landfill disposal”	5

The results of the interview questions as they relate to food waste management in the context of these hierarchies are provided in Appendix E and discussed in the sub-sections below. Appendix E contains a codebook which summarizes the themes identified during the data analysis process, their reference and frequency of appearance.

#### **4.3.1 Prevention and reduction**

The waste management- and food recovery hierarchies both give priority to source reduction as a measure to prevent food waste (Papargyropoulou *et al.*, 2014:108). Phrases related to food prevention and reduction were mentioned ten times during interviews.

Price markdown and demand planning were options practiced by the investigated stores to prevent food waste at source. These themes were identified during thematic analysis and are discussed below. Waste monitoring and measurement provides the means to track and manage progress towards waste prevention.

#### **4.3.1.1 Price markdown**

Reduction of prices of food items, which are minor flawed or about to reach “sell-by” or “best-before” date, is a common strategy for preventing food from being thrown away in the grocery retail sector. This is cost effective and beneficial because retailers still get to make some money from these items, whilst preventing them from being thrown away. Price markdown is recognized as an effective way to prevent food waste by several authors (Eriksson, 2012:20; Halloran *et al.*, 2014:298; Lebersorger & Schneider, 2014:1918; de Hooge *et al.*, 2017:89 & Aschemann-Witzel, 2018:126). Garrone *et al.* (2014) additionally state that price reduction driven by expiration date increases selling chances of an item.

Price markdown was practiced by the investigated retail grocery stores (mentioned twice), however, the extent of its effectiveness is not clear, because marked down items were present in the items analysed during the characterization exercise. This may mean that the supply of these marked down food products may exceed the demand. Similar findings are evident in research by Lebersorger and Schneider (2014:1916) and Filimonau and Gherbin (2017:1191). Improved demand planning and forecasting may, therefore, be more effective strategies towards achieving food waste prevention.

#### **4.3.1.2 Demand planning and forecasting**

Demand planning and forecasting entails ordering the exact items that are going to be needed by customers, and these are key for preventing the generation of food waste (Eriksson 2012:19). Poor demand planning and forecasting have been cited as some of the main drivers of food waste in the grocery retail sector (Mena *et al.*, 2011:652).

The findings of this research demonstrate that demand planning and forecasting were being implemented by the investigated retail stores, however, this remains an area that still needs improvement because a considerable amount of food waste was still being generated. Two of the respondents specifically mentioned that demand planning and forecasting need to be improved (mentioned five times), indicating that the motivation to improve these measures is mainly driven by targets of financial profit and loss.

Respondent 1 mentioned that: *“Our main focus is in improving our procurement in order to reduce wastage, it is still work in progress but we will get there”*.

Respondent 2 also said that: *“We have participation targets on profit and loss and this make us plan and forecast better”*.

### **4.3.1.3 Waste monitoring and measurement**

Monitoring and measuring the amount of food waste generated are key in establishing proactive measures to prevent and reduce food waste. According to Erickson (2012:21), this is a crucial step towards understanding *what* is wasted, *how much* is wasted and *when* waste occurs, in order to investigate *why* wastage is occurring and put preventative measures in place.

The investigated retail chain subscribes to the SDG 12.3 target, which commits to 50% reduction of food waste by the year 2030. In this context, measuring food waste is crucial to determine baseline food quantities, and whether reduction targets are met. All three of the investigated stores were measuring and tracking the food waste that they are generating. This activity was observed during the on-site characterization exercise, and confirmed by the historical data received from the head office. Waste monitoring and measurement also appeared as a theme mentioned during interviews (mentioned three times).

Respondent 2 explained that: *“Codes are allocated to each department within the store. Each department screens shelves for items that have passed or are about to pass its expiry date. After removing them (the food products) from shelves, they scan these items into the system prior discarding them. The process takes place every afternoon”*

### **4.3.2 Re-use**

Re-use ranks as the second priority step in terms of the waste management hierarchy (DEA, 2012), whilst the US EPA’s food recovery hierarchy ranks “feeding hungry people” as its second priority. The investigated stores implemented food waste redistribution in the form of donations and in-house redistribution as part of their food waste “re-use” (or repurposing) strategy (mentioned nine times).

#### **4.3.2.1 Social redistribution**

The on-site characterization exercise identified that two of the three participated stores diverted food that is still fit for consumption to a local charity. The other store disposed all food waste produced to landfill.

Food donation in the context of food waste also appears as one of the dominant themes identified in interviews during the coding process. This practice was managed at store level based on the availability of collectors. Prior to dispatching waste to the waste area, the edible food items were isolated from the rest of the pile and kept aside to be collected by charity organizations. The charity personnel were in charge of verifying that all the items donated were perfectly fit for human consumption. Only those deemed edible were then picked up and recorded as donations. This practice was also observed in the study conducted on food waste by Cicatiello *et al.* (2017:277).



Retailers felt at ease that at least some of the food still fit for consumption is diverted to people than being thrown away.

Respondent 1 stated that: *“Shrinkage and wastage is an unavoidable by-product of the retailing process and our volume food is generally low. Most of it is taken by local charity and very less is thrown away”*

Apart from the donation to charity organizations (mentioned seven times), internal redistribution was also mentioned (twice) as a measure to “re-use” or repurpose food.

#### **4.3.2.2 Internal redistribution**

Another form of re-use being implemented by the investigated stores was to use some of the items removed from sales in their in-house kitchen. In a study conducted by Phetho (2018:70) a strategy used by the participated stores to reduce food waste whilst saving money was to re-use food that has passed its sell-by-date or best-before internally, food was “reworked in the deli and sold as salads and relish such as fruit salad or the SA’s famous *chakalaka*”.

Respondent 2 mentioned that: *“I feel that food waste is much controlled because we are able to use some items that are still in good condition at the deli and also give the rest to the charity”*

This strategy was practiced by the retailers included in a study conducted by Holweg *et al.* (2016: 648). When products were not sold after price reduction they, were used to prepare ready to eat meals in order to recover cost. Which is noteworthy, however, is that a large proportion of prepared meals (referred to as “deli prepared foods” in this study), ultimately, ends up as food waste. In a study conducted

#### **4.3.3 Recovery and composting**

Food waste, containing large fractions of organic waste, is a suitable substrate for energy recovery, usually in the form of biogas. Another option is “treating” the food waste through composting. Both of these options are preferred to landfilling in the waste management- and food recovery hierarchies (Papargyropoulou *et al.*, 2014:113).

In a study conducted by Goodman-Smith *et al.* (2020:4), 15% of the 77% food waste diverted from landfill was composted and used for protein processing. Jamaica and Thailand have a commendable record of successfully integrating food waste treatment facilities using the composting and anaerobic digestion. Vegetables and fruits are used to generate compost and biogas at the Rayong plant of Thailand whilst the CaribShare Biogas Group in Jamaica treats food waste via an anaerobic digester to generate electricity for supplying power in the rural areas (Thi *et al.*, 2015:223)

No mention was made of food waste from the retail store being used for energy recovery or composting. It may be an area that could be investigated by the retailers (in collaboration with the local authority) as a preferred option to landfilling.

#### **4.3.4 Landfilling**

The option of land disposal is the last resort in both the waste management- and food recovery hierarchies, globally.

The food waste remaining after internal redistribution and donation to charity, were collected for landfill disposal by the municipality (mentioned five times). In isolated cases where charity organizations did not arrive to collect food waste as scheduled, all of the food waste was disposed. Of the three investigated stores, one store did not implement any food waste redistribution. These results relate to the results of Holweg *et al.* (2016:649) where food waste was collected for disposal if redistribution and collection by charities did not take place. Although priority diversion avenues (i.e. re-use, recycling and recovery) were being implemented by New Zealand retailers, about 23% of investigated waste was landfilled. Dairy products followed by bakery, meat and fish products were the streams most directed to the landfill (Goodman-Smith *et al.*, 2020:4), mostly due to the risks related to their consumption, once they have passed their expiry or best-before date.

Although records were kept on the quantities of food waste being generated, no records were kept by any of the three stores to indicate how much of the food waste is donated to charity and how much ends up being disposed of at the municipal landfill site. The scope of the study did also not provide for “cradle to grave” verification to verify whether the food waste collected for landfill disposal actually end up being disposed of at the landfill site.

#### **4.4 Results relating to RO 3: Explore the causes behind food wastage in the retail sector**

Thematic analysis of interviews and the on-site waste characterization exercise results provided insights into the drivers (or causes) behind food wastage at the retail stores included in the study. Responses related to the drivers or main causes for food wastage are summarized in Table 4-3. Appendix E contains a codebook, which summarizes the themes identified during the data analysis process, their reference and frequency of appearance.

**Table 4-3: Summary of interview responses related the drivers or causes behind food wastage in respect of mentioned themes and frequency of appearance**

Theme	Mentioned phrases	Frequency of appearance (Number of times mentioned)
Date labelling	“sell-by date”, “expiry date”, “best-before date”, “date label”, “labelling”	5
Food safety standards	“food hygiene”, “corporate image”	2
Shelf life	“shelf life”	4
Handling	“poor handling”, “handling”	4
Quality standards	“quality standards”	4
Promotions	“promotions”, “sales”	4
Lack of diversion avenues		3
• Redistribution challenges	“redistribution challenges”	1
• Lack of market for compost	“no market for compost”	1
• Lack of infrastructure and services for recovery	“lack of infrastructure and services”	1

#### **4.4.1 Date labelling**

The results of this research demonstrate that the main reason for removing items from shelves and declaring them as unsalable was the “sell-by” or “best-before” dates. This was mentioned in five responses. From the store manager’s perspective, the definition of food waste relates to date labelling (as an indicator of food being fit for consumption). A study which aimed at exploring store managers’ perspectives on food waste revealed that the majority of store managers felt that they should conform to date labelling (such as “best-before date”) as an indicator for when food items become unsalable in order to retain their responsibility of selling proper products to customers (Gruber *et al.*, 2016:15).

South Africa is one of the countries where date labelling is a statutory requirement to which the grocery retail sector must comply. These labels are an indication of the date of a guaranteed safe consumption and does not mean that food products cannot be consumed after that date. However, misinterpretation around this concept results in throwing away food that is still fit for consumption by both retail stores and consumers (Gruber *et al.*, 2016:19; Patra *et al.*, 2020:2).

#### **4.4.2 Food safety standards**

Food safety and hygiene regulations are often the reason behind discarding food based on safety concerns. Holweg *et al.* (2016:650) indicate that these regulations are complex and lead to the discarding of food due to date labelling concerns (also refer to section 4.4.1 above).

The results of this study shows that the store that did not participate in the donation of surplus food cited concerns around food safety hygiene and corporate image as their reason for non-participation (mentioned twice).

Respondent 3 mentioned that: *"We are worried about hygiene issues and company image as well. Only food from normal stock is donated to charities"*

This concern was also identified as a significant barrier to food waste reduction within the grocery retail sector in New Zealand. The study participants mentioned concerns around donated food compromising people or animal health and how this may implicate them as a business (civil or criminal liability in worst-case scenarios). Date labelling and food safety standards are mentioned as some of the main reasons why retailers discard food (landfill disposal) rather than diverting it for re-use, because retailers remain very cautious when donating food for re-use (Goodman-Smith *et al.*, 2020:7).

In this study, the stores that donated this food allowed charity personnel to select only food items that they believed were in good condition. This practice was also observed in research conducted by (Hermsdorf *et al.*, 2017:2541).

#### **4.4.3 Shelf life**

Short shelf life was identified as another significant cause for food waste generation in the participated stores. This was mentioned in four responses. This theme is also supported by the quantification results of this study where fruits and vegetables, which are very sensitive in terms of perishability, were the most wasted food waste category.

FUSIONS (2014) adds that the increase of food waste from fresh produce category is attributed to the growing demand for fresh-cut produce with shorter shelf-lives. Retailers generally consider fresh produce unsalable based on its quality in terms of cosmetic standard. When these products deteriorate, softens, and sprouts they are removed from shelves.

In a study conducted by Lebersorger and Schneider (2014:1918), fresh produce was discarded mainly due to apparent flaws. If a single item in a package was spoiled, the whole pack was discarded. The time that fresh produce spends in transit (during road transportation) is also a culprit causing the deterioration of these products. During long trips, the shelf life of fresh produce may already be compromised when they reach the retailers (de Moraes *et al.*, 2020:13).

#### **4.4.4 Handling**

Poor handling of food items was mentioned as another driver for food waste generation in the investigated stores (mentioned in four responses). Literature cites incorrect handling as a cause for food waste production mostly in the context of retail employees mishandling food items, and incorrect loading, which may affect the quality of fresh produce.

Authors suggest mitigation measures such as employee professional training on handling equipment such as forklifts and pallets (Holweg *et al.*, 2016:643; Cicatiello *et al.*, 2017:278; Kliaugaitė & Kruopienė, 2018:17; de Moraes *et al.*, 2020:13). Packaging faults due to poor handling by employees and consumers when shopping was cited as the cause of food waste in a study conducted by (Holweg *et al.*, 2016:643). In work done by Lebersorger and Schneider (2014:1916), packaging damage and breakage was identified as one of the main causes for discarding dairy products. Both employees and customers were mentioned as potential causes for damaging packaging.

Poor handling cited by the participants of this study related to customers mishandling food items, especially on busy days.

#### **4.4.5 Quality standards**

Customers prefer high quality products in terms of freshness and appearance, demand product variety and also expect full shelves (Filimonau & Gherbin, 2017:1191; Kliaugaitė & Kruopienė, 2018:17). This theme appears four times in this study's codebook.

In a study conducted by Goodman-Smith (2018:6), several stores indicated that they had to remove poor quality products from shelves in order to ensure customer satisfaction and to maintain their loyalty. This food waste cause was also identified as a food waste reduction barrier by (Gruber *et al.*, 2016:14).

#### **4.4.6 Promotions**

Promotions are frequently mentioned as the cause for food waste generation at household level due to their ability to entice customers to buy more than they need. "Buy one get one free" is an example of a marketing strategy used by retailers to lure consumers into buying more (Filimonau & Gherbin, 2017:1191). Promotion-related food waste also occurs at the grocery retail level due to too many items being allocated to stores during promotions (Gruber *et al.*, 2016:8; Teller *et al.*, 2018:987). This was mentioned in four responses.

Respondent 3 indicated that: *"Too much products are allocated for promotions to present full shelves in order to attract customers, some of these products end up being wasted"*

A study conducted by Gruber *et al.* (2016:15) identified that the top-down decision making on promotions and allocations through the buying department is a problem because it is done without considering store size and product demand. Store managers are the most knowledgeable about the actual product demand and they need to be consulted during the planning of promotions in order to ensure that the quantity of products allocated matches the demand by consumers.

Although the results of this study confirm a relationship between promotions and production of food waste, the results of a study conducted by Le Roux (2017:67) highlighted that the South African grocery retail sector wasted more food during out of promotion periods than during promotional periods. The justification for this is that “promotions create a genuine increase in demand for the whole perishable department, but that demand drops lower than average out of promotion creating food waste” (Le Roux, 2017:67). To take advantage of the price benefit, consumers purchase more items during promotions and this in turn decreases the demand for those items during out of promotion periods and this creates a potential for food waste production.

#### **4.4.7 Lack of diversion avenues**

Diversion avenues are very crucial in the subject of diverting food waste from landfilling. Challenges relating to the lack of knowledge about redistribution channels, lack of market for organic waste compost and lack of infrastructure for food waste recovery were mentioned by the study participants. The sub-sections to section 4.4.7 provide a more detailed discussion on these challenges.

##### **4.4.7.1 Redistribution difficulties**

Redistribution of food waste is a second priority step in the food recovery hierarchy. The store that did not implement this intervention cited concerns around food safety standards and not knowing who to give the food to as a cause for not donating food (mentioned once).

Respondent 3 mentioned that: *“The farmers used to collect (the food waste) as well but no one is coming now hence we throw everything away”* and

*“Although the percentage is low, in the past we use to give it to the community. However, we no longer have the truck to go there and deliver”*

These results affirm the finding by Goodman-Smith (2018:6) where retailers indicated that they were not sure about what avenues they can use to divert food waste from land disposal. In the study by Goodman-Smith, it was discovered that food waste recipients experience a challenge with capacity to absorb food available for donation.

At the stores that implemented food waste donation to food rescue charities, the collection of food was voluntary and based on the charity personnel coming to the stores to collect food. In the

event where the charity personnel did not come, the food waste was discarded, as mentioned earlier.

According to Garrone *et al.* (2014:1471), food rescue charity organizations need to be capacitated in order to absorb all food available for donation and suggests that resources need to be invested in and third parties with logistics excellence need to be involved in order to facilitate the redistribution of food waste. In the United Kingdom, organizations such as FareShare and FoodCycle have facilitated food waste redistribution through their logistics capabilities by tackling issues such as collection timing agreements or concerns around food handling and food safety (FUSIONS, 2014).

A research by Mena *et al.* (2011:655) supports the notion that efforts need to be focused on raising awareness on the issues of food waste in general so that its production can be reduced at source to reduce the need for diversion. In cases where it cannot be prevented, the retailers would know about the alternative diversion platforms.

#### **4.4.7.2 Lack of market for compost**

As stated in section 4.3, composting was not mentioned by any of the stores as an option to divert their waste from landfill disposal. A scarce market for compost was cited as another driver for food waste (mentioned once). According to the study participant, composting is not well developed in the KwaZulu-Natal region due a lack of demand for compost in the area. This may be true for other areas in South Africa as well.

Respondent 4 mentioned that: *“The next option is recycling, probably via composting. This has been well facilitated. In KZN unfortunately, there is not much of a market for compost which is why it hasn’t taken off here”*.

The demand for compost is an area which may need to be researched further.

#### **4.4.7.3 Lack of infrastructure and services for recovery**

Godfrey *et al.* (2019:6) suggest that approximately US\$8 billion can be injected into the African economy every year through diverting waste from landfilling towards the priority levels of the waste management hierarchy. Lack of supporting infrastructure and services is, however, mentioned as a limiting factor.

Sentiments around a lack of infrastructure as a driver for food waste were shared by the waste manager (mentioned once). In KwaZulu-Natal, there are limited facilities for food waste recovery. Similar findings are evident in a study conducted by Gorski *et al.* (2017: 9), where all interviewed jurisdictions across the USA cited lack of infrastructure and funding as an obstacle for including food waste activities in their strategic plans. The main concern included funds for composting facilities and anaerobic digesters.

Respondent 4 mentioned that: *“Then, there is recovery, usually via anaerobic digestion or thermal technology. Due to economies of scale, these happen best at large centralised facilities. There are two commercial AD plants in South Africa for agricultural waste. There was a third built to handle the organic fraction of municipal solid waste in Cape Town, but it closed its doors less than 9 months after opening. In order to support recovery, there needs to be support from local and national government to build and run such plants”* Interview 4

In this context, Godfrey *et al.* (2019:7) cite investment as an opportunity to improve the waste management sector. Poor financing remains the dominant challenge for improving the waste sector in Africa. This translates to the challenge of raising investor confidence due to inefficiencies in understanding project costing and recovery by government departments responsible for waste management.

**4.5 Results relating to RO 4: Explore motivators and opportunities for food wastage prevention and reduction in the retail sector**

This section explores motivators and opportunities for prevention and reduction of food waste in the retail sector. Interview responses relating to research objective four are summarized in Table 4-4. Opportunities appearing on the codebook are training and awareness, improving demand planning and forecasting, supporting redistribution initiatives, landfill ban legislation and infrastructure.

**Table 4-4: Summary of interview responses related to motivators and opportunities for food waste prevention and reduction in respect of mentioned themes and frequency of appearance**

Theme	Mentioned phrases	Frequency of appearance (Number of times mentioned)
Economic benefits	“profit”, “cost saving”, “financial benefit”, “economic benefit”	6
Training and awareness	“training”, “awareness”	4
Improve demand planning and forecasting	“demand planning”, “forecasting”	3
Legislation to support food redistribution	“redistribution”, “donation”, “regulation”	3
Legislation to restrict the disposal of food waste	“law to restrict the disposal of food waste”	1
Investment in infrastructure	“Investment in infrastructure”, “infrastructure”, “improvement”	5



#### **4.5.1 Economic benefits**

The majority of the study participants indicated that their primary motive for reducing food waste was to save costs (mentioned six times). This affirms the findings from literature where monetary value was prominently cited as a driver for adoption of food waste reduction initiatives in the retail sector (Filimonau & Gherbin, 2017:1190; Swaffield *et al.*, 2018:46). Rosenlund *et al.* (2020) and Goodman-Smith *et al.* (2020:4) made similar findings, however, their studies identified environmental concerns as one of the main motivators for reducing food waste by the retailers. What is clear about these results is that awareness played a significant role in capacitating the retailers about the negative impacts of food waste on the environment and the financial implications associated with sending food waste to the landfill.

#### **4.5.2 Training and awareness**

Training and awareness are the backbone of food waste prevention and reduction by both retailers and consumers. The participants of this study pointed out that training staff and raising awareness to the consumers about the concept of food waste can bring about change (mentioned four times). The respondents further mentioned that retail leadership needs to take charge of such initiatives in order to transfer knowledge about food waste prevention downstream in the retail life cycle. This finding correlates with the results of work done by (Goodman-Smith, 2018:80).

Raising awareness is also suggested as a platform to change the views and behaviour of retail staff, regardless of their level, in order to increase their commitment to reduce food waste in their stores (Strotmann *et al.*, 2017:12). According to Kliaugaitė and Kruopienė (2018:17), raising awareness has the potential to also change consumer behaviour and demand. Knowing the impacts of food waste (socially, economically and environmentally) can enhance the commitment towards food waste reduction by all food supply chain stakeholders (Gruber *et al.*, 2016:16; Goodman-Smith, 2018:80 ; Kliaugaitė & Kruopienė, 2018:17).

Food waste campaigns need to address awareness around the meaning of date labelling, and the impacts of food wastage on natural resources. According to Baglioni *et al.* (2016:2040), the misunderstanding around the meaning of date labelling affects both retailers and consumers. Gruber *et al.* (2016:16) suggest that customers being more informed about the meaning of different labels (i.e. “best-before,” “use-by”) could allow them to make better decisions for food waste reduction at household level. In the effort of addressing this issue, the German Logistic Association focuses on raising consumer awareness on “best-before” and “use-by” dates (Baglioni *et al.*, 2016). Some other efforts directed at raising awareness on food waste include the UK initiative “Love Food-Hate Waste”, which is estimated to have contributed to preventing about 137,000 tonnes of consumer food waste within a year by educating people about date

labels. The initiative called “Too Good for the Bin” in Germany provides recommendations about responsible purchasing and consumption (PlanetRetail, 2011).

Initiatives like these may be regarded as good practices, which the retail sector in South Africa can learn from. However, raising awareness about food waste is not enough. Attention is needed in terms of proper merchandising techniques and product characteristics. These factors are often discounted and this is the precursor for many of the drivers of waste in the grocery retail sector.

#### **4.5.3 Improve demand planning and forecasting**

An accurate demand planning and forecasting of products is critical for business performance and customer relations. If this is not done right, it results to lower or higher inventory levels than required. In this context, food waste results from inaccurate demand forecasting.

The respondents of this study were in agreement that enhanced demand planning would yield positive results in terms of food waste reduction (mentioned three times).

Respondent 4, for instance, mentioned that: *“The best way is procurement management to facilitate reduction”*.

PlanetRetail (2011) recommends that enhanced demand planning can be achieved by forecasting better at store level. Factors such as historical data and current trading conditions need to be taken into account during the forecasting process. A study conducted by Sarfraz (2018:45) suggests that integrating business intelligence can improve demand forecasting and subsequently reduce food waste through accurate stock management. It is advisable for grocery retailers to primarily focus their efforts in improving demand forecasting elements of their business before considering price reduction strategies. Price reduction strategies may negatively impact on revenue, whilst enhanced demand forecasting has a strong focus on food waste reduction (PlanetRetail, 2011).

Technological innovation such as blockchain helps with predicting a more accurate market demand. This tool stores digital data in a decentralized and irreversible manner and enables the traceability of products throughout all stages of the food supply chain (Marin *et al.*, 2019:3275; Annosi *et al.*, 2021:218). Blockchain technology enables retailers and suppliers to connect and share a variety of information, “especially regarding forecasting and market-intelligence activities” (Annosi *et al.*, 2021:218).

#### **4.5.4 Legislation to support food redistribution**

Regulatory tools to support food redistribution by the retail industry and to restrict landfilling of food waste were suggested by the study participants as an approach to reduce food waste (mentioned three times).

Redistribution of surplus food for re-use is identified as a significant approach in preventing food waste from being discarded, however, concerns around food safety and date labelling remain a barrier for donation of surplus food by the grocery retail industry (Hermsdorf *et al.*, 2017:2541; Goodman-Smith *et al.*, 2020:7). Related findings are also expressed in a study conducted by (Phetho, 2018:71)

In this study, one of the participants cited absolving the donator from liability as an opportunity to reduce food waste in the South African grocery retail sector.

Respondent 4 suggested that: *“The best way is procurement management to facilitate reduction. After that, food donations as a form of re-use where possible. To facilitate this, there must be a third party, e.g. a food bank to absolve the donator from liability”*.

This suggestion is, however, not supported by the “duty of care” and “cradle to grave” principles underpinning waste management in terms of the NEMWA.

Some countries have adopted various tools to support surplus food redistribution and absolve the donator from a liability. An example is the “Good Samaritan Law”, which is adopted and implemented in Italy. With this law, non-profit and social utility organizations are recognized as final consumers. In this context, food consumers cannot file a lawsuit against the food donor in a case of subsequent poisoning or misuse. However, the donating companies need to ensure food safety prior to donating, using their internal processes (Baglioni *et al.*, 2016:2039).

#### **4.5.5 Legislation to restrict the disposal of food waste**

Restricting the disposal of organic waste was cited as an opportunity for food waste reduction by the study participants (mentioned three times). This instrument is prominent in countries such as Europe and the USA. Examples include the Swedish government banning the landfilling of organic waste in 2005, as well as the promulgation of the disposal ban regulations by Massachusetts state in October 2014. Massachusetts state regulations give targeted institutes such as universities, hotels and grocery stores options to donate food that is still fit for consumption and send any remaining food to recycling and recovery facilities. However, this is subjected to entities that produce a threshold of one ton per week (Tatjana & Aija, 2015:104).

Although South Africa has not yet explicitly prohibited or restricted the landfilling of food waste, a number of legislative instruments are in place to divert it from landfills. The norms and standards for the disposal of waste to land (GNR. 636 of August 2013) restricts the landfill disposal of waste with a high calorific content and waste with a high liquid content. These restrictions are, however, presently mainly applicable to hazardous waste (DEA, 2013b).

Composting is one of the measures promoted by the NWMS in order to achieve the waste management hierarchy objectives provided for in the NEMWA. To enable this, the NOWCS was

established by the DEA, now DEFF in 2013, with the *aim to develop and promote the diversion of organic waste from landfill sites for soil beneficiation and other uses through composting* (DEA, 2013a). The anticipated norms and standards for organic waste composting which will reduce licensing requirements for waste composting facilities are in the pipeline, a draft was gazetted in September 2019 (GN. 1135 *Draft National norms and standards for Organic Waste Composting*) (DEA, 2019).

The Western Cape province, through the DEA&DP, has implemented a strategic plan to divert a target of 50% organic waste from landfill by 2022 and a target of 100% diversion by 2027 (GreenCape, 2019).

This may be a motivator or an opportunity for diverting waste away from landfill disposal.

#### **4.5.6 Investment in infrastructure**

Lack of infrastructure was discussed in section 4.4.7.3 as a barrier towards diverting food waste from land disposal. The promulgation of legislation to restrict food waste from land disposal would be unrealistic and overambitious if there is no infrastructure to handle (treat and recover) food waste. The need for support from government to put in place and run such infrastructure was cited by a study participant (mentioned five times).

Respondent 4 highlighted that: *“In order to support recovery, there needs to be support from local and national government to build and run such plants”*.

Godfrey *et al.* (2019:7) suggest cooperative efforts between government and private sector to facilitate investment in the waste management sector.

#### **4.6 Chapter summary**

The study aimed at addressing four research objectives. Quantification of food waste categories from this study affirmed the findings from previous research where fresh produce was the most wasted stream, followed by dairy and in-store baked goods. Efforts are made to divert food waste from landfilling, however, room for improvement exists. Management practices currently being implemented include demand planning, redistribution to charities and in-house repurposing, monitoring and measurement, as well as disposal to landfill. This demonstrated a gap in terms of taking advantage of priority management options provided by the waste management hierarchy i.e. landfilling over recycling and recovery.

The results of the study further demonstrate that the South African grocery retail industry experiences similar problems to the rest of the world with food waste management in terms of drivers and management options being implemented. However, the motive behind reduction varies from country to country.

The investigated stores were mainly motivated by economic benefits, whilst reviewed literature demonstrated a variety of motivations including environmental, social and economic concerns. This highlighted a need for training and awareness in the grocery retail sector.

It was identified that difficulties with infrastructure investment and government support were perceived as the main barriers for waste diversion from land disposal. It was also highlighted that food donation is not well established and legislation to support redistribution was cited as an opportunity to reduce food waste in the retail sector. Landfill restrictions of organic (food) waste was also suggested as an opportunity.

Chapter five provides the final conclusions and recommendations of this research.

## CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

This research aimed to address four research objectives:

- *RO1: Assessing (identify, categorize and quantify) food waste types from selected grocery retail stores;*
- *RO2: Determining how food waste is managed in relation to the waste- and food waste management hierarchies;*
- *RO3: Exploring the drivers behind food wastage in the grocery retail sector; and*
- *RO4: Exploring the motivators and opportunities for food wastage prevention and reduction in the grocery retail sector.*

This chapter provides the conclusions (5.1) and recommendations (5.2) related to the four research objectives.

### 5.1 Conclusions

Reflecting on the literature reviewed and the results of this study, the magnitude of food waste occurring at the grocery retail stores, the most wasted food categories, the management, drivers, reduction motivators and opportunities for food waste in South Africa are similar to other countries. The sub-sections of section 5.1 outline the conclusions related to each of the research objectives.

#### 5.1.1 Conclusions related to RO 1: Assessing the food waste types from selected stores

Oelofse and Nahman (2013:85) cite the absence of food waste quantification data as one of the barriers for improving food waste management in South Africa. The participating stores demonstrated a high level of efficiency when it comes to food waste quantification. The practice of quantifying food waste was evidenced by historical quantification data and an on-site assessment exercise. An area of improvement highlighted during the on-site assessment was recordkeeping of the destination of food waste after it has been “classified” by the stores as waste. The stores did not have any records demonstrating how much food waste was donated, repurposed in the in-house kitchen, and collected for final disposal.

In this study, fresh produce was ranked as the most wasted food type with a contribution of 33% of the total amount of food waste generated by the three stores, followed by perishable groceries (mostly dairy) at 19%, in-store bakery products at 16%, and butchery department products (mainly read meat) at 11%. These results were in agreement with research by other authors such as Eriksson (2012:31); Lebersorger and Schneider (2014:1916); Cicatiello *et al.* (2017:278) and Kliaugaitė and Kruopienė (2017:12).

### **5.1.2 Conclusions related to RO 2: Determine how food waste is managed in relation to the waste- and food waste management hierarchies**

The second objective of this study was to determine how food waste is managed in relation to the waste- and food recovery hierarchies. This objective was achieved through on-site food waste evaluation and observations, as well as semi-structured interviews with four representatives from the grocery retail stores. The waste management hierarchy options implemented by the participated stores included prevention, re-use/repurposing and landfilling. Composting and energy recovery were not mentioned as waste management measures by any of the respondents.

Price markdown and demand planning were options practiced by the investigated stores to prevent food waste at source. The effectiveness of price reduction strategies is questionable, however, because marked down items were present amongst the food waste items analysed during the characterization exercise. Lebersorger and Schneider (2014:1916) and Filimonau and Gherbin (2017:1191) expressed a similar concern in their studies.

Demand planning and forecasting remain the areas that still need improvement because a considerable amount of food waste is still being generated.

As a re-use strategy, the stores implemented food waste redistribution in the form of donations and in-house repurposing, by mainly using products that were close to their “sell-by” or “best-before” dates to make prepared meals. The remaining food waste, of which the quantity could not be established, was landfilled. Re-use strategies are supported by monitoring and measurement. Monitoring and measurement provide information on how much food waste is produced and enable the retailer to identify food waste trends and meet food waste reduction targets.

These options are not unique to this study but also evident in studies conducted by Eriksson (2012:20), Halloran *et al.* (2014:298), Lebersorger and Schneider (2014:1918), Holweg *et al.* (2016:648), Cicatiello *et al.* (2017:277), de Hooge *et al.* (2017:89), Filimonau and Gherbin (2017:1191); Aschemann-Witzel (2018:126) and Goodman-Smith *et al.* (2020:4).

### **5.1.3 Conclusions related to RO 3: Explore the drivers behind food wastage in the retail sector**

To achieve the avoidance of and reduction in food waste, efforts need to be directed towards understanding the underlying factors (or drivers) of food waste generation (Irani & Sharif, 2016:177). The findings of this study demonstrated that the food waste occurrence at the grocery retail stage is driven by both internal store operations and external factors. The identified causes include issues relating to date labelling, food safety standards, shelf life, handling, promotions, and lack of diversion avenues.

The key external factor identified is that redistribution to food rescue charities took place only if charity personnel voluntarily collected food waste from the stores. When no collection took place, food waste was discarded to landfill. Poor infrastructure for the processing and treatment of food waste (mainly referring to biodigesters) and lack of demand for compost in KwaZulu-Natal were cited as another driver for food waste being disposed to landfill. Customer needs and expectations in terms of product quality and variety were another cause of food waste that retailers did not have much control over, because they want to ensure customer satisfaction and to maintain their loyalty.

Internal factors such as poor planning of promotions lead to the production of food waste. In this study, some of the food waste resulted from products that were in promotion because as a culture, the retail group allocates too much products during promotions to present full shelves and attract customers. To align forecasting and product demand, the planning of promotions by head office should include store managers because they are most knowledgeable about the actual product demand. Finally, poor handling practices by employees and customers were cited as a contributing factor to food wastage, especially on busy days.

Concerns around food safety hygiene and corporate image came up as a barrier to redistribution of food waste during an interview. Store managers associated food waste as food items that have passed "sell-by" or "best-before" dates. These items were declared unsaleable and removed from shelves. Issues around interpretation of date labelling remains one of the food waste causes.

Literature has identified a variety of food waste causes in the grocery retail sector, which are similar to the ones identified by this study. In conclusion, food waste represents an important issue that need to be addressed in the retail grocery sector.

All grocery retail staff, especially those that execute merchandising functions, need to be capacitated with knowledge to ensure that food waste reduction interventions outlined in corporate policies are implemented.

#### **5.1.4 Conclusions related to RO: 4 Explore motivators and opportunities for food wastage prevention and reduction in the retail sector**

Financial gain was identified as the main motivator for food waste reduction in this study, where store managers cited that waste reduction would reduce loss of profit in their stores. Although this finding is consistent with studies conducted in other countries (Filimonau & Gherbin, 2017:1190; Swaffield *et al.*, 2018:46), many developed world countries prioritized environmental and social concerns as motivators for reduction of food waste (Goodman-Smith *et al.*, 2020:4; Rosenlund *et al.*, 2020).

Training and awareness as an opportunity to reduce food waste were highlighted in the results of this study. The participants of this study pointed out that training of staff and raising awareness



of the consumers about the concept of food waste in relation to its impacts and date labelling interpretation can bring about change. The respondents believed that retail leadership needs to take charge of such initiatives in order to transfer knowledge of the management of food waste.

Enhanced demand planning, legislation to support the donation of food waste, legislation to restrict the disposal of food waste, and investment in infrastructure to process food waste were also identified by this study, as an opportunity to reduce food waste. Legislation to support the donation of food waste is key in addressing concerns around food safety and hygiene, date labelling interpretation, corporate image and to absolve the donor from liability (Baglioni *et al.*, 2016:2039). Landfill restrictions can move the management of food waste towards the upper options of the waste management hierarchy (Tatjana & Aija, 2015:104). Composting and energy recovery are two of the options promoted by the NWMS, however, infrastructure for processing food waste remains a challenge and collaborative efforts between government, private sector and other stakeholders are needed to facilitate investment to address this issue (DEA, 2013a; Godfrey *et al.*, 2019: 7).

Finally, recommendations are made in section 5.2 of this dissertation.

## **5.2 Recommendations**

This section forms the last part of this study and provides recommendations based on the literature reviewed and the results of this study.

### **5.2.1 Recommendations from literature related to improving the management of food waste**

This section provides some recommendations derived from literature and the results of this study for the improved management of food waste by the grocery retail sector.

Adopting a digital information management tool such as blockchain can improve order forecasting by minimizing the gap between predicted and actual sales. Such technology tracks and trace product information throughout the food supply chain and improves inventory monitoring. Supply chain role players are able to share product information, especially regarding product demand and forecasting, through this decentralized platform (Marin *et al.*, 2019: 3275; Annosi *et al.*, 2021: 218).

The understanding of and awareness on food waste need to be enhanced at retail and consumer level. This is key to changing behaviour towards the reduction of food waste (Gruber *et al.*, 2016:16; Goodman-Smith, 2018:80 ; Kliaugaitė & Kruopienė, 2018:17). Awareness campaigns can address issues such as the negative impacts of food waste and misperceptions around date labelling interpretation. Such campaigns have been well facilitated in other countries and these

include “Love Food-Hate Waste” (in the United Kingdom) and “Too Good for the Bin” (in Germany) (PlanetRetail, 2011). The use of communication channels such as magazines, newsletters and social media to raise awareness on food waste and educating consumers about date labelling can influence consumer behaviour and reduce food waste generation at household level (Young *et al.*, 2018: 12). Venter (2017:90) proposed the use of smartphone app to mitigate consumers’ misinterpretation of date labelling. Such technology could be used to track expiration dates on food and alerts consumers to use their food before it goes off. However, the success of such interventions requires collaborated efforts amongst food waste stakeholders such as the government, producers, retailers and interested and affected organizations.

The regulation of food waste through law and policy has been identified as a possible enabler for food waste prevention and reduction. The focus needs to shift to a regulatory framework that would enhance food redistribution by addressing concerns around food safety and date labelling, which are usually a barrier for donation of surplus food by the grocery retail industry (Hermsdorf *et al.*, 2017:2541; Goodman-Smith *et al.*, 2020:7). Policies could focus on lessening the burden of liability from the donating retailer by conferring the legal status of “end user” to social institutions (Gruber *et al.*, 2016: 20). Introduction of a landfill prohibitions or restrictions would also restrict the disposal of food waste to landfill (Thi *et al.*, 2015:234).

Investment in food waste treatment technologies need to be strengthened. Godfrey *et al.* (2019: 7) suggests that collaborative efforts between government and the private sector need to facilitate investment in the waste management sector (Godfrey *et al.*, 2019:7).

Lastly, the compost market need to be enhanced. While promoting agriculture, governments need to encourage the sale of bio-products whilst considering shifting from chemical- to, more environmentally-friendly, bio-compost (Thi *et al.*, 2015:233).

### **5.2.2 Practical recommendations for improving the management of food waste**

This section provides some practical recommendations for the improved management of food waste by the grocery retail sector.

The in-house bakery generated a significant amount of bakery food waste compared to outsourced bakery goods. This difference may be ascribed to take-back agreements with external bakeries. The production schedules need to be revisited in order to possibly decrease the quantity of baked goods produced within the in-house bakery department.

Keeping track of which and how much items are donated and disposed of is crucial, especially in terms of the “cradle to grave” principle. The food waste measuring programme needs to include recording of the quantities of food waste items donated and disposed of. This will enable the grocery stores to report more accurately on their waste to landfill quantities, and possible improvement in reducing waste to landfill targets.

Grocery retail employees need to be made cognisant of the corporate vision relating to food waste reduction objectives and the related management programme. This can be done through an internal training and awareness programme. Benefits (environmental, social, and financial) associated with reduction of food waste should be included in this programme. In-store campaigns to encourage customers to reduce their own food waste must be considered by grocery retailers.

As part of their social responsibility, grocery retailers need to identify charities within their geographical location and assist those without resources with transportation to collect food. This will promote redistribution of food waste rather than disposal, however, the reduction at source should remain the most preferred option and be prioritized.

Roles and responsibilities need to be assigned at ground level to ensure that the corporate vision relating to food waste reduction materialise in practice.

### **5.2.3 Recommendations relating to further research**

The identified challenges relating to food waste makes the topic a point of importance and opens a gap for more studies to be executed in South Africa. Recommendations for further studies include:

- Evaluating food waste management beyond the grocery retail store “gate” – i.e. investigating what happens with food waste that is not donated to charities;
- Investigating opportunities and challenges for diverting food waste away from landfill, considering best practices and lessons learned from the developed world;
- Exploring customer perceptions and expectations in relation to the management of food waste (i.e. how important is aesthetical aspects and “sell-by” dates, for instance);
- Investigating consumer demand, behaviour and factors driving food waste in the grocery retail sector; and
- Repeating the research objectives and research approach used for this study in more provinces and including more stores to gather more empirical data on how waste is managed by the grocery retail sector.

## BIBLIOGRAPHY

African Union (AU). 2014. *Malabo declaration on accelerated agricultural growth and transformation for shared prosperity and improved livelihoods*.

[https://au.int/sites/default/files/documents/31247-doc-malabo\\_declaration\\_2014\\_11\\_26.pdf](https://au.int/sites/default/files/documents/31247-doc-malabo_declaration_2014_11_26.pdf)

Date of access: 25 Nov. 2020.

Alexander, P., Brown, C., Arneith, A., Finnigan, J., Moran, D. & Rounsevell, M.D.A. 2017. Losses, inefficiencies and waste in the global food system. *Agricultural Systems*, 153:190-200.

Annosi, M.C., Brunetta, F., Bimbo, F. & Kostoula, M. 2021. Digitalization within food supply chains to prevent food waste. Drivers, barriers and collaboration practices. *Industrial Marketing Management*, 93:208-220.

Aschemann-Witzel, J., de Hooge, I., Amani, P., Bech-Larsen, T. & Oostindjer, M. 2015. Consumer-Related Food Waste: Causes and Potential for Action. *Sustainability*, 7(6):6457-6477.

Aschemann-Witzel, J. 2018. Consumer perception and preference for suboptimal food under the emerging practice of expiration date based pricing in supermarkets. *Food Quality and Preference*, 63:119-128.

Baglioni, S., De Pieri, B. & Tallarico, T. 2016. Surplus Food Recovery and Food Aid: The Pivotal Role of Non-profit Organisations. Insights from Italy and Germany. *International Journal of Voluntary and Nonprofit Organizations*, 28(5):2032-2052.

Bosman, C & M, Kidd. 2009. Water Pollution. In: Strydom, H. & King, N., eds. *Fuggle and Rabie 's environmental management in South Africa*. 2nd ed. Cape Town: Juta. p. 630-698.

Braun, V. & Clarke, V. 2006. Using thematic analysis in psychology, *Qualitative Research in Psychology*, 3:2, 77-101.

Cicatiello, C., Franco, S., Pancino, B. & Blasi, E. 2016. The value of food waste: An exploratory study on retailing. *Journal of Retailing and Consumer Services*, 30:96-104.

Cicatiello, C., Franco, S., Pancino, B., Blasi, E. & Falasconi, L. 2017. The dark side of retail food waste: Evidences from in-store data. *Resources, Conservation and Recycling*, 125:273-281.

Consumer Goods Council of South Africa (CGCSA). 2020. *South Africa's food loss and waste voluntary agreement: Implementation plan*.

<https://www.cgcsa.co.za/wpcontent/uploads/2020/11/South-African-Food-Loss-Waste-Agreement-4.pdf> Date of access: 25 Nov. 2020.

Council for Scientific and Industrial Research (CSIR). 2017. The Sustainable Development Goals in South Africa: Key actors, roles, relationships, and gaps. *Briefing note February 2017*. [http://www.nstf.org.za/wp-content/uploads/2017/10/CSIR\\_Sustainable-Development-Goals\\_Briefing-Note.pdf](http://www.nstf.org.za/wp-content/uploads/2017/10/CSIR_Sustainable-Development-Goals_Briefing-Note.pdf) Date of access: 25 Nov. 2020.

Creswell, J.W. 2014. Research Design. *Qualitative, Quantitative, and Mixed Methods Approaches*. 4th Edition. Lincoln, USA: SAGE Publications.

de Hooge, I.E., Oostindjer, M., Aschemann-Witzel, J., Normann, A., Loose, S.M. & Almlí, V.L. 2017. This apple is too ugly for me! *Food Quality and Preference*, 56:80-92.

de Moraes, C.C., de Oliveira Costa, F.H., Roberta Pereira, C., da Silva, A.L. & Delai, I. 2020. Retail food waste: mapping causes and reduction practices. *Journal of Cleaner Production*, 256:1-16.

DEA **see** Department of Environmental Affairs (South Africa).

DoH **see** Department of Health (South Africa).

Department of Environmental Affairs (South Africa). 2012. National Environmental Management: Waste Act 2008 (Act no. 59 of 2008): National Waste Management Strategy, 2012. (Notice 344). *Government gazette*, 35306:3, 4 May.

Department of Environmental Affairs (South Africa). 2013a. *National Organic Waste Composting Strategy*. <http://sawic.environment.gov.za/documents/3635.PDF> Date of access: 25 Nov. 2020..

Department of Environmental Affairs (South Africa). 2013b. National Environmental Management: Waste Act 2008 (Act no. 59 of 2008): National norms and standards for disposal of waste to landfill, 2013. (GNR 636). *Government Gazette*, 36784:34, 23 August.

Department of Environmental Affairs (South Africa). 2018. South Africa State of the Waste Report. A report on the state of the environment. Second Draft Report. Department of Environmental Affairs, Pretoria. XX pp.

Department of Environmental Affairs (South Africa). 2019. National Environmental Management: Waste Act 2008 (Act no. 59 of 2008): Draft national norms and standards for organic waste composting. (Notice 1135). *Government Gazette* ,42681, 04 September 2019.

Department of Health (South Africa). 2010. Foodstuffs, Cosmetics and Disinfectants Act, 1972 (ACT 54 OF 1972). Regulations relating to the labelling and advertising of foodstuffs, 2010. (Notice R146). *Government Gazette*, 32975, 01 March.

- Eriksson, M. 2012. *Retail food wastage: A case study approach to quantities and causes*. Uppsala: Swedish University of Agricultural Sciences. (Licentiate Thesis).  
<https://pub.epsilon.slu.se/9264/>
- Eriksson, M., Strid, I. & Hansson, P.-A. 2012. Food losses in six Swedish retail stores: Wastage of fruit and vegetables in relation to quantities delivered. *Resources, Conservation and Recycling*, 68:14-20.
- Filimonau, V. & Gherbin, A. 2017. An exploratory study of food waste management practices in the UK grocery retail sector. *Journal of Cleaner Production*, 167:1184-1194.
- Food and Agriculture Organisation of the United Nations (FAO). 2015. *Global Initiative on Food Loss and Waste Reduction*. <http://www.fao.org/3/a-i4068e.pdf> Date of access: 24 Nov. 2020.
- FUSIONS. 2014. *FUSIONS Definitional Framework for Food Waste Full Report*. <https://www.eu-fusions.org/phocadownload/Publications/FUSIONS%20Definitional%20Framework%20for%20Food%20Waste%202014.pdf> Date of access: 24 Nov. 2020.
- FUSIONS. 2014. *Drivers of current food waste generation, threats of future increase and opportunities for reduction*.  
<https://www.eufusions.org/index.php/download?download=111:drivers-of-current-food-waste-generation-threats-of-future-increase-and-opportunities-for-reduction> Date of access: 24 Nov. 2020.
- FUSIONS. 2016. Norway – Country Report on national food waste policy Status: Second draft. <http://www.eu-fusions.org/phocadownload/country-report/NORWAY%2023.02.16.pdf>. Accessed 25 November 2020.
- Garrone, P., Martin, C., Dr Alessio Cavic, P., Melacini, M. & Perego, A. 2014. Surplus food recovery and donation in Italy: the upstream process. *British Food Journal*, 116(9):1460-1477.
- Giordano, C., Falasconi, L., Cicatiello, C. & Pancino, B. 2020. The role of food waste hierarchy in addressing policy and research: A comparative analysis. *Journal of Cleaner Production*, 252:1-10.
- Godfrey, L., Ahmed, M.T., Gebremedhin, K.G., Katima, J.H.Y., Oelofse, S., Osibanjo, O., Richter, U.H. & Yonli, A.H. 2019. Solid Waste Management in Africa: Governance Failure or Development Opportunity? DOI: <http://dx.doi.org/10.5772/intechopen.86974>.
- Goodman-Smith, F. 2018. *A quantitative and qualitative study of retail food waste in New Zealand*. Dunedin: University of Otago. (Thesis – M.Sc.). <http://hdl.handle.net/10523/7972>

Goodman-Smith, F., Miroso, M. & Skeaff, S. 2020. A mixed-methods study of retail food waste in New Zealand. *Food Policy*, 92:1-12.

Gorski, I., Siddiqi, S. & Neff, R. 2017. *Government plans to address waste of food.*

[https://www.researchgate.net/publication/319546584\\_GOVERNMENTAL\\_PLANS\\_TO\\_ADDRESS\\_WASTE\\_OF\\_FOOD](https://www.researchgate.net/publication/319546584_GOVERNMENTAL_PLANS_TO_ADDRESS_WASTE_OF_FOOD) Date of access: 25 Nov. 2020.

GreenCape. 2019. *Waste Market Intelligence Report 2019.*

<https://www.greencape.co.za/assets/Uploads/WASTE-MARKET-INTELLIGENCE-REPORT-WEB.pdf> Date of access: 14 Oct. 2019.

Gruber, V., Holweg, C. & Teller, C. 2016. What a Waste! Exploring the Human Reality of Food Waste from the Store Manager's Perspective. *Journal of Public Policy & Marketing*, 35(1):3-25.

Gustavsson, J., Cederberg, C., Sonesson, U., van Otterdijk & Meybeck, A. 2011. Global Food Losses and Food Waste: Extent, Causes and Prevention. Study conducted for the International Congress SAVE FOOD! At Interpack 2011, Düsseldorf, Germany. Food and Agriculture Organisation of the United Nations, Rome, Italy.

Hall, K.D., Guo, J., Dore, M. & Chow, C.C. 2009. The progressive increase of food waste in America and its environmental impact. *PLoS One*, 4(11):1-6.

Hermsdorf, D., Rombach, M. & Bitsch, V. 2017. Food waste reduction practices in German food retail. *British Food Journal*, 119(12):2532-2546.

Holweg, C., Mena, Michael Bourlakis, C., Teller, C. & Kotzab, H. 2016. Unsaleable grocery products, their residual value and instore logistics. *International Journal of Physical Distribution & Logistics Management*, 46(6/7):634-658.

Irani, Z. & Sharif, A.M. 2016. Sustainable food security futures. *Journal of Enterprise Information Management*, 29(2):171-178.

Kliaugaite, D. & Kruopiene, J. 2018. Food waste generation and prevention measures in retail sector: a comparative study. *Environmental Research, Engineering and Management*, 73(4):7-20.

Lebersorger, S. & Schneider, F. 2014. Food loss rates at the food retail, influencing factors and reasons as a basis for waste prevention measures. *Waste Management*, 34(11):1911-1919.

Lee, K.C.L. 2018. Grocery shopping, food waste, and the retail landscape of cities: The case of Seoul. *Journal of Cleaner Production*, 172:325-334.

- Le Roux, C.R.L. 2017. *The extent and drivers of perishable food waste in the retail supply chain industry of South Africa*. Pretoria: University of Pretoria. (Mini-dissertation – MBA). <http://hdl.handle.net/2263/64863>
- Lewis, J. 2003. Design Issues. In: Ritchie, J. & Lewis, J., eds. *Qualitative Research Practice: A Guide for Social Science Students and Researchers*. London: SAGE Publications. pp. 49-76.
- Luis González, V. 2017. French and Italian Food Waste Legislation. An Example for other EU Member States to Follow? *European Food and Feed Law Review*, 12(3):224-233.
- Marin, M.-P., Marin, I. & Vidu, L. 2019. Learning About the Reduction of Food Waste Using Blockchain Technology. Conference *Proceedings*. 13th annual International Technology, Education and Development Conference (INTED 2019), Valencia, Spain.
- Mattsson, L., Williams, H. & Berghel, J. 2018. Waste of fresh fruit and vegetables at retailers in Sweden – Measuring and calculation of mass, economic cost and climate impact. *Resources, Conservation and Recycling*, 130:118-126.
- Mena, C., Adenso-Diaz, B. & Yurt, O. 2011. The causes of food waste in the supplier–retailer interface: Evidences from the UK and Spain. *Resources, Conservation and Recycling*, 55(6):648-658.
- Mena, C., Terry, L.A., Williams, A. & Ellram, L. 2014. Causes of waste across multi-tier supply networks: Cases in the UK food sector. *International Journal of Production Economics*, 152:144-158.
- Moodley, L., Papanicolaou, R. & Domun, V. 2019. *Insufficient airspace – Please load airspace*. <https://iwmsa.co.za/sites/all/themes/corporateclean/pdf/landfill%20papers/LAWTIG%202019%20-%20Academic%20Paper%20%28L%20Moodley%29.pdf> Date of access: 19 Feb. 2021.
- Mouton, J. 2001. *How to succeed in your Masters & Doctoral Studies: A South African Guide and Resource Book*. Pretoria: Van Schaik Publishers.
- Munhuweyi, K. 2012. *Postharvest losses and changes in quality of vegetables from retail to consumer: A case study of tomato, cabbage, and carrot*. Stellenbosch: Stellenbosch University. <http://hdl.handle.net/10019.1/71946>
- Nahman, A. & de Lange, W. 2013. Costs of food waste along the value chain: Evidence from South Africa. *Waste Management*, 33:2493-2500.
- Nahman, A. & Godfrey, L. 2010. Economic instruments for solid waste management in South Africa: Opportunities and constraints. *Resources, Conservation and Recycling*, 54:521-531.



National Planning Commission. 2012. *National Development Plan 2030 Our Future-make it work*. <https://www.gov.za/issues/national-development-plan-2030> Date of access:16 Apr. 2019.

North-West University. 2018. Compliance and enforcement: Tools, instruments and indicators. Presented during the week of 28 May to 01 June 2018, Centre for Environmental Management, NWU Potchefstroom, South Africa.

Oelofse, S. 2014. Food waste in South Africa: *Understanding the magnitude, water footprint and cost*.[https://researchspace.csir.co.za/dspace/bitstream/handle/10204/8367/Oelofse1\\_2014.pdf?sequence=1&isAllowed=y](https://researchspace.csir.co.za/dspace/bitstream/handle/10204/8367/Oelofse1_2014.pdf?sequence=1&isAllowed=y) Date of access: 25 Nov. 2020.

Oelofse, S.H. & Nahman, A. 2013. Estimating the magnitude of food waste generated in South Africa. *Waste Management Resources*, 31(1):80-86.

Papargyropoulou, E., Lozano, R., K. Steinberger, J., Wright, N. & Ujang, Z.b. 2014. The food waste hierarchy as a framework for the management of food surplus and food waste. *Journal of Cleaner Production*, 76:106-115.

Patra, D., Leisnham, P.T., Tanui, C.K. & Pradhan, A.K. 2020. Evaluation of global research trends in the area of food waste due to date labeling using a scientometrics approach. *Food Control*, 115:1-10.

Phetho, B. 2018. *Food corporations and government rethinking food waste reduction strategies in Johannesburg City*. South Africa: University of South Africa. (Dissertation – MA).  
<http://hdl.handle.net/10500/25953>

PlanetRetail. 2016. *The challenge of food waste: Retailers step up to the next level of inventory management*. [https://www.gs1.org/sites/default/files/gs1\\_uk\\_the\\_challenge\\_of\\_food\\_waste.pdf](https://www.gs1.org/sites/default/files/gs1_uk_the_challenge_of_food_waste.pdf)  
Date of access: 25 Nov. 2020.

Redlingshöfer, B., Barles, S. & Weisz, H. 2020. Are waste hierarchies effective in reducing environmental impacts from food waste? A systematic review for OECD countries. *Resources, Conservation and Recycling*, 156:1-17.

Republic of South Africa. The Presidency. 2014. National Environmental Management: Waste Amendment Act (Act 26 of 2014). *Government Gazette*, 37714, 2 June 2014.

Rosenlund, J., Nyblom, Å., Matschke Ekholm, H. & Sörme, L. 2020. The emergence of food waste as an issue in Swedish retail. *British Food Journal*, 122 (11):3283-3296.

Saldana. J. 2015. *The coding manual for Qualitative Researchers*. Great Britain. Ashford Colour Press.

Sheahan, M. & Barret, C.B. 2017. Review: Food loss and waste in Sub-Saharan Africa. *Food Policy*, 70:1-12.

South African Cities Network (SACN). 2014. *Modelling Impacts of landfilling in Cities: Final Report*. <http://www.sacities.net/wp-content/uploads/2015/11/Final-Report-Modelling-Impacts-of-Landfilling-in-Cities.pdf> Date of access: 20 Jul. 2020.

Southern Africa Food Lab (SAFL). 2017. *Legislation Discussion Paper: Food Donations as a Mechanism to Limit Food Waste, Food Insecurity and Malnutrition*. [https://www.southernafricafoodlab.org/wp-content/uploads/2017/08/4648377\\_4.pdf](https://www.southernafricafoodlab.org/wp-content/uploads/2017/08/4648377_4.pdf) Date of access: 19 Feb. 2021.

Stats SA (Statistics South Africa). 2019. Towards measuring food security in South Africa: An examination of hunger and food inadequacy. (Report: 03-00-14). <http://www.statssa.gov.za/publications/03-00-14/03-00-142017.pdf> Date of access: 19 Feb. 2021.

Stenmarck, Å., Hanssen, O.J., Silvennoine, K., Katajajuuri, J.M. & Werge, M. 2011. Initiatives on prevention of food waste in the retail and wholesale trades. Stockholm: Swedish Environmental Research Institute.

Strotmann, C., Göbel, C., Friedrich, S., Kreyenschmidt, J., Ritter, G. & Teitscheid, P. 2017. A Participatory Approach to Minimizing Food Waste in the Food Industry—A Manual for Managers. *Sustainability*, 9(1): 1-21.

Swaffield, J., Evans, D. & Welch, D. 2018. Profit, reputation and 'doing the right thing': Convention theory and the problem of food waste in the UK retail sector. *Geoforum*, 89:43-51.

Tatjana, T. & Aija, E. 2015. Legislation on Food Waste Prevention: Overview of Practices in Industrialized Countries. *Socialiniai tyrimai / Social Research*, 38:101–109.

Teller, C., Holweg, C., Reiner, G. & Kotzab, H. 2018. Retail store operations and food waste. *Journal of Cleaner Production*, 185:981-997.

TESCO. 2020. *UK Food Waste Data 2019/20*. <https://www.tescoplc.com/sustainability/performance/data-tables/food-waste-data/uk-data/> Date of access: 25 Nov. 2020.

Thi, N.B., Kumar, G. & Lin, C.Y. 2015. An overview of food waste management in developing countries: Current status and future perspective. *Journal of Environmental Management*, 157:220-229.

Tonini, D., Albizzati, P. F. & Astrup, T. F. 2018. Environmental impacts of food waste: Learning and challenges from a case study on UK. *Waste Management*. 76:744-766.

Topolansky, F., von Dewitz, P. & Gonzalez, M. 2017. Reducing food waste through retail influence on consumer buying behaviour. *Chemical Engineering Transactions*. 58:775-780.

UKEssays. 2018. The retail and UK grocery supermarket sectors.

<https://www.ukessays.com/essays/marketing/the-retail-and-uk-grocery-supermarket-sectors-marketing-essay.php> Date of access: 19 Feb. 2021.

United Nations Development Programme (UNDP). 2020a. *Go Goal 2: Zero hunger*.

<https://www.undp.org/content/undp/en/home/sustainable-development-goals/goal-2-zero-hunger.html> Date of access: 25 Nov. 2020.

United Nations Development Programme (UNDP). 2020b. *Sustainable development goals*.

<https://www.undp.org/content/undp/en/home/sustainable-development-goals.html> Date of access: 25 Nov. 2020.

United Nations Environment Programme (UNEP). 2017. *Think-eat-save reduce your footprint: South African Food Waste Prevention Programme*.

[https://www.unece.org/fileadmin/DAM/trade/agr/meetings/wp.07/2016/FoodLossConf/09\\_Rie\\_Tsutmi.pdf](https://www.unece.org/fileadmin/DAM/trade/agr/meetings/wp.07/2016/FoodLossConf/09_Rie_Tsutmi.pdf) Date of access: 25 Nov. 2020.

United Nations Environment Programme (UNEP). 2018. *Africa Waste Management Outlook*. UNEP, Nairobi, Kenya.

United States Environmental Protection Agency (USEPA). 2019. *Sustainable Management of Food: Food Recovery Hierarchy* <https://www.epa.gov/sustainable-management-food/food-recovery-hierarchy> Date of access: 05 Dec. 2019.

Venter, N.R. 2017. *Consumers' knowledge of date labelling and the influence thereof on household fresh produce waste practices in Gauteng*. (Dissertation - Masters in Consumer Science General). <http://hdl.handle.net/2263/65953>

Waste and Resource Action Program (WRAP). 2016. *Food Loss and Waste Accounting and Reporting Standard. Version 1.0*.

[s/20https://flwprotocol.org/wpcontent/upload17/05/FLW\\_Standard\\_final\\_2016.pdf](https://flwprotocol.org/wpcontent/upload17/05/FLW_Standard_final_2016.pdf) Date of access: 24 Nov. 2020.

World Wide Fund for Nature (WWF). 2017. *Food Loss and Waste: Facts and Futures*. WWF South Africa, Cape Town.

[http://awsassets.wwf.org.za/downloads/WWF\\_Food\\_Loss\\_and\\_Waste\\_WEB.pdf](http://awsassets.wwf.org.za/downloads/WWF_Food_Loss_and_Waste_WEB.pdf) Date of access: 11 Sep. 2018.

World Wide Fund for Nature (WWF). 2018. *Surplus food 2018 from farms and firms onto forks*. WWF South Africa, Cape Town.

[http://awsassets.wwf.org.za/downloads/wwf\\_2018\\_surplus\\_foods\\_from\\_farms\\_and\\_firms\\_onto\\_forks.pdf](http://awsassets.wwf.org.za/downloads/wwf_2018_surplus_foods_from_farms_and_firms_onto_forks.pdf) Date of access: 25 Nov. 2020.

World Wide Fund for Nature (WWF). 2019. *Agri-food Systems: Facts and Futures: How South Africa can produce 50% more by 2050*. WWF South Africa, Cape Town.

[https://wwfafrica.awsassets.panda.org/downloads/wwf\\_food\\_report\\_facts\\_and\\_futures\\_2019.pdf](https://wwfafrica.awsassets.panda.org/downloads/wwf_food_report_facts_and_futures_2019.pdf) Date of access: 25 Nov. 2020.

World Wide Fund for Nature (WWF). 2020. *Food waste initiatives*.

<https://www.worldwildlife.org/initiatives/food-waste> Date of access: 25 Nov. 2020.

Young, C.W., Russell, S.V., Robinson, C.A. & Chintakayala, P.K. 2018. Sustainable Retailing – Influencing Consumer Behaviour on Food Waste. *Business Strategy and the Environment*, 27:1-25.

# APPENDICES

## Appendix A: Consent form

### Research Project Title

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#### Understanding food waste management practices in the grocery retail sector in Durban, Kwa-Zulu Natal

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#### Dear Sir/Madam

Thank you for showing an interest in this project. Please read this information sheet carefully before participating.

#### Introduction

Miss Thembekile Dlomo (Student number: 25920146) is a registered Masters Environmental Management: Waste Management student at the North West University (Potchefstroom) under supervision of Dr. Claudine Roos, who is a staff member and a senior lecturer at this University. As part of this qualification, students need to conduct a research project and Miss Dlomo's proposed research project focuses on waste generated by the retail sector.

The study will focus on the quantities and types of waste generated and will involve interviewing key staff responsible for waste management about in-store practices with regards to waste management. It will also look at the characteristics and the types of waste being generated.

This is to request your consent to participate in this study.

#### Research purpose

The primary purpose of this research is to understand current food waste management practices in the grocery retail sector in Durban, Kwa-Zulu Natal.

#### Study benefits

The outcome of the study would support and enhance waste reduction initiatives within the retail sector. As a participant, you will be sent results upon completion of the research if you so indicate.

#### Type of participants being pursued

Store managers, waste managers and sustainability co-ordinators employed major grocery retailer (s)

#### Participant involvement

The study would involve about 15-30 minutes semi-structured interviews (qualitative data) with a pre-arranged list of questions with the waste management representative and a site walkabout for waste management process flow.

#### Confidentiality

All personal information and the names of the facilities will be kept confidential and there will be no personal ramifications of any results found. Results will be captured in a manner that will ensure confidentiality.

**Risks**

While nothing in life is risk free, there are, for all intents and purposes, no risks involved in participation

**Participation is voluntary**

The refusal to participate will have no penalty or loss of benefits to which the participant is otherwise entitled, and that the participant may discontinue participation at any time without penalty loss of benefits to which they are otherwise entitled.

**Reimbursements**

There are no reimbursements.

**Contact details**

If you have any questions about this project, either now or in the future, please feel free to contact me directly on [thembihdlomo@gmail.com](mailto:thembihdlomo@gmail.com) or my supervisor, Dr. Claudine Roos on: 018 299 1477 or [Claudine.roos@nwu.ac.za](mailto:Claudine.roos@nwu.ac.za)

**Participant consent**

I have read the information sheet concerning this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that: -

- 1. My participation in the project is entirely voluntary;
- 2. I am free to withdraw from the project at any time without any disadvantage
- 3. I understand that all my details (identifying data) will be kept strictly confidential.
- 4. I agree to take part in this project.

.....

(Signature of participant)

.....

(Date)

.....

(Printed Name)

## Appendix B: Key store personnel questionnaire

### QUESTIONNAIRE: KEY STORE PERSONNEL

1. What is your definition of food waste?
2. Does your store measure food waste quantities and types? If yes, please explain in detail how and why this quantification is done.
  - 2.1 For how long the above mentioned quantification process has been in place? Do you keep records?
3. How typical is the type and amount of waste observed daily, weekly, monthly?
4. Does the quantification process include reasons for wastage of different food types?
5. Do you have any indication as to why certain products are wasted more frequent than others?
6. What are your views on food waste within your store?
7. In your opinion, why food waste is generally a concern?
8. Do you have a corporate policy for food waste management?
  - 8.1 If yes above, does it set any reduction objectives and targets? How often these are measured?
9. Which of the following food waste management options is/are being implemented by your store?

Option	Tick	Describe how this is done in terms of process, location, technologies applied, use of products etc.
Surplus food volume reduction		
Feeding hungry people		
Feeding animals		
Resource recovery		
Composting		
Incineration		
Landfilling		

10. If food donation is used as a diversion avenue for unsalable food, do you keep records of food quantities given to food bank?
11. Which food products do you have take-back agreements for with suppliers?
12. Please explain in detail why other diversion avenues above are not used and if your organization consider using them in the future.
13. In your opinion, what are the barriers for food waste reduction in your store?

Barrier	Tick	Please explain

Quality standards (i.e. Shape, weight, appearance)		
Training		
Food safety concerns		
Promotions		
Availability and capacity of diversion avenues		
Resources availability (Time, Finance, etc.)		
Customer behaviour		
Other		

14. What would you describe as key benefits for food waste reduction in your store?

15. What do you think can be done to encourage future food waste reduction initiatives in the grocery retail industry?

**Thank you for your participation!**



## Appendix C: Waste manager questionnaire

### QUESTIONNAIRE: WASTE MANAGER

1. What is your definition of food waste?
2. Please explain your company's role in managing grocery retail sector waste
3. What are your views on food waste within the grocery retail sector?
4. In your opinion, why food waste is a concern?
5. Which of the following food waste management options is/are being implemented by your client?

Option	Tick	Describe how this is done in terms of process, location, technologies applied, use of products etc.
Surplus food volume reduction		
Feeding hungry people		
Feeding animals		
Resource recovery		
Composting		
Incineration		
Landfilling		

6. In your opinion, which options above can reduce food waste in the retail grocery sector and what are the barriers for implementing these?
7. What would you describe as key benefits for food waste reduction in the grocery retail sector?
8. What do you think can be done to encourage future food waste reduction initiatives in the grocery retail sector in South Africa?

**Thank you for your participation!**

## Appendix D: On-site food waste assessment and characterization data collection template

On-site Food Waste Assessment and Characterization Data Collection Template			
Supermarket ID:			
Date:			
Waste Stream:			
Food Category:			
Food type/ description (i.e. eggs, pack eggs, broken egg)	# units Weight/ unit (kg)	Total weight (Kg)	Date
	Units: Weight:		<input type="checkbox"/> Best-Before
			<input type="checkbox"/> Use-by
			/ /
	Units: Weight:		<input type="checkbox"/> Best-Before
			<input type="checkbox"/> Use-by
			/ /
	Units: Weight:		<input type="checkbox"/> Best-Before
			<input type="checkbox"/> Use-by
			/ /
	Units: Weight:		<input type="checkbox"/> Best-Before
			<input type="checkbox"/> Use-by
			/ /
	Units: Weight:		<input type="checkbox"/> Best-Before
			<input type="checkbox"/> Use-by
			/ /
	Units: Weight:		<input type="checkbox"/> Best-Before
			<input type="checkbox"/> Use-by
			/ /

## Appendix E: Codebook from Nvivo 12

Name	Description	Files	References
Motivators		0	0
Carbon footprint reduction		1	1
Cost saving		3	6
Help people		1	1
Drivers		0	0
Compost market availability		1	1
Date labelling		3	5
Diversion avenues		1	1
Food safety		1	2
Handling		3	4
Promotions		3	4
Quality standards		3	4
Shelf life		3	4
Lack of infrastructure		1	1
Opportunities		0	0
Enhanced demand planning		2	3
Enhanced redistribution		3	3
Infrastructure		2	5
Landfill ban		1	1
Training and awareness		3	4
Practices		0	0
Demand planning		4	5
Donation		3	7
In-house use		1	2
Land disposal		4	5
Price markdown		2	2
Waste measurement		3	3