MINIMIZING TERMINAL FOOD WASTE WITHIN THE FOOD SUPPLY CHAIN

by

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DEDICATION

I dedicate this thesis to all the strong, stubborn, independent and opinionated women in my family. I hope to be exactly like you when I grow up.

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ABSTRACT

Approximately 30% of food produced globally is wasted each year. There is a significant need to understand the situation surrounding this food waste phenomenon. This research used a variety of mixed method approaches to understand the conversation, perceptions, and behaviours of stakeholder within the food supply chain in relation to food waste. A jurisdictional review and content analyses were conducted to gain insight and understanding of the current conversation occurring. Stakeholder interviews were conducted to understand the current situation within the food supply chain and waste management system. Additional consumer surveys yielded experimental constructs surrounding the purchasing behaviours, waste separating practices, household waste perceptions, and level of environmental concern within respondents. For successful mitigation of terminal food waste within the food supply chain it is necessary for all involved to take a holistic approach and focus on initiatives on each level of the food waste hierarchy.

LIST OF ABBREVIATIONS USED

UN- United Nations

FAO- Food and Agricultural Organization

EU- European Union

CO_2-eq: Carbon Dioxide Equivalent

UK- United Kingdom

WRAP- Waste & Resources Action Programme

QWP- global warming potential

AD- anaerobic digestion

MWW- Mann-Whitney Wilcoxon

ICI- Industrial, commercial, institution

CEC- Commission for Environmental Cooperation

NZWC- National Zero Waste Council

FIT- feed-in-tariff

CET- Centre for EcoTechnology

dky- did you know

sdgs- sustainable development goals

COP14- Convention on Biological Diversity

sdgs2- sustainable development goal 2 (zero hunger)

LFHW- Love Food Hate Waste

CFIA- Canadian Food Inspection Agency

HRM- Halifax Regional Municipality

PB- purchasing behaviour

WS- waste separating behaviour

HB- Household waste beliefs

EC- environmental concern

NGO= non-government organization

ACKNOWLEDGEMENTS

CHAPTER 1: INTRODUCTION

Food waste has become a topical issue throughout developed nations, following reports from the United Nations Food and Agriculture Organization (FAO) that approximately one-third of all food produced is not consumed by humans. Food is a valuable resource. This value is only increasing as populations grow and the impacts of climate change become more evident. Yet loss or waste occurs throughout the food supply chain (Figure 1).
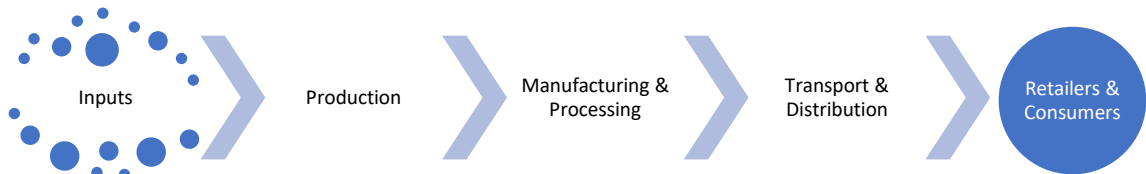
Figure 1: Food Supply Chain adapted from (Porter & Reay, 2016; Tsolakis, Keramydas, Toka, Aidonis, & Iakovou, 2014)

The United Nations have set out seventeen sustainability development goals. Zero waste is the second goal and is a high priority for the organization. Along with this, additional goals are directly related to the issue of food loss and waste. These other goals include Zero Hunger and Responsible Consumption and Production, although, given the impact and importance of the global agricultural industry, the reduction of food loss and waste would no doubt have an impact through all 17 of the sustainable development goals.

Despite the efforts being made throughout the globe, waste continues to occur, all while many of us still go hungry. But the issues of food insecurity and the food waste phenomenon are merely two symptoms of two fundamental problems within our society. An overabundance for some and an underabundance for others. While there are many

factors contributing to both issues, the overabundance that leads to food waste is almost entirely avoidable. Food waste has a significant environmental and economic cost, and it is within society's ability to curb this phenomenon instead of allowing it to continue to plague our food system.

Research in this area will typically focus on three primary stages of the food supply chain: 1 agriculture and production; 2 processing and manufacturing; 3 retail and consumption (Figure 2). Waste occurs along all three stages. Underdeveloped countries experience problems in stages 1 and 2. Within developed nations, the largest proportion of food waste occurs during the retail/consumption stage of the food supply chain. This waste primarily occurs within the household by consumers, with smaller proportions within the hospitality industry and at retail stores.
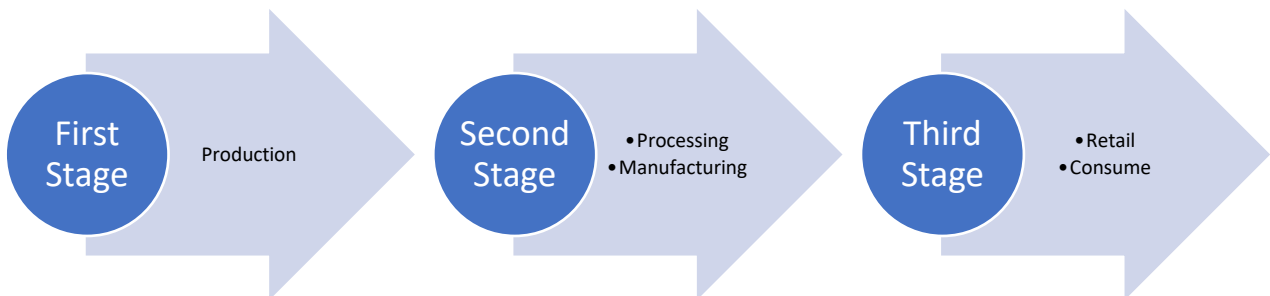
Figure 2: Food Supply Stages adapted from (Porter, Reay, Higgins, & Bomberg, 2016)

There are still no conclusive solutions to this issue, with many even in disagreement over the very definition of 'food waste'. Is waste a material not used for its intended purpose (to feed people in the case of food)? Or, is waste material that exits the circular economy (no longer available for use) by being sanitarily landfilled or incinerated without energy use? The discussion varies depending on the country, as well as the source of the material. There is consensus, however, surrounding the use of the food waste hierarchy,

although the specifics of the hierarchy can differ slightly depending on the organization/country.

The waste hierarchies used all follow the prevention, re-use, recovery, and disposal model, with each step being less desirable than the previous. **Error! Reference source not found.** (p. 9) shows the food waste hierarchy developed by the United States' Environmental Protection Agency (EPA) (2014). This model is used by the European Union, as well. At every level of the food supply chain, waste is occurring (Marenick, Gooch, & Felfel, 2010).

The current economic model of food use follows a linear *take-make-use-dispose* model (Ribić et al., 2016). This linear economy was a result of periods of affluence and abundance of items, benefiting manufacturing and retail industries, but this is no longer sustainable (Andrews, 2015). The amount of waste we, as a society, are producing will only continue to rise unless measures are taken to respond to the changing social and environmental needs. Walter Stahel (2016) compared the linear economy to a river in his paper in Nature, where value is added in one direction. A circular economy is more of a lake, with the water being recycled and repurposed while staying within the system (Stahel, 2016). He also considered the linear model to be a cradle-grave, where the circular economy would be cradle – cradle (Andrews, 2015)

Many countries and organizations, including the European Union (EU), have declared that a fundamental change in the linear model is necessary – shifting to a circular economy, which is designed to mirror nature and be a restorative process (Jurgilevich et al., 2016). A circular economy is structured around the same re-use, repair, refurbishing, and recycling principles outlined in the waste hierarchy (Jurgilevich et al., 2016). The

model aims to ensure that resources remain within the system, avoiding end disposal, and removal from the system.

The circular economy uses principles from industrial ecology and biomimicry to close the loop off and reduce loss from the system (Andrews, 2015; Jurgilevich et al., 2016). Biomimicry uses nature's patterns and strategies to find solutions to human challenges (Benyus, 1997). A circular economy would promote re-use over disposal, in that the same decomposing organic material provides nutrients for other organisms in the ecological system (Andrews, 2015).

CLOSING LOOPS
Using resources for the longest time possible could cut some nations' emissions by up to 70%, increase their workforces by 4% and greatly lessen waste.

Resource losses partly recoverable by industrial symbioses.
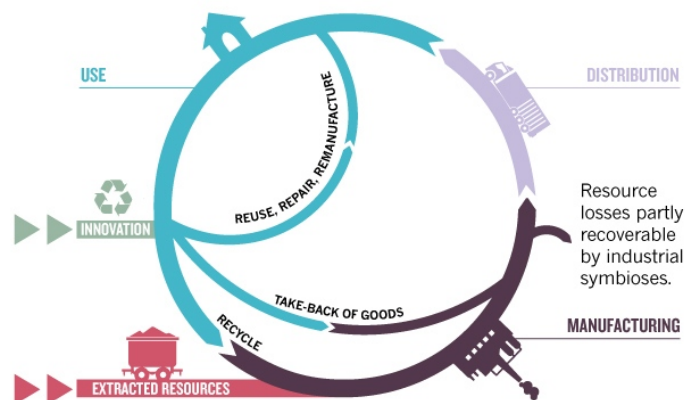
INNOVATION
Research is needed to transform used goods into 'as-new' and to recycle atoms.

EXTRACTED RESOURCES
Water, energy and natural resources enter the manufacturing process.

MANUFACTURING
Renewing used products lessens the need to make originals from scratch.

DISTRIBUTION
Ownership transfers from manufacturer to consumer at point of sale.

USE
Is controlled by buyer-owner-consumers of goods, or by fleet managers who retain ownership and sell goods as services.

©nature

Figure 3: Closing the Loop: Circular Economy (Stahel, 2016)

In the context of the food supply chain, inputs and resources are used to grow and process the food we eat. The chain relies on plant production, which requires minerals from the air, soil and water, along with the sun's energy to grow (Marten, 2001). While the Sun's energy is unlimited, the minerals on earth are finite. Figure 3 shows the ideal material cycling of the ecosystem. In reality, more than heat energy is lost from the cycle. As available minerals decrease, the cycle begins to breakdown.

Marten (2001) demonstrates the flow of energy of food within our ecosystem in Figure 4. This would be an ideal system, with the only loss occurring from heat energy leaving the system. Figure 5 shows a more realistic view of the system, with the losses of minerals leaving the system in addition to the heat energy lost (Marten, 2001).
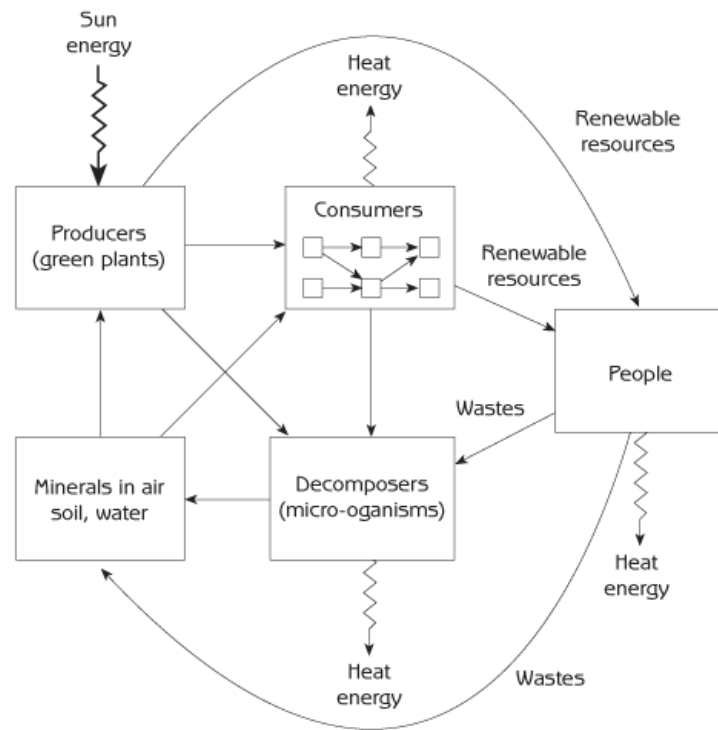
Figure 4: Material Cycling within the Ecosystem (Marten, 2001)
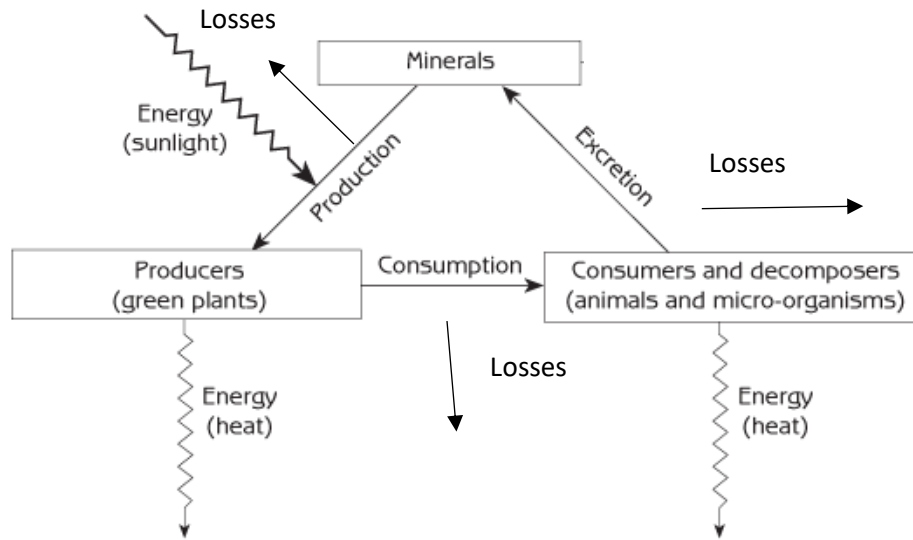
Figure 5: Material Cycle and Energy flow (adapted from Marten, 2001)

As stated previously, these losses are occurring in some quantity during production, consumption, and excretion. Of these losses, some are unavoidable, but the majority are avoidable. The goal of the circular economy is to recapture these avoidable losses, to maintain them within the system. Additionally, a goal to decrease the unavoidable losses would also be within the objectives of a circular economy approach.

The life cycle of different food products is shown in Figure 6, showing the process from the 'cradle to grave' (Brancoli, Rousta, & Bolton, 2017). This is a simplified view of a few commonly wasted product types. The geographical reference city used for this model, Boras, Sweden, use anaerobic digestion as a means of handling the disposal of food waste. The figure is a good visualization of all of the inputs required to grow and process food product for human consumption.
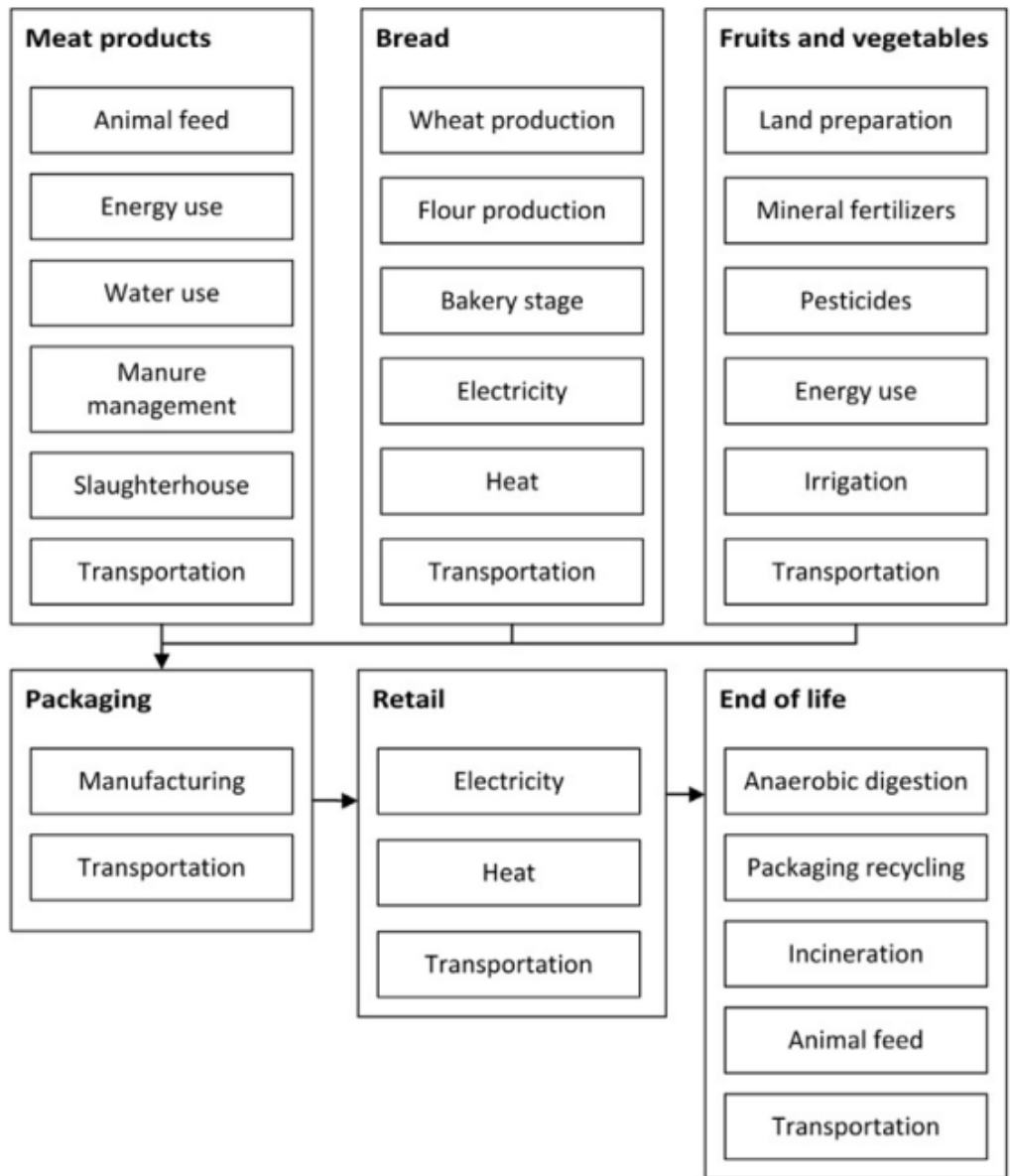
Figure 6: Flow chart for different wastes in food supply (Brancoli et al., 2017)
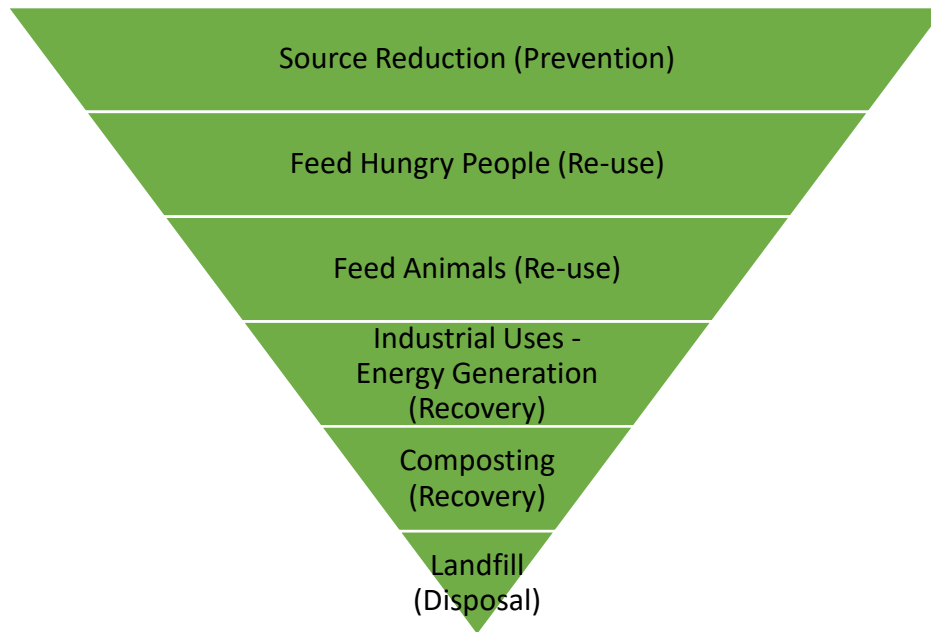
Figure 7: EPA's Food Waste Hierarchy (EPA, 2014)

The food waste (or food recovery) hierarchy (Figure 7) developed by the Environmental Protection Agency (EPA) in 2014 lists the various levels of food recovery (EPA, 2014a). The uppermost levels provide the least amount of loss to the environment, economy and society (most preferred approach). The lowest level (least preferred), incineration/landfill disposal, is the least efficient and has greater environmental consequence and loss to the food system (EPA, 2014b; Ian Murray & Company Ltd, 2017).

Prevention relies on behavioural change and would be the prevention of avoidable waste. Opportunities for prevention are present at the production stage with producers, among retailers, and with consumers (Dou et al., 2016). Retailers have significant power within the market given their location within the supply chain (Eriksson, Ghosh, Mattsson, & Ismatov, 2017). Business practices such as discounting bulk purchasing and date labelling have been noted as contributing to food waste (Dou et al., 2016; Newsome et al., 2014).

Re-use is divided into two tiers. Re-use for human consumption is the more desirable of the two. The food had originally been produced for human consumption and the re-use (or redistribution) for human consumption offers the higher return on the inputs. Re-use for animal feed (or insects) is the second tier and is not as desirable as human consumption but is still a high-level use for captured food waste. Food banks often do not have the resources available to remove inedible food from packaging, this can lead to landfill disposal as a result of the mixed materials used in the packaging of food products (Hoover, 2017).

There are also two tiers of recovery. Some sources will place energy generation at a higher tier than composting, while others will consider them to be equal in desirability. Energy generation would be aerobic or anaerobic digestion. Aerobic is the decomposition of the organic matter in the presence of oxygen and anaerobic without the presence of oxygen. Composting or energy generation are both more desirable than disposal, even though they are a lower level tier in the hierarchy.

Landfill disposal is the least desirable within the food waste hierarchy. Food matter that reaches this level has been the most inefficient use of inputs and resources. Waste occurring at this level of the hierarchy elicits the most loss from the system and has the highest cost to the three pillars of sustainability. This waste can be considered to be a terminal waste, as it has not been able to recapture at any of the other stages of the waste hierarchy.

According to the Ribić (2016) study on the feasibility of food waste management, the most common waste producers in urban areas are households, restaurants and retail stores. Within Canada, households account for 47% of annual food waste, with retail and

restaurants contributing 10% and 9% respectively (National Zero Waste Council, 2016). This percentage distribution is similar in other developed countries.

Nationally, organic materials in landfills contribute 4% of the greenhouse gas inventory (National Zero Waste Council, 2016). By removing organic waste from landfills, there is a measurable reduction in the amount of greenhouse gas emissions. A study that evaluated four food waste disposal options, showed that landfill disposal produced 1,010kg of CO_2-eq while composting produced 123kg of CO_2-eq (Kim & Kim, 2010). Another benefit of changing the food waste paradigm is using the energy potential of organics as an alternative to fossil fuels via biogas production (Carlsson, 2016). Using food waste as feedstock for composting, anaerobic digestion or animal feed are all options that have proven popular.

However, if food waste is not separated from its packaging, it cannot be decomposed, repurposed or digested productively and the food product is likely to end up in a landfill as it is not suitable for the alternative food waste handling options. Not only is that food resource then lost, but it leads to the production of methane gas as the food and packaging break down over time (Ribić et al., 2016). In the UK, packaging contaminants in food waste reach upwards of 20%. If that organic matter were sent to composting in its package, the packaging would break down, and the chemicals and particulate from the packaging would make the organics unsuitable for alternate use.

The presence of contaminants such as paper, plastic, cardboard, or glass can prevent the food waste being used in recovery systems such as anaerobic digestion, feed for insects or animals, or compost (Brancoli et al., 2017). Depackaging equipment has been developed to alleviate this issue and remove the packaging while still recovering high-quality organic

material. Depackaging equipment (sometimes called deconditioning) is a preconditioning system that uses a process of compression, shredding, agitation and screening to remove food material from various packaging materials. These systems produce an output that is high-quality and free of contaminants.

As noted by Fisgativa et al. (2016), there have been very few studies reviewing the process of package deconditioning (depackaging). Anaerobic digestion is considered to be the best technology for the use of the food waste that has been depackaged and has the highest potential for energy creation (Fisgativa, Tremier, & Dabert, 2016; Zhang, Su, Baeyens, & Tan, 2014). The high variability of the waste collected can cause uncertainty for the anaerobic digestion systems (Fisgativa et al., 2016).

Food waste on the retail level is primarily due to poor stock management; over-inventory staying on the shelves too long to be saleable (European Commission, 2008; Marenick et al., 2010). In reports prepared for the American states of Connecticut and Massachusetts, a comprehensive review was conducted to identify and characterize food waste generators in the food value chain (Draper/Lennon Consulting, 2002; Draper/Lennon Consulting, 2012). These reports did not consider packaged food products, which were disposed of – they were not accounted for in the amount of food waste generated by the institutions measured. The reports did note that food waste collected was often contaminated with various forms of packaging (Draper/Lennon Consulting, 2002; Draper/Lennon Consulting, 2012).

With the ratification of the Paris Accord (2016), Canada has committed to combatting climate change, making the shift to renewable energy and environmentally responsible practices of greater importance than in previous eras. Research related to innovation and

the use of new technologies in the recycling industry can create a significant opportunity for waste management systems to reduce terminal waste and thereby help combat climate change. This study will focus on how Nova Scotia, which is the leader in waste reduction in Canada; can make improvements to its established system for effective waste collection and waste reduction. It can be used as a model for other regions.

Consumers are directly responsible for nearly half the food waste produced annually in Canada, with household food waste generation estimates around 47% (National Zero Waste Council, 2016). Producers, manufacturers, and retailers model their products and stores off of consumer purchasing preferences. Consumers are more likely to purchase a product from a full shelf and are looking to buy the picture-perfect product (Thyberg & Tonjes, 2016). It could be argued that given that consumer needs and wants are the motivators for all stakeholders within the food supply chain, consumers would be responsible for all food waste occurring post-harvest.

There are clearly many factors at play when considering the food waste phenomenon. With multiple levels of stakeholders and clear implications throughout each of the three pillars of sustainability, the problem must be viewed and analysed from multiple perspectives to identify opportunities for solutions that promote change on every level of the food waste hierarchy.

This research utilised a variety of methods that examine the conversation surrounding the phenomenon as fully as possible. A jurisdictional review was completed to identify the actions and perceptions of government and government adjacent organizations in combatting food waste. Following this, a thematic content analysis of mixed sourced

publications was done to identify the frequency of themes within works that were published with the intention of having members of the public read the works.

An additional thematic content analysis was also conducted to identify the themes present within the online social media conversation, where the data is self-published without any (or much) expectation of readers outside of their own network (followers). The use of social media as a means of spreading awareness related to environmental issues was also conducted using the collected social media data. Two campaigns were profiled to look at the engagement and different approaches of the two campaigns.

Primary data was also collected. This data contributes to the solicited conversation from a specific target. Interviews were conducted with eight individuals from different stakeholder groups within the food supply chain. A consumer and grocery store employee survey were also completed. The consumer survey looked at the consumer's purchasing behaviour, waste separation practices, household waste behaviour, and level of environmental concern. The employee survey also evaluated the household waste behaviour and level of environmental concern of the employee, in addition to their level of job satisfaction and waste separating practices within the retail grocery stores.

By use of the above methods of analysis, the aim of this research is to have a complete understanding of the perceptions and behaviours of the stakeholders involved with waste generation at the consumer end of the food supply chain. Through this understanding, gaps within the conversation can be address and recommendations for the reduction of terminal waste can be made.

Purpose and Objectives

The purpose of this research is to review what is known and what is being said about the food waste phenomenon throughout the consumer stages of the food supply chain to identify gaps in knowledge and opportunities to minimize the amount of food waste reaching landfills.

Research Question:

How can we minimize the amount of food and organic matter reaching landfills (terminal waste) in the food supply chain?

The objectives of this thesis are to:

- Determine the practices and motivations of stakeholders at the academic, government, and retail level with regards to food waste and waste diversion
- Identify the behaviours and perceptions of consumers and retail employees in Canada towards food waste
- Examine existing legislation, policies and initiatives of multiple jurisdictions to determine practices that could be adopted or avoided in Nova Scotia
- Identify the behaviours and perceptions of consumers and retail employees in Canada towards food waste

These objectives will be met using the food waste hierarchy as the thought framework. Each level of the waste hierarchy will be considered and valued according to their ranking within the hierarchy.

CHAPTER 2: LITERATURE REVIEW

Table 1: Common terms and their definition in context

Common Terms	Definition	Source	Stage	
Food Loss	Decrease in quality or quantity of food	FAO	Production, harvest, and processing	
Food Waste[1]	wholesome food material intended for human consumption that is discarded or consumed by pests	FAO	Distribution & retail, restaurants & catering, household consumption	After re-use for human consumption
Food Waste[2]	food originally intended for human consumption that is discarded or fed to animals	Stuart	Distribution & retail, restaurants & catering, household consumption	After re-use for human consumption
Food Waste[3]	the gap of energy consumed vs energy needed for the food per capita	Papargyropoulou et al.	Distribution & retail, restaurants & catering, household consumption	
Food Recovery	The diversion of disposal through redistribution for human consumption or animal feed			
Food Surplus	The overproduction of food in excess of consumer demand			

Table 1 shows the varying terms and definitions for said terms that are used within the literature.

Food Waste Definition

  Several terms are used when describing waste occurring within the food supply chain. The FAO uses 'food loss' and 'food waste' to refer to the decrease of food mass throughout the food supply chain (Gustavsson, Cederberg, Sonesson, Van Otterdijk, & Meybeck, 2011). 'Food loss' is used to refer to waste during the early stages of the supply chain up to distribution and retail sale; at that point, waste is referred to as 'food waste'. Depending on the institution and region, the definition of food loss and food waste can differ (Killeen, 2016). In a report published in the Journal of Retailing and Consumer Services, the authors define food loss to be a qualitative or quantitative drop in the nutrient value or weight of the food (Cicatiello, France, Pancino, & Blasi, 2016). This is similar to the definition presented by Dou et al. (2016), which also stated that food loss is typically attributed to the production, processing and transport stages of the food supply chain. This paper did also note that the term food loss and food waste are used interchangeably (Dou et al., 2016). This presents a problem when reviewing the existing literature within this area, as different authors may have differing interpretations of the terms used.

  Papargyropoulou et al. (2014) noted that there were three primary definitions of 'food waste'. The FAO defined it as any wholesome food material intended for human consumption that is discarded or consumed by pests. This definition was later expanded by Stuart (2009) to include food originally intended for human consumption that is fed to animals. This definition would suggest that food waste begins following the second stage of the waste hierarchy, where the definition from the FAO suggests food waste would begin during the recovery stages of the waste hierarchy. The third definition added the gap of energy consumed vs energy needed for the food per capita (Papargyropoulou, Lozano, K.

Steinberger, Wright, & Ujang, 2014). Food surplus is another term that is often used for food loss/waste. Food waste is a result of a food surplus, but the terms are not interchangeable.

Food Waste

The largest drivers of food waste are the globalisation of the food system, cultural factors and societal change, and economic growth (McCarthy & Liu, 2017). The FAO estimates that just 25% of the food wasted globally would be able to feed all the people currently without food (Garcia-Garcia, Woolley, & Rahimifard, 2017). While there is a growing amount of international literature related to food waste reduction, studies show varying results and uncertainty remains as to the appropriate solutions to deal with the issues surrounding food loss/waste (Liu, C. et al., 2016). This presents difficulty in what can and should be targeted and how to most effectively create change in the food lifecycle.

Research has largely focused the compositional aspects of the food waste itself, and qualitative studies are looking at household/consumer food waste (Cicatiello et al., 2016; Katajajuuri, Silvennoinen, Hartikainen, Heikkilä, & Reinikainen, 2014). Studies highlight the impacts of the food waste phenomenon within the food system. Inefficiency within the food system has social, economic and environmental consequences.

Food waste has a direct impact on the producer, the consumer and society as a whole (Bilska, Wrzosek, Kołożyn-Krajewska, & Krajewski, 2016; Cicatiello et al., 2016). The FAO estimated the direct cost of food waste in 2009 was approximately $750 billion (USD) (Fisgativa et al., 2016). Within Canada, over one-third of food produced and distributed is never consumed, costing the national economy up to $100 billion in direct

and indirect costs (IMC, 2017; National Zero Waste Council, 2016). Some of these costs are the cost of production, packaging, distribution, and purchasing, as well as the cost of disposal and waste treatment (Cicatiello et al., 2016; Papargyropoulou et al., 2014).

In addition to the economic cost of food waste, there is also a substantial environmental impact resulting from food waste. Food production in itself is the exploitation of natural resources, contributing to climate change, loss of biodiversity, and the depletion of natural resources (Brancoli et al., 2017; Cicatiello et al., 2016). As the food system needs to move to meet production demands for the growing population, there is an increased need for efficiencies within food production to be made (Bilska et al., 2016). Cicatiello et al. (2016) note that there has been a limited estimation made on the social impact of food waste, although in the few studies that have been done, the focus has been on the implications of social justice and the role of education of food waste.

The largest concern is ensuring that food production is improving production within the regions that are facing food insecurity, while also addressing the overconsumption within developed regions (Bilska et al., 2016). As stated previously, if a portion of the globe's wasted food was able to be redistributed to those in need, food insecurity would not be an issue any longer. Unfortunately, there is a mismatch in the regional distribution of strong agricultural industries and populations in need. Undeveloped regions will experience food loss as a result of harvesting techniques, extreme conditions, and poor storage (Gustavsson et al., 2011; Papargyropoulou et al., 2014). Within developed countries, food waste is largely a result of overconsumption.

Prevention of food waste is the highest level of the food waste hierarchy. Prevention relies on the engagement of all parties (Dou et al., 2016). Consumers contribute the largest

proportion of food waste generation. However, consumers are not significantly engaged. Dou et al. (2016) consider the recognition of the problem to be required if there is a potential for change. Waste prevention is different than waste management. Waste prevention avoids the generation of the waste, ensuring it does not fall to the lower levels of the food waste hierarchy (Papargyropoulou et al., 2014). Waste management is the process and development of solutions to deal with the waste once it has occurred. The prevention of food waste is the most sustainable and provides the highest social, economic, and environmental benefits (Thyberg & Tonjes, 2016).

The re-use of food waste can be divided into two categories. The first is the re-use of food waste through redistribution for human consumption (Alexander & Smaje, 2008). Retailers are often encouraged to divert their surplus food to food banks. It has been estimated that of the food retailers donate for human consumption, 40% is not able to be redistributed and still finds its way into the waste stream. They cite that most of this waste may be unavoidable and that the 60% that is redistributed for human consumption is still a significant portion diverted from landfill (Alexander & Smaje, 2008). The most common foods collected by food banks are bread, fresh fruits and meat products (Cicatiello et al., 2016).

A very small portion of food waste in the wholesale retail sector (6% of reported 1.7 million metric tonnes) is diverted for animal consumption (Dou et al., 2016). This is the second category for the re-use of food waste. Food manufacturers diverted waste as animal feed much more frequently (69% of 21 million metric tonnes). Typically, the food waste collected for use as animal feed requires further rendering (CEC, 2017). Use as animal feed is of lower value and a loss in opportunity cost, but provide more benefits than

the recovery or disposal of the organic waste (Buzby, Hyman, Stewart, & Wells, 2011). In some situations, redirecting for animal feed over human consumption may be the preferable option as redirecting for human consumption may yield an increase in environmental and economic costs (Chaboud & Daviron, 2017). Use for animal feed can also reduce the demand for imported animal feed. There are often regulatory and technical barriers that prevent the re-use of food waste as animal feed, as a result, the recovery can sometimes be the only option for the food waste (Dou et al., 2016).

The recovery of food waste refers to the recapturing of the organic material that was not recaptured through the re-use for human or animal consumption. The category of the food waste hierarchy is divided into energy generation and composting. Energy generation is typically done through aerobic or anaerobic digestion to create biogas. Composting has been very common throughout North America as land is comparatively cheap and available (CEC, 2017). As public demand for renewable energy shifts aerobic and anaerobic digestion is gaining popularity and is seen as a higher utility level for food waste.

The final stage for food waste is disposal. Food that has not been diverted at any of the other stages of the hierarchy would need to be disposed of through landfill disposal. This is considered to be terminal food waste. This is the least sustainable and contributes significantly to the social, environmental and economic cost of food waste. Eriksson et al. (2016) evaluated the global warming potential (GWP) of five food products within six different management strategies. The studies showed that landfill disposal had the largest
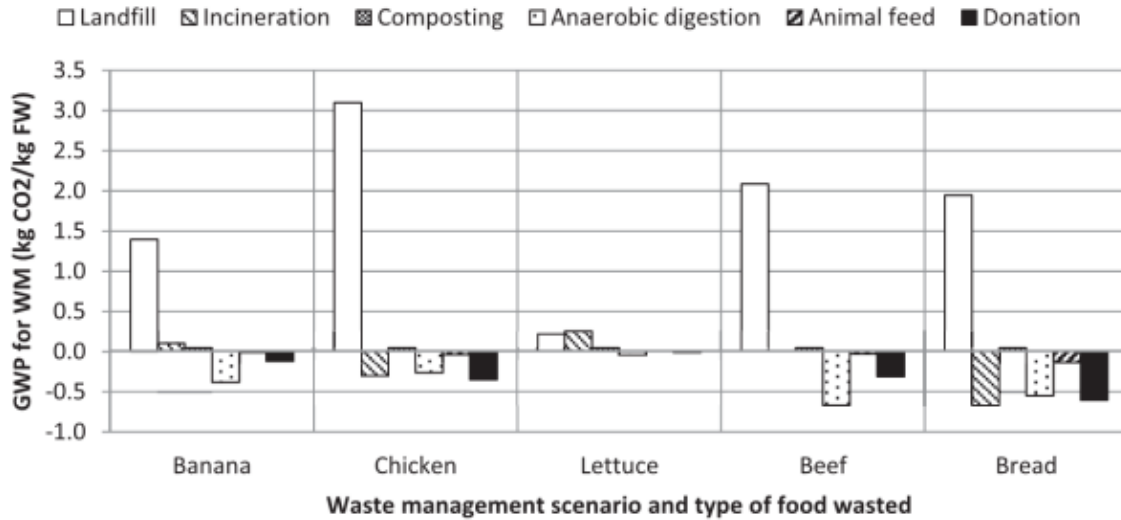
Figure 8: The GWP of waste management strategies when dealing with Food Waste (Eriksson et al., 2016)

GWP than all the other waste management strategies investigated (Eriksson, Strid, & Hansson, 2016). Complete results are summarized in Figure 8.

Cultural, geographic, personal, political, and economic forces influence behaviours that all lead to food waste generation. These forces differ among individuals and change over time (Thyberg & Tonjes, 2016). In response to this, while food waste should be view as a global issue, mitigation strategies and policy initiatives need to be reviewed in a way that considers these influences on behaviour.

Globally

Food loss and waste is an undeniably a global issue. Multi-national organizations such as the United Nations, the European Union, the Natural Resource Defense Council, the FAO, have all discussed the importance of improving systems to reduce terminal food waste (Environment Agency, 2011; EPA, 2014b; European Commission, 2008; National Zero Waste Council, 2016; UK Environment Agency, 2015). It is estimated that in North America and Europe a third of the food produced ends up as food waste (Mourad, 2016).

The effectiveness of waste reduction policies will rely on proven economic benefits, regardless of the level of interest in this phenomenon (Eriksson et al., 2017).

Lipinski et al. (2013) suggest that a sustainable food future could be achieved if a global strategy for reducing food waste were implemented. The responsibility of implementing such a strategy lies in the developed world, as more than half of all food waste occurs in North America, Oceania, Europe, and industrialized Asia (Lipinski et al., 2013; Mourad, 2016). Cicatiello et al. (2016) note that in Italy, Poland, Portugal and Lithuania the food supply exceeds the countries' needs more than in other European countries.

Developed countries have higher levels of food loss per capita than in developing countries (Papargyropoulou et al., 2014). This is a result of the overconsumption and food surplus that has previously been stated. In developing countries, inhabitants will often not have access to surplus food and will have high rates of recycling and recovery (Chaboud, 2017). Food loss in the South Asia and Sub-Saharan Africa regions is on average 120-170kg per capita, while Europe and North America have food loss at nearly double that amount, 208-300kg per capita (Papargyropoulou et al., 2014).

In 2015, the FAO published a Global Initiative on Food Loss and Waste Reduction. The report detailed the impacts of food loss and waste, as well as strategies and actions that could be taken (FAO, 2015). Alexander & Smaje (2008) suggest that gaps in policies in the United Kingdom (UK) food waste generation will continue, regardless of the advancing technologies within the recycling industry. The focus for the UK shown in the literature is on food redistribution and improving food security for the disadvantaged population (Alexander & Smaje, 2008; Cicatiello et al., 2016).

A study was done by the UK Waste & Resource Action Programme (WRAP) estimated that commercial and industrial food waste range between 8.3 and 11.3 million tonnes within the United Kingdom. Waste from businesses typically has a higher proportion of packaging when compared to household waste (Balkenhoff, 2009). Tax credits have been suggested and/or implemented for encouraging food donations from retailers across France, the United Kingdom, the United States and certain provinces across Canada (Lee & Tongarlak, 2017; Mourad, 2016; Vared & Fowler, 2016).

Within the United States, the food supply is the largest in the world, while the country itself is the third most populated (Dou et al., 2016). A reduction in food wastage within the United States could potentially improve food security across the globe. Mourad (2016) suggests that the United States is lagging behind in incentives for food waste reduction, with notions of a 'circular economy' as being seen as taboo. Although, a federal 'Good Samaritan' clause has been implemented to encourage the donation of food for redistribution while freeing the donors of any legal liability should the donation cause illness or injury (Bilska et al., 2016).

An anaerobic digestion facility in Colorado was forced to close as a result of public complaints about the smell and amount of traffic from the trucks. A similar situation was seen in Richmond, BC in 2016. Harvest Power voluntarily shut down its anaerobic digestion facility following public complaints about the foul odour (Wood, 2017). Municipal and public support is paramount to the success of these renewable energy businesses (Rosengren, 2017). It is exceedingly important to focus on the positives of such businesses. They provide much-needed employment in rural areas and help to gain economic benefit out of what would otherwise be an environmentally harmful waste.

An expanding organic recycling industry has led to increased technologies and capacity for processing recovered food matter and saving it from reaching landfills and becoming terminal food waste (Balkenhoff, 2009). The National Zero Waste Council and WRAP UK both agree that the expansion of the organics recycling industry provides society with a significant opportunity to improve the collection and quality of food waste (Balkenhoff, 2009; National Zero Waste Council, 2016). As discussed previously, the presence of packaging material is a problem for food waste recovered for re-use. The presence of contaminants such as paper, plastic, cardboard, or glass can prevent the food waste from being used in recovery systems such as anaerobic digestion, feed for insects or animals, or compost (Balkenhoff, 2009). Depackaging equipment has been developed to alleviate this issue and remove the packaging while still recovering high-quality organic materials (Flynn, 2011).

In 2014, Massachusetts placed a disposal ban on businesses that are disposing of more than one ton of food waste per week. Businesses were given the option of having the food waste delivered to off-site anaerobic digestion (AD) or composting facility. They were also offered the option to donate their surplus foods to food banks or soup kitchens (RecyclingWorks Massachusetts, 2014). Packaged food products were included under this organic food waste ban.

Within France, a retail food waste ban was put in place to require all supermarkets and grocers to donate edible food (Mourad, 2015). The law was passed by the French Senate unanimously in 2016 (Chrisafis, 2016). Those behind the campaign now hope to encourage the EU to pass similar legislation. The grocer is required to donate unsellable food or face a fine. Marie Mourad, a researcher at the Centre for the Sociology of

Organization in Paris completed a report in September of 2015 that outlined 36 policies and regulations that if implemented would greatly reduce the food wasted in the food value chain (Mourad, 2015). The comprehensive list of recommendations offers not only solutions for France, but for many nations. Research is being conducted globally on how to best deal with the problem of not only food waste but waste in general.

Following the creation of Japan's Food Waste Recycling Law in 2001, waste reaching landfill disposal and incineration have slowly begun to decline in the past 15 years (Liu, C. et al., 2016). With 50% of food waste being recycled as animal feed, the Japanese agriculture system is in decline, so this may not be a sustainable solution. Within Sweden, they opt for anaerobic digestion for energy generation, overusing food waste for animal feed (Brancoli et al., 2017). Dou (2016) notes that in the United States regulatory and technical specification can limit the opportunities to recover food waste for animal feed, particularly as the composition of the waste is often diverse and variable.

Retail Food Waste

While the focus has largely been placed on household food waste, several papers noted the importance of considering the distribution and retail stages of the food supply chain (Alexander & Smaje, 2008; Bilska et al., 2016; Brancoli et al., 2017; Killeen, 2016). While the retail stage contributes lower amounts of food waste than other steps within the chain, retailers hold significant bargaining power, which indicates a significant opportunity to enact change (Brancoli et al., 2017; Eriksson et al., 2017). Additionally, reducing food waste presents retailers an opportunity to improve their sustainability and improve social standing with consumers, while also potentially reducing their costs (Buisman, Haijema, & Bloemhof-Ruwaard, 2017).

Participants in the Graham-Rowe (2014) study felt that commercial entities are responsible for food waste reduction, but many reports argue that behavioural change at the consumer level is essential for significant prevention of terminal food waste (European Commission, 2008; National Zero Waste Council, 2016). Parfitt et al. (2010) suggest that this cultural shift in how consumers are viewing their food, awards retailers more power to influence change. Prevention is the first step in the food recovery hierarchy. The highest levels of the hierarchy are difficult to measure and rely heavily on qualitative approximation (Chaboud, 2017; Mourad, 2016).

Retail food waste is largely a result of choices of the retailers themselves, in response to consumer preferences (Thyberg & Tonjes, 2016). Consumers will be more likely to purchase a product from a fully stocked shelf; this leads to overstocking to encourage purchases and ensure that they always have the products their customers are looking for (Buisman et al., 2017). This will lead to waste as grocers are often faced with uncertain demand, and perishable food products (Alexander & Smaje, 2008; Lee & Tongarlak, 2017).

Education within the retail sector towards consumers, as well as retailers themselves, has been said to be the most effective option for enacting food waste prevention (Parfitt, Barthel, & Macnaughton, 2010). For example, there is often a significant amount of confusion surrounding the sell-by, or best before date shown on the packaging. Many would deem this food waste, although it is likely still suitable for human consumption (Alexander & Smaje, 2008). Some grocery stores will use pricing incentives to attempt to sell foods close to their labelled date, but many consumers may not choose to

purchase that item as they deem it to be of lower quality (Buisman et al., 2017; Lee & Tongarlak, 2017).

Retailers are also taking advantage of food bank donations to reduce food waste. This redistribution to the needy helps to improve their social image as well as alleviates them of the responsibility for the disposal of the product (Alexander & Smaje, 2008). Cicatiello et al. (2016) identified five types of retail food waste and possible uses, as shown in Figure 9. Recovery for human consumption is shown to be a possible use for edible food that has had damage to its packaging, does not meet quality standards or is blemished and unpurchased items. According to Stuart's definition of food waste, food that is not recovered for human consumption is now categorized as food waste, as the possible uses are now past the second stage of the waste hierarchy.
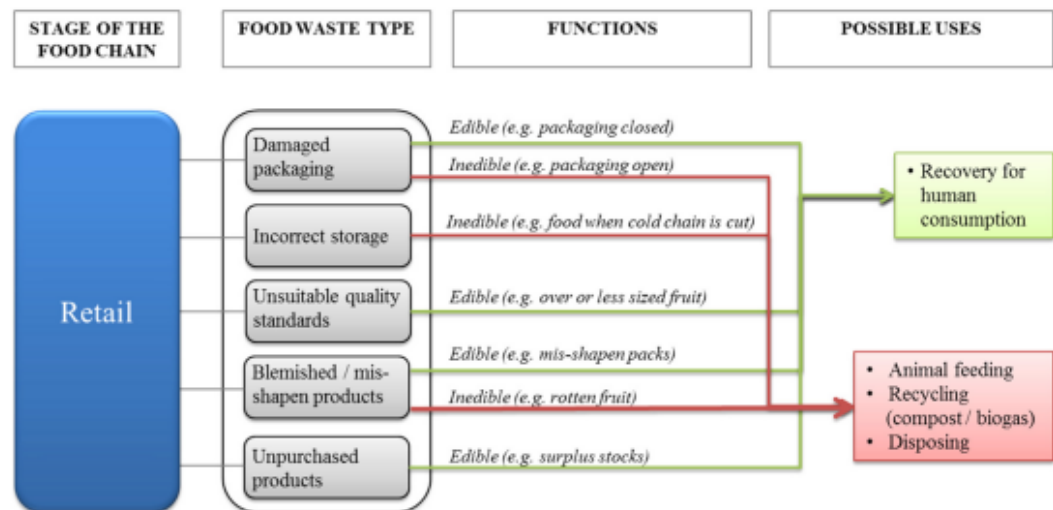
Figure 9: Possible uses for retail food waste (Cicatiello et al., 2016)

Given that food had already met the quality assurance guidelines required to reach the store shelves, there are few instances where food products would not be able to be recovered for human consumption. As shown in Figure 9, from the retail stage there are

27

only three instances where food would not be suitable for recovery for human consumption. Food would not be deemed inedible, according to Cicatiello et al, unless packaging had been opened, incorrectly stored, or rotten. Even if food were to be deemed inedible, there are still options available to retailers to avoid terminal waste, animal feed and recycling and noted in the figure above.

Product labelling is also stated to be responsible for food loss (Bilska et al., 2016; Buisman et al., 2017). Improved food labelling 'Best-before dates' were noted to be responsible for 78% of milk and dairy losses in Poland supermarkets, with the remaining loss a result of packaging damage (Bilska et al., 2016). There have been suggestions that by providing clear date labelling unified across all products, can help consumers use what they buy, with the example of adding 'freeze-buy dates' (Quested, Marsh, Stunell, & Parry, 2013). Improving food labelling can help to educate consumers, but the use of innovative packaging and dynamic shelf life are also noted as options available for the retailer to reduce their food waste amounts (Buisman et al., 2017; Parfitt et al., 2010). Dynamic shelf life is a method that Buisman et al. (2017) recommend, which would allow retailers to use an adjustable 'best-before' date to reduce unnecessary food waste within the supermarket.

Effective communication among consumers and retailers is essential to ensure that they are receiving the necessary information and are making informed decisions. Active engagement and support for the public in recommended to pressure for improved and uniform labelling protocols (Buisman et al., 2017).

Social Media Discourse

Social media initiatives are growing in importance in the public sector and are recognized as a useful platform to engage and interact with the public. Citizens have an increased expectation of the responsiveness and information delivery of both public and private agencies (Medaglia & Zheng, 2017). In 1972, the United Nation's stated a need for communication campaigns to disseminate information to protect and improve the environment. The question, however, remained how can such programs be developed and shared to maximize their impact (Maibach, 1993).

The use of information and communication technology has been explored as a means to handle the food waste phenomenon and food insecurity (Sharma, Shandilya, Sunday Tim, & Wong, 2018). The use of social media has been one of the most prominent means of advocating for change. Online user-generated media serves as an inclusive vehicle for public discourse (Moscato, 2016).

Effective consumer communication relies on several different factors. These communication styles must also extend when communicating with users online. More importantly, consumer-consumer communication has been seen to have a growing impact within online marketing communications (Mangold & Faulds, 2009). Social movements and communication initiatives involve both traditional offline as well as online communication (Moscato, 2016). Online marketers, including social awareness campaigns such as those seeking to reduce food waste, must be mindful not only of what they are saying but also what other users are saying to each other.

Twitter has been identified as a powerful tool for educational and social awareness campaigns. Twitter is a microblogging website that allows users from across the globe to share short 'tweets' of 280 characters with the ability to add a link, photo, or 'hashtag' (Moscato, 2016; Munro, Hartt, & Pohlkamp, 2015; Young, Russell, Robinson, & Barkemeyer, 2017). The use of the 'hashtag' began during the 'Web 2.0' user-generated tagging system following the dot.com crash (Bruns & Burgess, 2011; O'Reilly, 2009). It moved to the Twitter platform in 2007 and is credited to Chris Messina, as a means of having tag channels or groups for Twitter (Bruns & Burgess, 2011).

The use of these hashtags allows users to coordinate information and contribute to a conversation occurring on the platform (Bruns & Burgess, 2011). Through these coordinated conversations, a new form of activism has grown. The concept of 'hashtag activism' has been influential within higher educational settings and supports countercultural learning (Fang, 2015).

Hashtag activism can often be likened to 'armchair activism' or 'slacktivism' as it does not require the same sort of action activism has previously required from participants (Moscato, 2016). Critics also suggest that users are trading likes and retweets as a form of social currency and that their social persona is of more importance than the justice or change they are seeking (Fang, 2015).

In addition to the hashtag, Twitter users are also able to retweet or repost other users' tweets as a mean of sharing with their followers or showing support to whatever has been shared. Whether a retweet or a hashtag, the system allows for the diffusion of information extending past the originators own Twitter following, spreading their reach and continuing the conversation to new users (Moscato, 2016).

CHAPTER 3: METHODS

Jurusdictional review (Government)

| Social Media (Public) | Publications (Acadiema & Traditional Media) |

| Consumer Survey | Insiders' Perspectives (Industry) |

| Stakeholder Interviews | Employee Surveys |
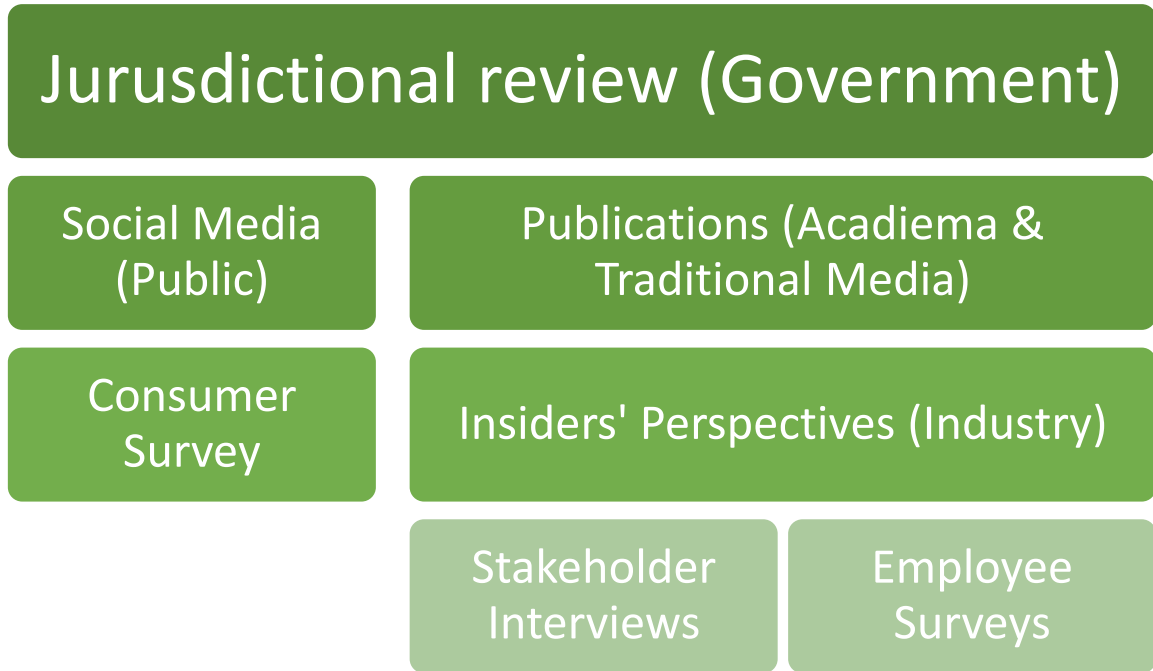
Figure 10: Process map of research method

To achieve the objectives and answer the research question set out in the previous section, multiple methods were required. An initial jurisdictional review was first conducted gather in-depth information on key regions that had been chosen by researchers based on the literature review and the initial scoping review that was conducted. Following the jurisdiction review, the methods were divided out to look at the informal public perspective, through social media analysis and consumer surveys, and the academic and industry stakeholders through thematic content analysis of food waste publications and industry interviews and employee surveys. This process is shown in Figure 10.

Through this process, the practices of stakeholders through the food supply chain are identified, along with what sort of legislation and policies are in place in regions that are actively combatting food waste. Additionally, the perceptions and behaviours of the

public are analyzed based on the results of the social media analysis and consumer surveys. The results from these answers the research question of how to best minimize the amount of terminal waste reaching landfills.

3.1 Jurisdictional Review

A review was conducted to identify initiatives and actions being taken throughout the world to understand and combat food waste. Key locations were identified from the literature review. The decision was made to focus on North American locations as there would be a more direct comparison with the results of the interviews and surveys being conducted.

This jurisdictional review followed a three-stage approach (Figure 11), starting with a scoping analysis to identify the locations to be profiled in the second stage. The second stage was an adapted case study methodology to conduct the jurisdictional review (Liu, J. et al., 2018). The focus of the case studies was to identify best practices within the selected jurisdictions (Rivard et al., 2014).

Figure 11: Jurisdictional Review process

The scoping phase was completed concurrently with the literature review. This method was used to identify knowledge gaps and summarize the current understanding of the broad research question (Armstrong, Hall, Doyle, & Waters, 2011; Levac, Colquhoun, & O'Brien, 2010). Scoping the discussion and initiatives surrounding food waste provides

a preliminary valuation of what different regions and locations are, as well as what different forms of documents and legislation are in place (Anderson, Allen, Peckham, & Goodwin, 2008; Grant & Booth, 2009). By first conducting the scoping review, researchers were able to identify what level of value there was in continuing with the jurisdictional review, as well as identifying the locations for profiling in the case analysis (Anderson et al., 2008).

From the scoping review, state and province-based initiatives and policies were reviewed for four states and three provinces. These locations were identified as the most active locations engaged with food waste reduction and waste diversion. By conducting a multiple case study analysis, the researcher was able to compare each of the regions based on the activities occurring and legislation in place (Bryman, Bell, Mills, & Yue, 2011). The cases provided a variety of data in the form of government and non-government reports, legislative articles and bills, and news media articles (Cooper, D. R., 2018). These sources were analyzed and interpreted based on common themes and activities in the different regions, allowing for an overall portrait of the issue in these exemplary regions to be formed (Cooper, D. R., 2018). From this portrait, best practices could be identified and evaluated.

"Best practices" refers to the processes adopted to yield a more desirable outcome than another process (Bergek & Norrman, 2008). As this is the third phase of the jurisdictional review, existing "benchmarks" have already been evaluated during the case study analysis (Kahn, Barczak, & Moss, 2006). From the case study analysis, the practices and initiatives occurring to combat food loss are equivalent to the "benchmarks" that are commonly used for best practices framework development.

3.2 Thematic Content Analysis of Food Waste Publications

An academic publication analysis was conducted using articles collected using google scholar and the Dalhousie library database. Additional news articles and government and non-government reports were also collected via online searches. Initial searches were conducted using the terms of 'food waste' and 'food loss'. Related articles were also selected using the recommendations of the journal as well as the resources cited in the articles themselves. For this portion of the research, 41 peer-reviewed articles, 22 government reports, 15 non-government reports, and 23 grey literature articles were selected for review (100 in total). Most common sources of academic articles discussing waste were the Journal of Resource, Conservation and Recycling (6 articles), Waste Management (7 articles) and The Journal of Cleaner Production (9 articles). The most common news source was the Canadian Broadcasting Corporation (4 stories); the others ranged from Scientific American to Forbes. The grey literature ranged widely from blogs to trade articles.

Content analyses vary in different fields. The method can be used with both qualitative and quantitative data, and the appropriate approach for the analysis is dependant on the purpose of the study itself (Elo & Kyngäs, 2008). The summative content analysis is seen as a nonreactive method to study the phenomenon and will provide information for how the terms are used in context (Hsieh & Shannon, 2005).

The first step of this study, following the collection of the academic articles, was to conduct a textual review. This was done to highlight the existing research with regards to food waste, and identify any gaps in knowledge, as well as determine if there are issues that are being considered within the non-academic discussion that may be important to

interrogate. The articles were selected using the search term "food waste". The resulting articles were then selected based on their relevance to the research objectives, with a particular focus on qualitative and mixed method research, and research looking at the consumer and retailer end of the food supply chain.

Open coding was done throughout the review with notes, and headings added as necessary using MaxQDA 18 (Elo & Kyngäs, 2008). This software allows for the organization and coding of the material.

Codes were developed following the review of the articles selected based on the overall themes present in the academic publications. The codes and themes developed throughout the review were then used in the content analysis. The coded segments were then extracted based on the theme of the segment and analyzed. The code table for the academic publication content analysis is shown in Table 2.

This thematic style of analysis was also used in the content analysis that followed the initial academic literature analysis (Fereday & Muir-Cochrane, 2006). The thematic analysis allows for the key ideas surrounding food waste research to be identified and facilitates the further coding and analysis of the publications used in the content analysis (Thomas & Harden, 2008).

Table 2: Food Waste Academic Publication Analysis Code Table

Colour	Parent code	Sub Code
●	Food Waste	
●	Food Waste	Environmental
●	Food Waste	Definition
●	Food Waste	Economic
●	Food Waste	Food Loss
●	Food Waste	Developed/ Under-Developed
●	Food Waste	Social
●	Food Waste	Food Security
●	Food Waste	Avoidable/ Unavoidable
●	Food Waste	Household
●	Waste Hierarchy	
●	Waste Hierarchy	Re-Use
●	Waste Hierarchy	Recovery
●	Waste Hierarchy	Prevention
●	Waste Hierarchy	Disposal
●	Retail Food Waste	
●	Global Initiatives	
●	Content Analysis	
●	Labelling	

A summative content analysis was conducted following the literature using the qualitative data analysis software, MaxQDA 18. Keywords were then determined for each code. A keyword word search was then conducted to identify the sentences where the terms appeared, and that section was then coded with the appropriate code. The code table and related keywords can be seen in Table 3.

Table 3: Content Analysis Code Table

Color	Code
●	Food Waste
●	Recovery
●	Disposal
●	Food Packaging
●	Policy
●	Europe
●	Commercial Food Waste
●	North America
●	Re-Use
●	Prevention
●	Developing World
●	Canada
●	Labelling
●	Nova Scotia
●	Waste Hierarchy
●	Circular Economy
●	Supply Chain

3.3 Social Media Discourse Analysis

The food waste phenomenon facing the globe is not only being discussed in academic research and traditional media. A significant portion of the discourse is occurring online via social media platforms and is an important tool to view the interactions among individuals on the platform (Munro et al., 2015). To examine this portion of the discussion, an analysis of the social discussion was done using data collected from Twitter over the month of November. Social media data is freely provided by the user and is readily accessible (Driscoll & Walker, 2014).

Launched in 2006, Twitter has become one of the leading social media applications. The application is both a social network and microblogging service that can be used by

individual users or by companies. There were 321 million active monthly users at the end of 2018 (Statista, 2019b). As of January 2019, Twitter is the twelfth most popular social network with 65.5% of users being male (Statista, 2019a). According to an article by Paige Cooper, people are 31% more likely to remember something if they have seen it on twitter with 71% of users using the site to consume news (Cooper, P., 2019). Twitter and other social media sites have allowed for the typical user to shift from merely being a content consumer to now also be a 'content creator' (Mitrou, Kandias, Stavrou, & Gritzalis, 2014).

An exploratory search was conducted to identify current food waste awareness and prevention campaigns currently being run on Twitter. Once the campaigns were identified additional hashtags related to the accounts and the campaign were added to the hashtag search along with the original campaign hashtag. In total, seven hashtags were selected as search terms; #foodwaste, #chillthefridgeout, #zerohunger, #futureoffood, #lovefoodhatewaste, #circulareconomy, and #zerowaste. The hashtags #circulareconomy and #zerowaste had an additional requirement of having the word 'food' somewhere in the tweet. This was done to limit the number of tweets that used the hashtag but were not relevant to food. Background information was also collected on each organization and the campaign itself. The two organizations with active campaigns during the search period were FAO and Love Food Hate Waste UK. These campaigns were using specific hashtags, which were followed throughout the month.

Data were collected from November 1, 2018, until November 30, 2018, using MaxQDA twitter data collection. A total of 47,853 tweets were collected using the seven hashtags. Following the collection and review of the collected data, a frequency analysis was conducted. Tweets were coded based on the initial search hashtag. A secondary coding

was completed using the themes established in the content analysis of the publications. The keyword search was conducted using the themes' respective terms to assign tweets to the appropriate theme code(s).

3.4 Interviews and Consumer and Grocery Employee Surveys

Initial interviews with expert stakeholders in the food supply system were conducted. This was completed using an informal, semi-structured interview style. The intent of these interviews was to inform all levels of the research, but mainly to help build the survey and identify key points to consider when forming the questions. Contact with the stakeholders was made via email using contact information provided by DivertNS, the provincial recycling board. A report on retail food waste and de-packaging was being conducted in sequence with this thesis work, and they aided in establishing initial contacts for interviews. The research coordinator and director were also a source of information.

A total of eight interviews were conducted with a representative from a food recovery volunteer program, a municipal waste representative, a private waste hauler, the manager of a composting facility, a representative from a recycling consultancy in the United States, an employee at a local waste sorting facility, and through meeting notes with Nova Scotia's provincial recycling agency. Due to a fire on campus, the original notes from the interviews were lost, although summary notes, follow up interviews, and some recordings were maintained.

Following the interviews, it was decided that a branch survey would be conducted that would funnel participants to different survey questions depending on whether they were a consumer, grocery store employee or store manager. This allowed for the

perspectives of all stakeholders at the food waste (consumer) end of the food supply chain to be collected. Survey questions were collected from various validated survey instruments with additional questions added as needed.   The full survey can be found in Appendix A, B, and C. The survey used a Likert scale, in combination with various short answer and multiple choice questions (Boone & Boone, 2012).

Surveys for both consumers and employees were developed using other validated research instruments. The benefits of using a validated research instrument were that the survey has already been used and results analyzed for reliability (Boynton & Greenhalgh, 2004; Dowrick, Wootten, Murphy, & Costello, 2015). Questions for the consumer survey were adapted from a food behaviour survey written on behalf of WRAP (Cox & Downing, 2007). The survey identified drivers for food waste, as well as potentials for change.

The employee section of the survey was adapted from five sources. The employee section included questions relating to the employee's job satisfaction, job characteristics, and food waste practices of the retail grocery store (Cook, 1981; Cox & Downing, 2007; Food Waste Reduction Alliance, 2016; Rizzo, House, & Lirtzman, 1970; Sims Jr, Szilagyi, & Keller, 1976).

The objective of these surveys was to identified consumers' and retail employees' perceptions and behaviours surrounding the issue of food waste. Four theoretical constructs were established based on the questions within the consumer survey. These constructs are consumer purchasing behaviour (questions 1- 11), waste separating behaviour (12-23), household waste beliefs (24-42), and environmental concern (43-51). The household waste behaviour questions and environmental concerns questions were also asked to survey

participants who identified themselves as grocery store employees. These four constructs are defined and explained below.

Purchasing Behaviour- These eleven questions ask how often the participant purchases different types of food in a variety of packaging. These questions allow for researchers to evaluate what type of food products consumers are purchasing and in what form.

Waste Separating Behaviour- The questions ask participants how often the participants separate their food waste from the assorted packaging and how they dispose of them. Statements, where the participant separates the packaging from the food waste, are considered to be a more favourable outcome, where statements, where the participants do not separate the food from the packaging, is an unfavourable outcome.

Household waste beliefs- Participants were asked how strongly they agreed or disagreed with statements regarding their beliefs about a variety of waste situations. These include how they feel about throwing away food and how they interact with their food at home.

Environmental Concerns- These questions ask participants to identify how strongly they agree and disagree to statements relating to climate change, greenhouse gas emissions and pollution sources. These allow researchers to evaluate the motivation and perceptions of the participants when it comes to climate issues and environmental concerns.

To test the validity of the constructs, the reliability of each construct will be testing using Cronbach's alpha. This value will determine if the questions 'hang together' (Malhotra & Grover, 1998). If constructs are proven to be reliable, average values are created for the four constructs as new variables, allowing for the Likert survey data to be used in a regression analysis as an aggregated mean (Ettlie & O'Keefe, 1982).

Mann-Whitney U test (also known as the Wilcoxon rank sum test) were conducted. This test allows for independent sample t-tests to be conducted between two groups (McKnight & Najab, 2010). This is similar to the t-test, except it does not assume a specific distribution. This allows for statistical tests to be conducted without accessing a large normally distributed sample (Nachar, 2008). A study conducted in 2010 determined that Mann-Whitney-Wilcoxon (MWW) and t-tests have a similar power (de Winter & Dodou, 2010).

A large portion of participants were from Nova Scotia. Given that Nova Scotia has a unique waste management system when compared to the rest of the country, it was determined that comparing Nova Scotian consumers to other Canadian consumers shows how the waste management system influences their behaviour. The education level of the survey participant was also selected as a factor for comparison.

Following the MWW but prior to the regression, the demographic questions were transformed into binomial (dummy) variables (Grotenhuis & Thijs, 2015). For example, the question asking survey participants gender two variables were created, *female* and *male.* If the participant responded as a 'female', it was coded a 1 in the *female* variable and a 0 in the *male* variable. This was done for education level, province of residence, gender, and type of community. A factor analysis was conducted to review the variable and

determine if any could be binned together depending on the correlation direction and if the variables are related (ex. geographical locations).

Participants were recruited via online sharing (Facebook, Twitter, and Reddit) with the survey link. Survey participants were also asked to forward the link, making use of a snowballing sampling method. The targeted population of the consumer survey was residents of Canada over the age of 18 years of age.

The survey used branching to direct participants to the appropriate set of questions. Consumers completed a survey that focused on four main topics of questions: 1 purchasing behaviour, 2 food separation, 3 household waste behaviour, 4 environmental concerns.

Surveys by employees had four sections: job characteristics, organizational reaction, job roles and training and waste reduction practices These sections help put the food waste question in the context of the employee's situation and assess any halo effect of employment satisfaction/dissatisfaction on the food waste responses. The halo effect is a cognitive bias the participant may form on one aspect of their job that will influence how they feel about another. Employees were also asked about their household waste behaviour and environmental concerns.

A total of 189 consumers surveys were completed, with 7 employee surveys, and one manager survey. Given that only one manager survey was completed, it was removed from the analysis. The employee surveys were reviewed but given the small number of responses the statistical analysis reported is not significant. Additionally, the low number of employee surveys prevented in-depth statistical analysis. Instead, a qualitative analysis

was conducted to determine overarching themes and attempted to determine the opinions held by employees with regards to the retail food industry and food waste.

Chapter Summary

To answer the research question, five methods of analysis were selected. Through these five methods, the research question is answered, and the four objectives are addressed. The five methods were chosen to view every aspect of the conversation surrounding the food waste phenomenon. The first step was conducting a jurisdictional review. This was followed by a thematic content analysis of publications on the topic of food waste within academic publications and grey literature. Following the content analysis of the published texts, a social media discourse analysis was conducted using tweets collected over the month of November. In addition to this, two social media awareness campaigns focusing on food waste were also profiled.

The final step was to conduct interviews and surveys to solicit responses directly from stakeholders within the food supply chain. Interviews with seven industry stakeholders were conducted and one retail store manager questionnaire was completed. Employee surveys were also distributed. Unfortunately, due to a lack of retail participation, only seven employee surveys were completed. There was also a consumer survey completed by 189 participants. The consumer survey was analyzed through statistical analysis while the interviews and employee survey was analyzed qualitatively.

CHAPTER 4: RESULTS

In the previous chapter, the methods of research and analysis were outlined. The first step in answering the research question and evaluating the current situation surrounding food waste was to conduct the jurisdiction review. This led to a case study being conducted for regions in Canada and the United States. Following this thematic content analyses were completed using the published academic and grey articles and the collected tweets. Semi-structured interviews with industry stakeholders were conducted following the thematic content analysis in addition to the employee surveys that were distributed online. Consumer surveys were also distributed online following the collection of the social media posts.

4.1 Jurisdictional review

4.1.1 Canada

In Canada, food waste costs are estimated at over 100 billion dollars per year in direct and indirect costs. In 2012, 6.7 million metric tonnes of organic waste was generated residentially, with food waste accounting for 28%. National households are by far the largest waste generator at 47% of food waste across the food supply chain (see Figure 12). Industrial, commercial, and institutional organizations (ICIs) generated an estimated 2.78 million metric tonnes of food waste nationally in 2012 (or 34% of ICI organic waste). These values were calculated by the Commission for Environmental Cooperation (CEC) in their report on the characterization of organic waste in North America. In it, they identified the ICI generated organic waste as the "largest potential target for diversion to industrial uses".

(Source: $27 billion revisited: The cost of Canada's annual food waste, VCM International, 2014)
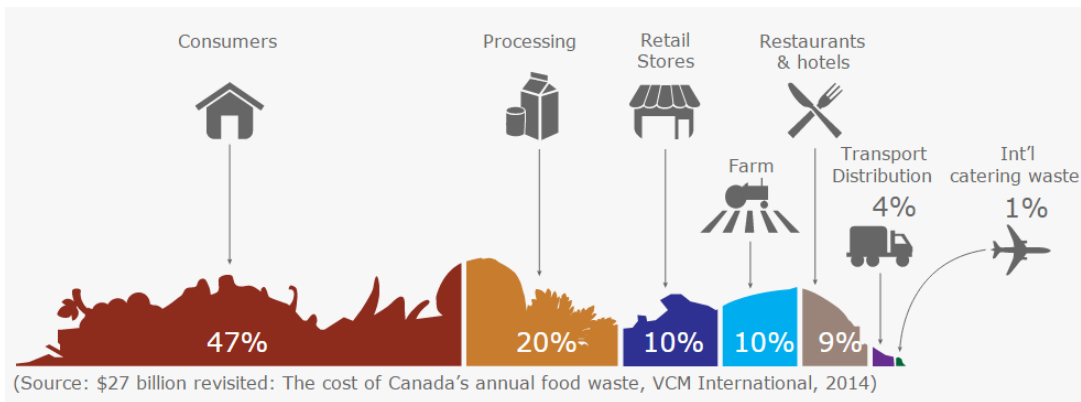
Figure 12: Canada's Food Waste Across the Supply Chain

No national policies are focusing on food waste within Canada. Provinces and territories are responsible for developing their own policies and guidelines. The federal government is in the works, however, to develop a proposed Food Policy for Canada, which will address food waste, along with other food-related issues. Presently, Nova Scotia and Prince Edward Island are the only provinces to implement an organic waste disposal ban, with Quebec and Ontario following suit by 2022.

Canada's National Zero Waste Council (NZWC) began in Vancouver, BC, in 2013, and works in collaboration with the Federation of Canadian Municipalities. The organization's mission is to "act collaboratively with business, government and the community, at the national and international level, as an agent of change for waste prevention and reduction in the design, production and use of goods."

NZWC has developed a Food Loss and Waste Strategy for Canada. It was developed through their stakeholder engagement program and outlines key findings and recommendations on how Canada can combat food waste nationally. The council has also called on the federal government to support a tax credit to encourage businesses to donate would be food waste to those who need it. Ontario, British Columbia, and Nova Scotia

have initiated a Farmers Tax Credit for food donations made, but there is presently no credit in place for retailers.

The Case of Nova Scotia

Nova Scotia has been a global leader in waste diversion for over 20 years, thanks to a stringent source separated waste management system. Waste produced per person in Nova Scotia has seen little reduction since 2004, although it is less than half the National average of 777 kg per person.

Wagner & Arnold conducted a review of the Nova Scotia waste management model in 2008. The paper was intended to determine if the Nova Scotia model is an approach that could be nationally adopted to reduce waste. One of the most notable successes is the public support of the strategy. Nova Scotia is the only province requiring the strict separation of materials and the difference is noticed when Nova Scotians travel. By placing more responsibility on the individuals in the waste management strategy, they have become accountable and show pride in what they, as a collective, have accomplished (Wagner & Arnold, 2008).

After the adoption of an organic waste ban, Nova Scotia saw a drop between 231,400 and 261,900 tonnes over a 12-year span in greenhouse gas CO_2-eq emissions (Wagner & Arnold, 2008). Nova Scotia has the lowest waste rate in Canada, and that is because of the early efforts made by the government to combat this growing issue (Wagner & Arnold, 2008).

A notable gap identified in Nova Scotia's regulation is the lack of a Food Donation Care Act. All provinces, except Nova Scotia and Quebec, have a Food Donation Care Act.

The act frees persons or corporations from any liability for the foods donated. Nova Scotia does have a Volunteer Service Act in place, in which it states:

"Food or sundries to person in need

4A A volunteer is not liable for damages incurred as a result of injury, illness, disease or death resulting from the consumption of food or the use of sundries by a person in need unless it is established that

(a) the injury, illness, disease or death was caused by the gross negligence or the wilful misconduct of the volunteer; or

(b) the volunteer knew that the food or sundries were contaminated or otherwise unfit for human consumption or use at the time of donation or distribution, respectively. 1992, c. 34, s. 2."

- Volunteer Services Act, Chapter 497, 1992

Given that the act refers to the provider of the donation as a volunteer, rather than a term such as persons, which could be interpreted to include businesses and corporations, the act may not extend to grocer donating foods to those in need. Some grocery chains have entered into contracts with the food banks to avoid any potential liability issues, but the addition of a Food Donation Care Act, similar to the other Atlantic provinces, could be an opportunity to remove a barrier for businesses in the province who wish to donate.

Nova Scotia currently has a Farmers Donation Tax Credit in place, where farmers can donate surplus or unsaleable crops to a registered food bank and received a tax credit

for 25% of the products market price. This incentivizes farmers to harvest the unsaleable crop, rather than leave it in the field. Extending this to include food retailers may be another potential opportunity to improve food donation.

Nova Scotia is faced with a problem that is echoed throughout the literature when discussing redistribution or donation of food. Food banks are limited on capacity, transportation, and storage space for perishable and fresh items. Additionally, the isolation of many communities adds another barrier not only for the collection of donated food but also distributing it to those in need.

The Case of Ontario

Ontario has recently announced that they will be shifting to a circular economy (Figure 13), by managing their resources more effectively to benefit the environment and the economy. To achieve this circular economy, the province plans to focus on reducing food waste, recovering resources, supporting resources recovery infrastructure and promoting beneficial uses of said recovered resources (Ontario Provincial Government, 2018). With over 2.2 million tonnes of terminal food waste occurring in the province, the province proposed a food and organic waste framework in November 2017. The document outlines an action plan, as well as a policy statement. Most notably, the document states that the province will develop and implement a food and organic waste disposal ban, which will be added to the Environmental Protection Act.
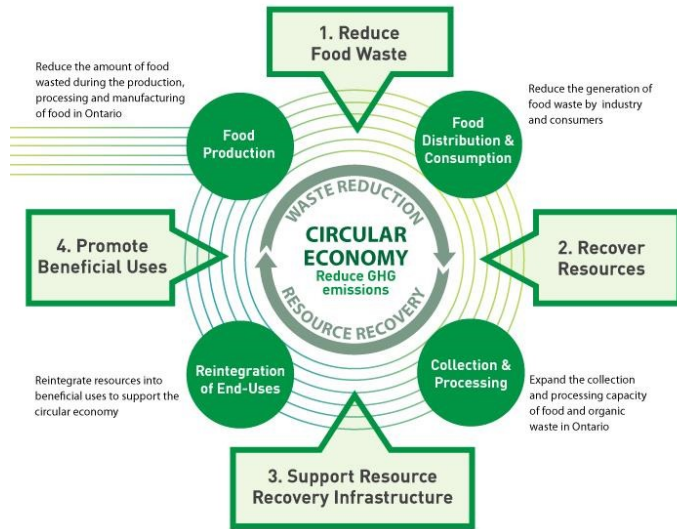
Figure 13: Food in a Circular Economy (Ontario Policy Framework, 2017)

Figure 13 shows that reducing food waste is the province's first step in achieving their circular economy. They identify the prevention of food waste to be a critical step, which will yield the largest positive impact (Ontario Provincial Government, 2018).

Ontario also has a feed-in-tariff (FIT) program, which was developed in 2009, that provided a preferential revenue stream to electricity generated from sources such as biogas from anaerobic digestion of organic waste. Provincial regulation 101/94 requires any municipality with a population of over 5,000 to provide home composters to residents, with green bin collection in municipalities with a population greater than 50,000.

The province has also recently begun a new initiative especially focused on improving food recovery in the commercial sector. The project, titled "Improving Food and Food Waste Recovery in the Non-Residential Sector Through Co-operative Collection", aims to aid in collaboration between the waste generators and waste services. The primary goal is to build a successful collection model that will not only be cost effective but also allow for maximum food recovery.

50

The proposed program, illustrated in Figure 14, would have one centrally located site that would collect all the waste and distribute it to the appropriate processing locations. Products that are still edible would be stored and then transported to a food recovery partner and products requiring depackaging would be processed and sent along to the appropriate location. It is the goal that this system would be both efficient and convenient for service providers and waste generators.
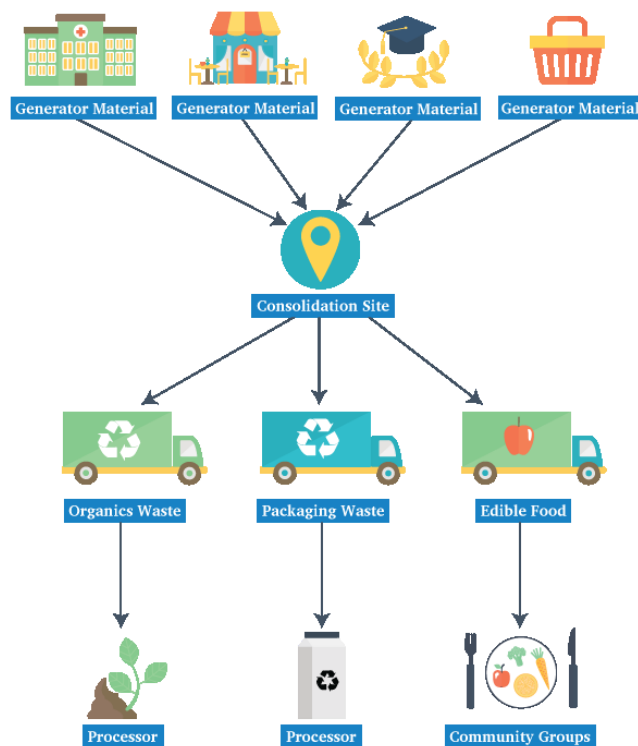
Figure 14: Proposed Commercial Food Waste Collection Co-Operative (Ontario Policy Framework, 2017)

The Case of British Columbia

British Columbia does not have a provincial organic waste ban in place, yet they do have organic waste diversion initiatives published on its provincial website (BC Ministry of Environment, 2019). The site included information on the provincial Organics Infrastructure Program, whose goal is to build the processing capabilities of the province, Residential and Business Organic Waste Diversion for the different regions. In total three

regions in the province have organics bans in place, serving 64.3% of the BC population (BC Ministry of Environment, 2019).

Vancouver's organic waste ban was enacted in 2015 and serves nearly 2.5 million residents. Metro Vancouver offered resources to household waste generators (consumers) as well as industrials, commercial, and institutional organizations (ICIs). Among these resources, de-packaging services were offered to help retailers properly handle their organic waste to meet the requirements of the new ban (Metro Vancouver, 2015).

Upon passing the organics ban, Metro Vancouver provided a review of on-site options available to waste generators impacted and motivated for effective management of the waste. Figure 15 shows the four options that the organization reviewed and considered to be capable of processing the organic waste on site. Storage is temporary storage of the waste prior to pick up, pre-treatment is the thermal or mechanical treatment of the waste to reduce volume, aerobic digestion is the microbial breakdown of the waste within oxygen, and anaerobic digestion is the breakdown in the absence of oxygen (Metro Vancouver, 2014).

#	Option	Sub-Option
1	Storage	Conventional
		Specialized
2	Pre-Treatment	Dewatering
		Dehydration
3	Aerobic In-Vessel	Small (approximately 10 tonnes per year)
		Medium (approximately 100 tonnes per year)
		Large (approximately 1,000 tonnes per year)
4	Anaerobic In-Vessel	Medium (approximately 500 tonnes per year)
		Large (approximately 1,000 tonnes per year)

Figure 15: Metro Vancouver's On-Site Waste Management Options (Metro Vancouver, 2014)

Further analysis of each of the options was also provided by the city. Figure 16 shows the summarized comparative analysis of each of the systems, ranking them from mediocre to best across 12 variables (Metro Vancouver, 2014). The optimal system would

be heavily dependent on the operation itself and what objectives of the organization are with regards to their waste diversion and management.

Option	Weekly Capacity	Capital Cost	Annual Maintenance Cost	Footprint	Materials Accepted	Time commitment	Corporate Sustainability Benefit	Odour control	Output Material	Maintenance	Capital	Process Time	Installation Requirements	Capacity	Electricity Requirements
Conventional Storage	Depends on hauling	Up to $1,000	Minimal	◕	●	●	○	○	○	●	●	●	●	◑	●
Specialized Storage	Depends on hauling	$4,000-6,000	Minimal	◕	●	●	○	◔	○	●	●	●	●	◑	●
Dewatering	Up to 400,000 kg/week	$25,000	$250	●	◑	◕	◔	◔	◔	◕	◑	●	◑	●	◔
Dehydration	Up to 14,000 kg/week	$27,000-50,000	$200	●	◕	◕	◑	◑	◑	◕	◑	◕	◑	◕	○
Small Aerobic In-Vessel	150-3,500 kg/week	$18,000	$400	◕	◑	◑	◕	◑	◕	◑	◕	◑	◕	◔	◑
Medium Aerobic In-Vessel	700-8,000 kg/week	$30,000+	$600	◑	◑	◑	◕	●	●	◑	◑	◔	◑	◑	◑
Large Aerobic In-Vessel	2,000-18,000 kg/week	$450,000	$500	◔	◕	○	◕	◕	◕	◑	◔	○	◔	●	◑
Medium Anaerobic In-Vessel	5000-20,000 kg/week	$240,000+	$14,000	◑	○	◔	●	◑	◕	○	◔	○	◔	◑	●
Large Anaerobic In-Vessel	20,000 kg/week	$825,000+	$10,000	○	◔	○	●	◑	◕	○	○	○	○	●	●

Icon	○	◔	◑	◕	●
Score	Mediocre	Fair	Good	Better	Best

Figure 16: Metro Vancouver's Comparative Analysis of On-Site Management (Metro Vancouver, 2014)

In 2017, two years since the implementation of the organic ban in Vancouver, compost from organic waste increased by 30%, yet diversion rates are still a ways away from the goal set by Metro Vancouver. The objective for 2020 was for the city to have an organics diversion rate of 80%, yet the 2017 reports showed they had only reached 63% (Pawson, 2017). The city is committed to reaching the 80% diversion rate for 2020 and setting new goals for 2040.

4.1.2 The United States of America

Within the United States, the food supply is the largest in the world, while the country itself is the third most populated (Dou et al., 2016). A reduction in food wastage within the United States could potentially improve food security across the globe. Mourad (2016) suggests that the United States is lagging behind in incentives for food waste reduction, with notions of a 'circular economy' as being seen as taboo. Although, a federal

'Good Samaritan' clause has been implemented to encourage the donation of food for redistribution while freeing the donors of any legal liability should the donation cause illness or injury (Bilska et al., 2016).

In 2015, the Environmental Protection Agency (EPA) and the Department of Agriculture set the country's first food waste reduction goal for a 50% reduction by 2030. While no federal policies are accompanying this goal, states and local municipalities have been making strides in organic waste diversion.

Residential programs can be found in 19 states and are typically curbside organics pickup. These programs are estimated to serve 2.7 million households in approximately 200 communities. As is the case in Canada, the municipal solid waste system is developed by the municipalities and counties and not at a state or federal level. Although some states have imposed organics bans, including commercial organics bans in California and Massachusetts.

ReFED is a data-driven US non-profit that has committed itself to reduce food waste (ReFED, 2019). Along with developing a comprehensive action plan to reduce food waste by 2020 called The Roadmap, their site also has a variety of interactive infographics and data reports. They aim to engage stakeholders at all levels of the food supply chain and provide action guides for food retailers, food services, and philanthropic support.

ReFED also partnered with Harvard Food Law and Policy Clinic June 2018, to host the US Food Waste Summit. They focused on six topics over the duration of the summit.

- Accelerating Date Label Standardization
- Bridging the Food Waste Research Funding Gap

- Building Infrastructure for Farm Level Surplus

- Exploring Food Waste Reduction Packaging

- Incentivizing & Supporting Healthy Food Donation

- Organic Waste management & Policy

ReFED reports that forty-one states and the District of Columbia require some form of date labelling, but specific restriction varies among the states (ReFED, 2019). Further restrictions exist prohibiting the donation or sale of food products past the date label.

There is a federal policy in place to incentivize the donation of food. Businesses are able to claim a deduction based on the fair market price of the goods donated, regardless of whether the donated food meets the eligibility criteria. However, if the food does meet the criteria, the business can claim the enhanced tax deduction, rather than the general deduction.

Independent retailers have also taken steps to combat food waste and adopt a circular economy within their own organization. The grocery chain, Kroger backhauls unsalable food from retail stores to their distribution centre. The company now has two distribution centres, one in California and another in Indiana, that have anaerobic digestors capturing biogas from decomposing food waste. This biogas is then converted into energy.

The Case of Massachusetts

Massachusetts chose to implement a commercial organic ban in 2014, requiring all commercial businesses producing more than one ton of organic waste per week to re-use or recover the material, thus avoiding terminal waste. When speaking with a representative from the Centre of EcoTechnology in Massachusetts, he stated that they choose to begin

with the commercial waste recovery to help build the infrastructure and resources before enacting a residential organic ban.

The Centre of EcoTechnology (CET) developed the RecycleWork Massachusetts program with the state government to serve as a resource for industry to become environmentally sustainable. The non-profit serves as a facilitator for government and industry to work together to identify gaps and opportunities to build engagement and networking throughout all stakeholders.

They offer a variety of services and resources to the business community, and while they do work with food recovery and re-use, they also have a keen interest in prevention. They have found that focusing on multiple levels of the hierarchy yields the best results.

The Case of Maine

Organic waste accounts for 43% of residential waste in the state, yet only 5% of this is composted. The availability of composting facilities is a barrier for the state, yet all other states in New England have some form of an organics ban in place (Burns, 2016). Maine does allow for food scraps to be re-used as feed for swine, although the organic matter must be heated thoroughly prior to being fed to the animals (ReFED, 2019).

Two communities in Maine have recently begun food waste collection for use in anaerobic digestion. The program has community residents place food waste in plastic bags, which are then sent to a company that uses its de-packaging machine to separate the food from the plastic bag and any other packaging that may be present (Karidis, 2017). After the organic material has been, separated out the organic matter moves to the

anaerobic digester at a separate facility. The pilot program is being run in the hopes of reaching the state's goal of 50% waste diversion by 2021 (Karidis, 2017).

The Case of Colorado

Heartland Biogas in Colorado has advanced de-packaging equipment and the total facility is valued at $115 million dollars, with estimated profits at $3.2 million per month (Rosengren, 2017). Unfortunately, public complaints regarding the smell of the facility have resulted in the county repealing its permits. Heartland responded by suing the county for pulling its contract (Silvy, 2017).

The Case of California

California's battle against food waste is largely championed by CalRecycle, the state government's Department of Resource Recycling and Recovery. With 6 million tonnes of food waste per year, California has set an ambitious goal of 75% diversion by 2020.

It was noted in the literature, that California might stand out when comparing to many of the other states because the cost of landfilling is higher there than in many other locations, due to a large amount of agricultural land and heavily populated city centres. This provides the state with an increased incentive to divert from landfill, particularly when the organic matter can be better used as green energy or fertilizer/compost for agriculture.

As mentioned previously, California is one of the states that has placed an organic material ban on non-residential waste generators. Some regions within the state have enacted a full organic ban for both residential and non-residential. San Francisco has had its mandatory recyclables and compostable collection in place since 2009. Along with the

separate bin collection, they rolled out an intensive outreach program, which allowed the city to achieve the highest diversion rate in North America at 80%.

Following this review of the policies and actions being made in North America, a thematic content analysis was conducted on publications and articles relating to food waste. This was done to review the published discussion occurring in academia and traditional and online publications and identify key themes and points within the discourse.

4.2 Thematic Content Analysis of the Food Waste Phenomenon

Following the academic publication analysis, keywords for each of the codes were determined and searched and coded using the 'keyword-in-context' function within MaxQDA 18. A total of 26,909 segments were coded, across 17 codes (Table 3 p. 37). A total of 103 keywords were selected for their corresponding codes, as shown in Table 4. Of these keywords, the frequency of each was also calculated. The top 20 keywords are shown in Table 5. Unsurprisingly, food waste was the most common term, appearing in 90% of the documents. The food waste code (including all related terms) was also the most frequent, appearing in 97 of the 100 texts collected for this study (Table 6).

Table 4: Content Analysis Codes and Related Keywords

Code	Keywords
Food Waste	Economic, environment, environmental, food loss, food security, Food Waste, Organic Waste, sustainability, avoidable, unavoidable
Supply Chain	supply chain, consumer, consumption, farm, farmer, farmers, farms, household, Producer, production
Recovery	anaerobic digestion, biogas, compost, recovery, recycling
Disposal	Landfill, disposal
Food Packaging	Cardboard, Decondition, Deconditioning, Depackage, depackaging, glass, Package, Packaging, Plastic
Policy	Act, bill, law, Legislation, Policy, regulation
Europe	Britain, EU, Europe, European, France, Netherlands, Sweden, Switzerland, UK, United Kingdom
Commercial Food Waste	Commercial food waste, grocery chain, grocery store, retail, retailer, supermarket
North America	America, Louisiana, Maine, Connecticut, Hawaii, New England, New Hampshire, New Jersey, Massachusetts, Mexico, Vermont
Re-Use	animal feed, donate, donation, food bank, re-use
Prevention	behavior change, behaviour change, behavioural, prevention
Developing World	Africa, Asia, developed countries, developing countries, developing country, poor countries, third world
Canada	Alberta, British Columbia, Canada, Manitoba, New Brunswick, Newfoundland, Ontario, Prince Edward Island, Quebec, Saskatchewan
Labelling	best-before, expiration, label, labelling, sell-by
Nova Scotia	Nova Scotia
Waste Hierarchy	Waste hierarchy
Circular Economy	Circular economy

There was a 32% difference in the most frequent term, food waste, and the next frequent term, production (Figure 5). Production was considered a keyword within the supply chain code, although it may have been used within a different context. In some instances, production would have been used in reference to energy production, which would relate to the recovery code. Packaging was the third most frequent term found in the text. This term was used both positively and negatively throughout the discussions. Packaging was said to extend the life of products and protect them during transport, but packaging can cause issues during the recovery stage of the food waste hierarchy, as it must be correctly separated from the organic matter.

Table 5: Content Analysis 20 most frequent keyword

Word	Frequency	Rank	Documents	Documents %
food waste	4940	1	90	90.00
production	1558	2	74	74.00
packaging	1285	3	61	61.00
disposal	1066	4	62	62.00
economic	827	5	66	66.00
consumption	804	6	65	65.00
food loss	775	7	37	37.00
landfill	764	8	62	62.00
household	678	9	45	45.00
policy	602	10	64	64.00
environment	581	11	73	73.00
recovery	553	12	53	53.00
prevention	538	13	45	45.00
social	510	14	53	53.00
UK	507	15	46	46.00
biogas	446	16	25	25.00
law	429	17	35	35.00
donation	425	18	37	37.00
compost	423	19	43	43.00
farm	376	20	49	49.00

The food waste code (including all terms) accounted for 29% of the segments coded (Table 6). Given that 'food waste' was the initial term for collecting the texts, this is unsurprising. 'Supply chain' and 'recovery' each accounted for approximately 13% of the coded segments, although 'supply chain' was present in five more documents. It should be noted as mentioned previously, 'supply chain' and 'recovery' could share the 'production' segment, depending on the context of the sentence. (ex. production of apples compared to the production of compost)

As previously mentioned, the definition of food waste is not universal among the sources. Where the academic articles would make it clear the context or definition they

were using for their analysis, the same was not the case for the other sources. During this analysis, the food waste code included food loss, which is, depending on the author, an alternative term or the precursor to food waste. The news articles reviewed used 'food waste' to describe food reaching landfill disposal, with only one article using the term "food loss" about the U.S. Department of Agriculture's Food Loss Project. In comparison, 'food waste' was used 195 times in 20 news articles. Of these 20 articles, seven focused on food waste disposal bans, requiring organic green bin disposal, and 4 included discussion around food lost during production as well as food wasted at later points of the supply chain. The decision to use 'food waste' throughout may have been done to prevent confusion among readers.

Table 6: Content Analysis code results and frequency

Colour	Code	Coded segments of all documents	% Coded segments of all documents	Documents
●	Food Waste	7687	28.67	97
●	Supply Chain	3457	12.89	84
●	Recovery	3414	12.73	79
●	Disposal	1841	6.87	67
●	Food Packaging	1791	6.68	75
●	Policy	1713	6.39	86
●	Europe	1527	5.70	67
●	Commercial Food Waste	1322	4.93	72
●	North America	1056	3.94	74
●	Re-Use	1020	3.80	70
●	Prevention	571	2.13	50
●	Developing World	470	1.75	35
●	Canada	416	1.55	32
●	Labelling	211	0.79	44
●	Nova Scotia	178	0.66	4
●	Waste Hierarchy	97	0.36	19
●	Circular Economy	38	0.14	12

Nova Scotia, Waste Hierarchy, and Circular Economy are the three least frequent codes, collectively accounting for 1.16% of the coded segments (Table 6). Each of these codes has only one term. Prevention, re-use, recovery, and disposal are all aspects of the waste hierarchy; these codes together account for 25.9% of the coded segments, nearly as frequent as the term food waste. Regional codes, Europe, North America, Canada, developing world and Nova Scotia, had a total of 3,647 coded segments (13.6%). The data suggested that food waste issues are specific to location, which is why reports would indicate location as results and recommendations may not be adaptable outside of the original location (Bilska et al., 2016; Cicatiello et al., 2016).

Additionally, commercial/retail food waste is not one of the more frequent codes, with 4.9% of the coded segments attributed to this code. This is in line with what some of the existing literature suggested. Retail food waste is not heavily featured as commercial food waste is occurring on a much smaller scale when compared to the consumer or household food waste.

4.3 Social Media Discourse Analysis

The seven selected hashtags produced 47,853 tweets over the month of November 2018. Of these tweets, 9,965 were original tweets, 37,226 were retweets, and 662 were replies (Figure 17).

Type

77.8%

1.4%

20.8%

Food Waste Tweets

Legend:
- Retweet
- Tweet
- Reply
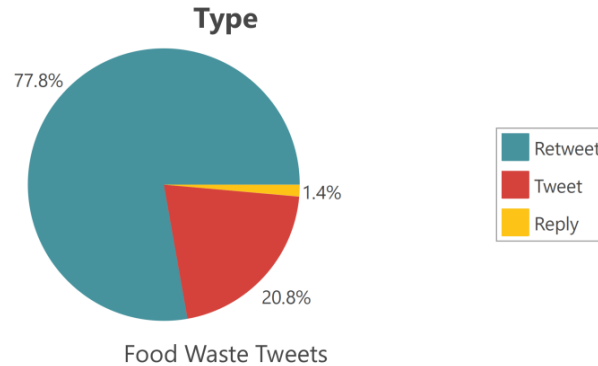
Figure 17: Type of Tweet collect in November 2018

Of the collected tweets over 27,000 hashtags were used. Listed in Table 7, we show the top 15 of these hashtags, which accounted for over 41% of tweets collected. Food waste, zero hunger, and future of food were the most frequent. While food waste is a more general hashtag, zero hunger and future of food are both associated with the FAO and their social media presence. The FAO's twitter campaign with relation to zero hunger and food waste will be discussed further as it is one of the selected campaigns for profiling.

Table 7: Most frequently used hashtags in Food Waste Search

	Frequency	Percent	Percent (without other)
#foodwaste	10343	11.44	27.73
#zerohunger	9817	10.86	26.32
#futureoffood	5246	5.80	14.07
#biodiversity	1791	1.98	4.80
#dyk	1405	1.55	3.77
#food	1384	1.53	3.71
#worldchildrensday	1054	1.17	2.83
#zerowaste	984	1.09	2.64
#water	973	1.08	2.61
#agriculture	852	0.94	2.28
#sustainability	799	0.88	2.14
#sdgs	761	0.84	2.04
#nutrition	651	0.72	1.75
#zer	628	0.69	1.68
#endhunger	608	0.67	1.63
TOTAL (without other)	37296	41.26	100.00
OTHER	53088	58.74	-
TOTAL	90384	100.00	-

Using the same codes and keywords that were developed during the thematic content analysis of the published literature, the collected tweets were coded based on the keywords present in the text. This will allow for fair comparisons to be drawn between the two sources. Results of this coding are shown in Table 8.

Table 8: Food Waste segments with content analysis codes

Code	Frequency	Percentage
Food Waste	8612	24.88
Food Supply Chain	7513	21.71
Europe	5875	16.98
Developing World	2848	8.23
Packaging	2354	6.80
Recovery	1615	4.67
Canada	1493	4.31
Policy	1340	3.87
Commercial Food Waste	1210	3.50
North America	560	1.62
Re-Use	452	1.31
Disposal	285	0.82
Prevention	209	0.60
Circular Economy & Waste Hierarchy	152	0.44
Labelling	91	0.26
TOTAL	34609	100.00

The most frequent theme code was 'Food Waste' accounting for 24.88% of all coded segments, followed by 'Food Supply Chain' and 'Europe'. The theme of labelling was the least frequent of the codes, accounting for 0.26% of coded segments with only 91 instances of related terms being found within the collection of tweets. As the table shows, a total of 34,609 segments were coded to the 15 themes.

The code configurations for the tweets were also collected using the keyword themes. Code configurations show the frequency that code appeared in the same segment together. This can show if certain themes were often used in tandem or if the conversations tended to be a focus on one aspect at a time.

The terms relating to the food supply chain and food waste were most commonly used together, although they accounted for only 0.81% of the coded segments. The singular codes accounted for 90.6%. The top five code combinations are shown below in Table 9.

Given the small frequency of overlapping or combined codes, it can be determined that the conversations twitter users are having are focused on a single theme over 90% of the time. Given twitter limits characters to 240, authors may feel the need to focus on one topic rather than multiple.

Table 9: Code Configurations for Food Waste Content Analysis

	Frequency	Percentage	Percentage (valid)
Food Supply Chain + Food Waste	257	0.81	0.81
Recovery + Food Waste	218	0.69	0.69
Food Waste + Europe	203	0.64	0.64
Policy + Food Waste	200	0.63	0.63
Food Waste + Packaging	132	0.42	0.42

A code map (Figure 18) using the seven hashtags was developed. The hashtags were clustered into 6 'clusters' and the width of the lines are indicative of the frequency of the intersections of codes in a segment. The clusters are formed by a hierarchical cluster analysis within the MaxQDA18 software.
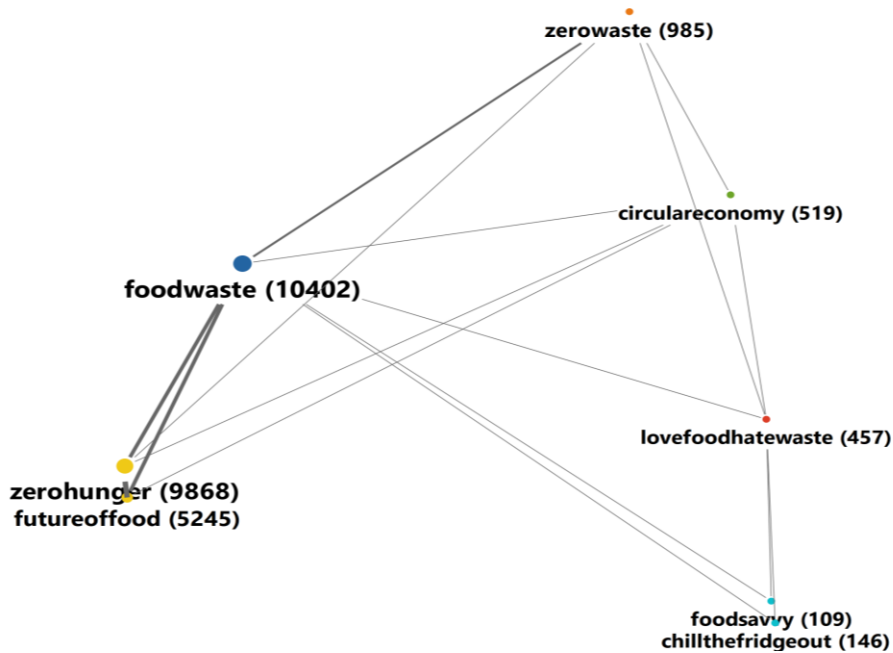
Figure 18: Food Waste Hashtags Code Map

As Figure 18 shows #zerohunger and #futureoffood were clustered together and also have a wide frequency line between them. These two hashtags were often used by FAO in their social media campaigns together. All the hashtags did link backed to food waste. The table below (Table 10) shows the number of linkages each of the hashtags had with the others.

Table 10: Hashtag linkages of Search Hashtags

Hashtags	Linkages
foodwaste	7
zerohunger	4
futureoffood	3
zerowaste	4
circulareconomy	5
lovefoodhatewaste	4
chillthefridgeout	2
foodsavvy	2

When the themed codes are combined with the hashtag search codes, the combination of the codes looks slightly different. Table 11 shows this second configuration table. Code combinations with less than 1% frequency were not included. These small frequency combinations accounted for 20.5% in total. Singular codes still accounted for a larger percentage of segment coverage, although two of the themes overlapped with hashtag codes with a substantial frequency. It is not surprising that the theme of food waste overlapped with #foodwaste, but the food supply chain theme also overlapped with #zerohunger. The zero-hunger hashtag is a part of the FAO's zero hunger campaign. This will be discussed and further analysed in the next section.

Table 11: Code Configurations with related Hashtags

	Frequency	Percentage	Percentage (valid)
zerohunger	6339	12.81	12.81
Food Supply Chain	5055	10.22	10.22
foodwaste	4996	10.10	10.10
Food Waste	4889	9.88	9.88
Europe	4806	9.71	9.71
futureoffood	3300	6.67	6.67
Developing World	2283	4.61	4.61
Packaging	1764	3.57	3.57
Canada	1301	2.63	2.63
Food Waste + foodwaste	1231	2.49	2.49
Food Supply Chain + zerohunger	1141	2.31	2.31
Recovery	772	1.56	1.56
Policy	755	1.53	1.53
zerohunger + futureoffood	682	1.38	1.38

Most frequently used hashtags

Hashtag	Tweets
#foodwaste	10,343
#zerohunger	9,817
#futureoffood	5,246
#biodiversity	1,791
#dyk	1,405
#food	1,384
#worldchildrensday	1,054
#zerowaste	984
#water	973
#agriculture	852
#sustainability	799
#sdgs	761
#nutrition	651
#zer	628
#endhunger	608

Tweets
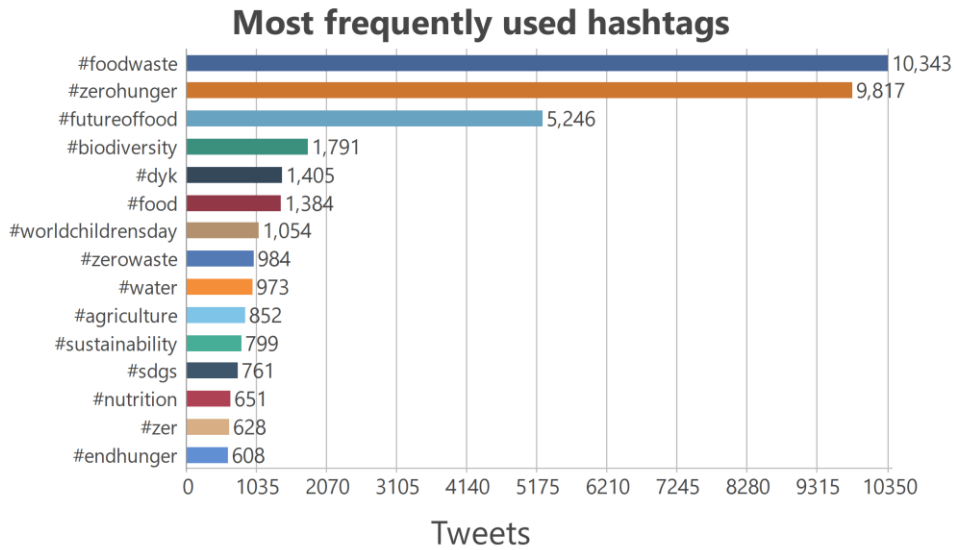
Figure 19: Most Frequently Used Food Waste Hashtags

Figure 19 shows the most frequent hashtags that were presented in the collected data set. It is unsurprising that food waste, zero hunger, and future of food were the top three most frequent hashtags as they were also search terms. Biodiversity was the fourth most frequent, with 'dyk' (which is short for did you know), food and world children's day all having more that one thousand instances during the month of November 2018.

4.4 Overview of Social Media campaigns

Two social media campaigns were profiled throughout the Twitter analysis. These were selected as they both had ongoing campaigns that were related to food waste during the month of November 2018.

4.4.1 FAO Zero Hunger

Figure 20: Word Cloud for FAO #ZeroHunger Campaign

The FAO's Zero Hunger campaign is focused on achieving three of the UN Sustainability goals; zero poverty, zero hunger and sustainable consumption and production. The zero-hunger campaign began in 2003.

> "There is more than enough food produced today to feed everyone, yet about 821 million people are chronically undernourished, and malnutrition affects around one in three people on the planet." FAO

The word cloud shown in Figure 20 was created using MaxQDA. The most frequently used words and emojis used in association with the hashtag zero hunger are shown, size is an

indication of frequency. Food was the most frequent and is therefore in the centre and is the largest.

The FAO's twitter account had a total of 264,914 followers as of November 30, 2018. The account averaged 79.4 retweets and 130.74 likes per tweets across 195 tweets in the month of November. Combining retweets and likes into overall engagement, the account had a total of 40,977 engagements over the month, averaging 210.14 per tweet. When this engagement is considered across the account following, there is a 15.58% engagement with followers.

Type

	Frequency	Percent
Retweet	5791	58.99
Tweet	3639	37.07
Reply	387	3.94
TOTAL	9817	100.00

Figure 21: Type of #ZeroWaste Tweets

When looking at the numbers in the campaign, we can see that during the month of November 2018, the #zerohunger was used 9,817 times. 59% of this number were retweets, where a user decides to share another's post with their own followers.
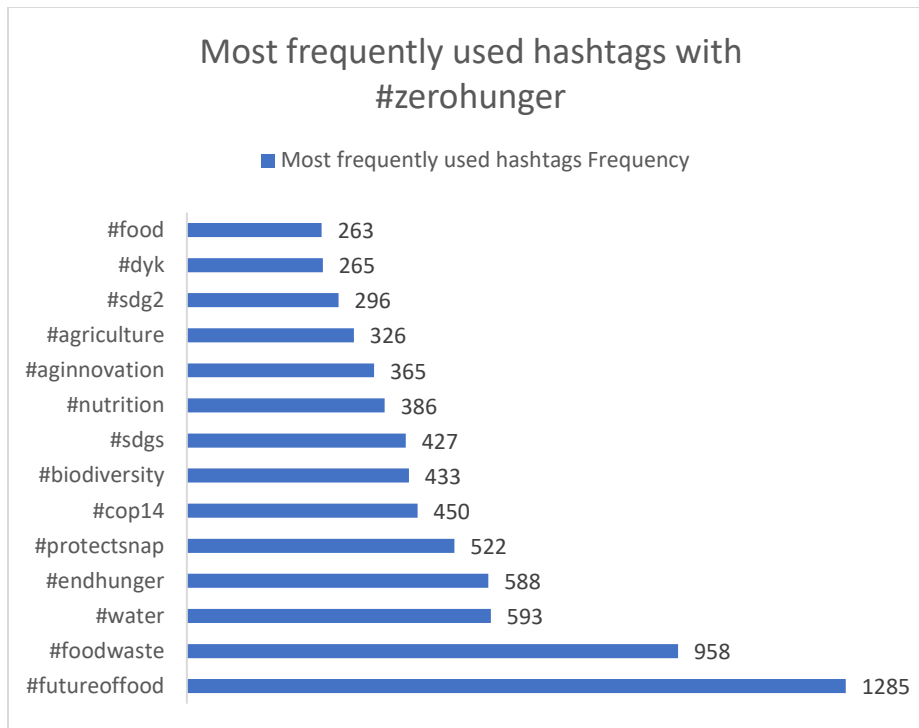
Figure 22: Bar Graph of Hashtags used with # ZeroHunger

In Figure 22, you can see the hashtags that were most often used with #zerohunger. Once again 'future of food' and 'food waste' are among the top hashtags used. There are, however, several hashtags that had not appeared among the top most frequent hashtags when reviewing the data set as a whole.

'COP14' is the hashtag associated with the conference of parties which occurred in November. The Convention on Biological Diversity provides a global legal framework for action on biodiversity. The biodiversity hashtag was used seventeen fewer times than the 'COP14' hashtag within the zero waste tweet set.

The hashtags #sdgs and #sdg2 are related to the UN's Sustainable Development Goals, zero hunger is the second goal and is therefore referred to as sdg2. The FAO is a department of the United Nations and is heavily associated with the sustainable development goals as a result of this.

The 'protectSNAP' hashtag relates to a program in the US, the supplemental nutrition assistance program. It is described as a domestic hunger safety net and was formerly known as the food stamps program. During November, the US Farm bill was being passed and this program was a point of contention for many involved. This issue was largely focused on food insecurity and is understandably paired with the zero hunger tag.

FAO itself often parred similar hashtags with #zerohunger as well. The organization tweeted 195 times throughout the month of November. 182 of these tweets used #zerohunger, the second and third most frequent hashtags were #futureoffood and #foodwaste. These are also search terms used in the data collection. Tweets included several additional issues related to agriculture and food production, including environmental issues related to biodiversity, water, soils, bees and climate change, and social issues with the addition of indigenous, women, and ag-innovation. The hashtag #dyk stands for did you know. These hashtags are shown in Figure 23.
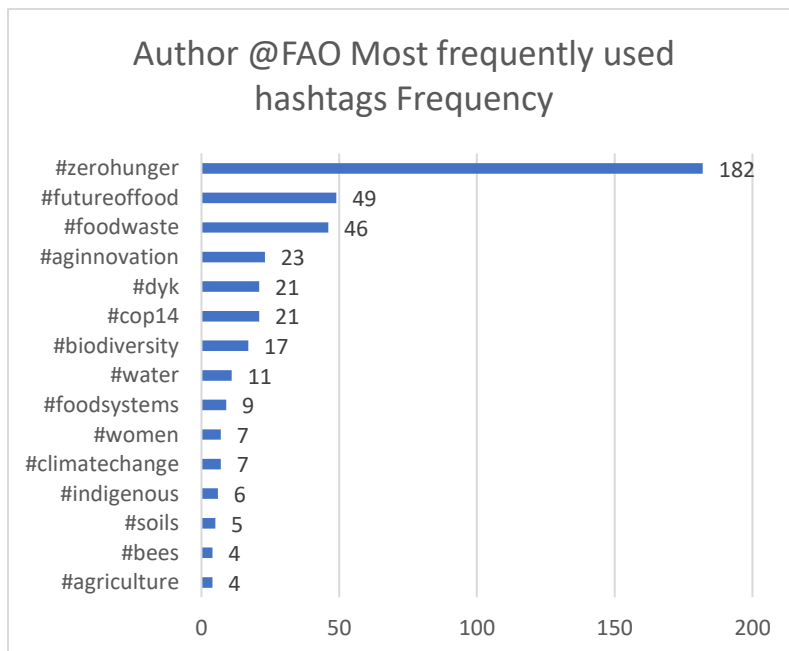
Figure 23: Most Frequently used Hashtags authored by @FAO

Once again, the top three hashtags used by the FAO twitter account are all search terms used for data collection. They did however also mention new hashtags (or causes) that have yet to be discussed. This includes aginnovation as the fourth most common hashtag the account used.

The FAO account was mentioned 16,726 times within the collected tweets. Over 96% of these were retweets, with the most common hashtag being zero hunger (27%), future of food (20%), and food waste (11.4%).

The FAO account had an average of 263,033 followers for the month of November, with an average of 130.74 likes and 79.4 retweets. Figure 24 shows the growth in the number of followers it experienced over the month. The account's follower count increased by 4,253 followers, this was a 1.6% increase for the account.
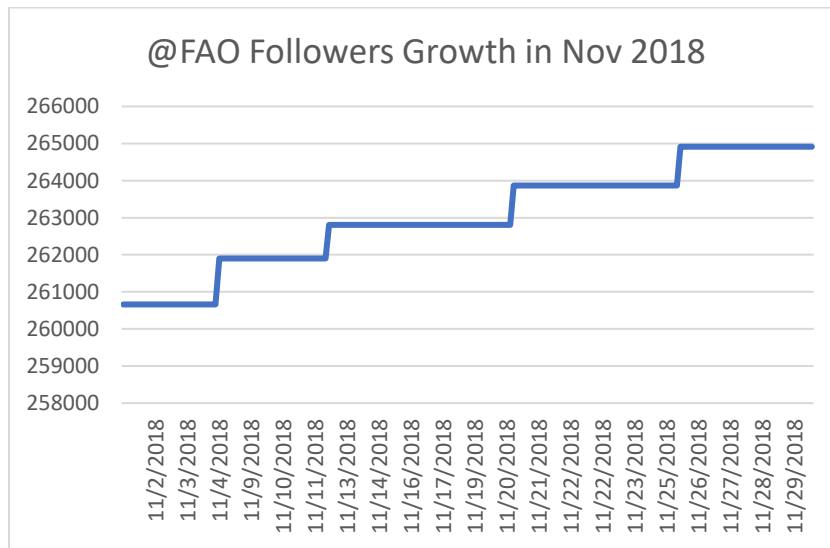
Figure 24: @FAO follower growth in November 2018

There were a total of 40,977 user engagements over the course of the month of November. User engagements are defined as likes or retweets. Given the average number

of followers, the account had a 15.58% user engagement rate that month. It should be noted that likes and retweets are not limited to followers, as the tweets may have been viewed and liked or retweeted by accounts that do not follow FAO but were somehow active in the discussion the tweet related to.

There was one tweet from the account on November 7th, 2018 that gained the most amount of likes (1,170) and retweets (565) for the month. This tweet is shown below in Figure 25. The tweet was also accompanied with a short video of a variety of differently shaped carrots, that would often be considered to be misshapen and unfit for retail sale.
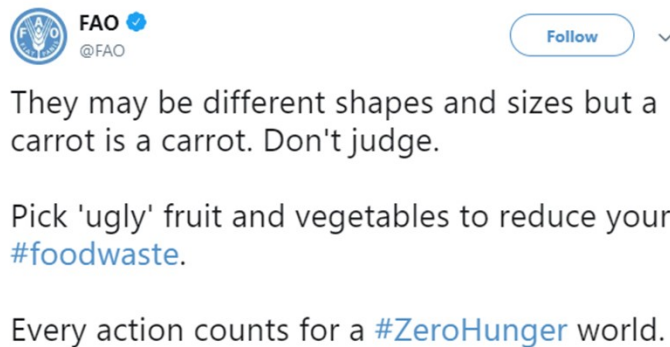
Figure 25: @FAO's highest engagement tweet

4.4.2 LoveFoodHateWaste Chill the Fridge Out

The LoveFoodHateWaste (LFHW) organization is based in the United Kingdom, with a similarly named organization in Canada. LFHW is a not for profit that is supported by WRAP (the UK charity focused on waste and resource management). The campaign was launched in 2007 and aims to reduce food waste in the UK. Along with there social media campaigns through Twitter, the organization also has a website with recipes and waste reducing tips for consumers. Love Food Hate Waste's campaign is called Chill the Fridge Out. This organization had run similar social media campaigns in the past, including

the Pumpkin Rescue during October, and the Make Toast not Waste throughout March. The information on all the campaigns is still available on their website, even when the twitter campaign is not active. The organization was asked if they would consider providing further comment to their campaigns and use of social media but they did not reply.

The LFHW twitter account had 59,093 followers at the end of the data collection period and tweeted a total of 63 times. Average retweet of 8.73 and average likes of 11.89 per tweet over the period. There was a combined engagement of 1,299 for both retweets and likes, averaging at 10.31 per tweet. This showed a 2.55% engagement rate with their followers.

Table 12: Type of Tweets with @LFHA_UK

	Frequency	Percent
Retweet	580	90.48
Tweet	41	6.40
Reply	20	3.12
TOTAL	641	100.00

The LFHW account was mentioned in 641 tweets, over 90% of these were retweets and the most common hashtags associated with these mentions are shown in Figure 26. These hashtags appeared in 399 of the 641 tweets mentioning the LFHW twitter account.
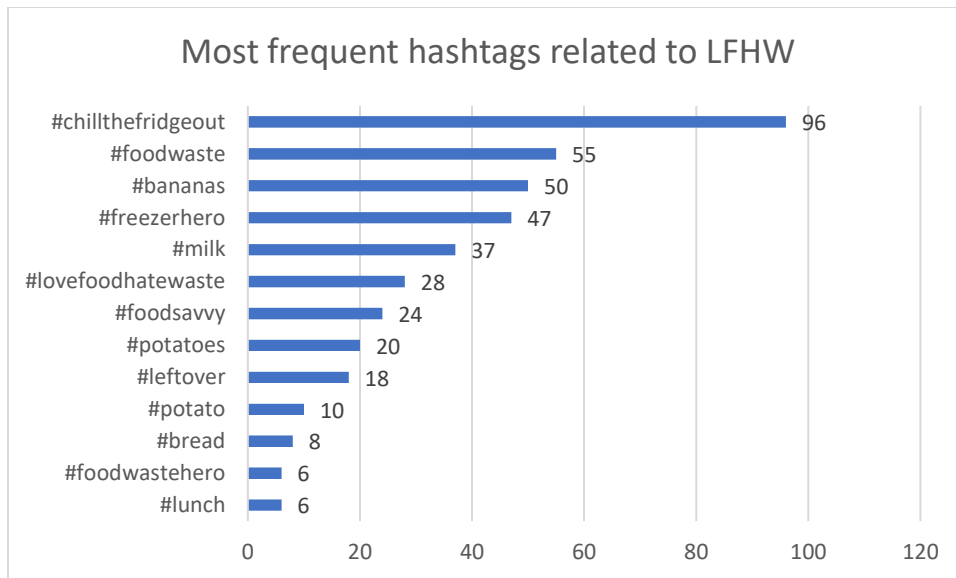
Figure 26: Most Frequently Used Hashtags related to LFHW

The hashtag related with the Chill the Fridge Out campaign was used 146 times over the month of November. As was seen previously the majority (52.1%) of these were retweets (Figure 27).
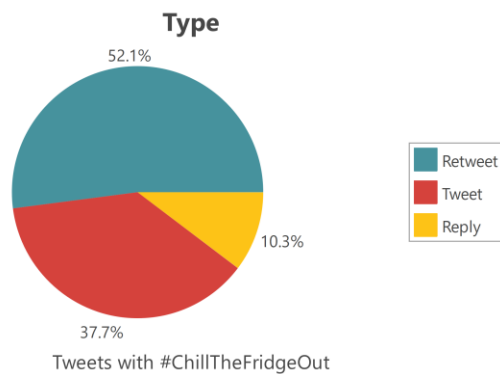
Figure 27: Types of Tweets using #ChillTheFridgeOut

As with the other campaign by FAO, there were several other hashtags used in combination with the 'Chill the fridge out' campaign. Many of these hashtags had not previously been featured in any of the most frequent lists. Many of the hashtags shown in Figure 28 are specific to the campaign, as its focus was on small practical step consumers

could take to reduce food waste at home. The hashtag 'Freezer Hero' was used by the organization to promote consumers freezing leftovers or surplus food to be used later, for example.
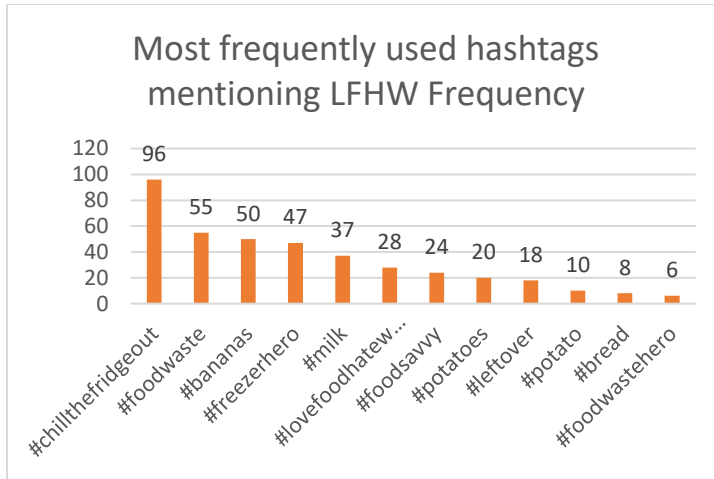
Figure 28: Most Frequently used Hashtags mentioning LFHW

Although the LFHW account has a smaller following than the FAO twitter account, they too experienced growth in the month of November, as shown in Figure 29. The account went from 58,976 followers to 59,093; this was a growth of 117 followers (0.2% growth). LFHW averaged 59,037.78 followers, 13.57 likes, and 9.94 retweets. The sum of their retweets and likes was 1270, giving them an estimated user engagement of 2.15%.
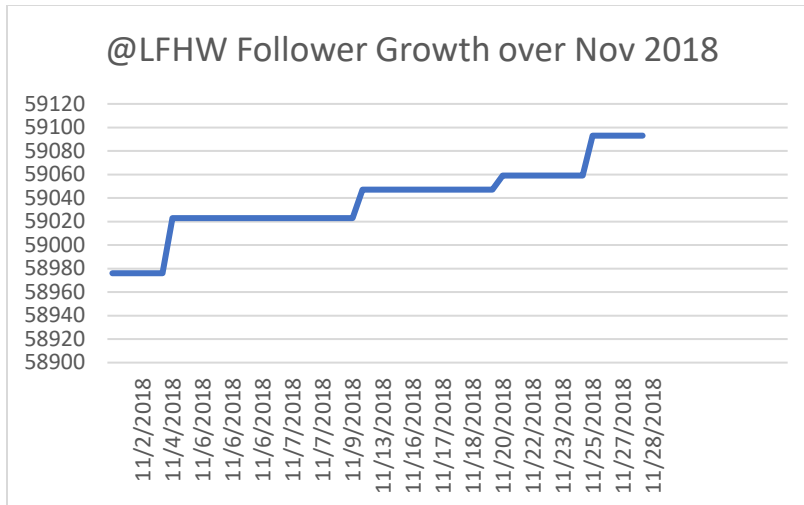
Figure 29: @LFHW_UK's Growth in Twitter Followers for November 2018

4.5 Interviews and Surveys

4.5.1 Interviews

Interviews were done via phone, using semi-structured interview questions. Due to the fire that occurred on campus during the time of research, interview notes were lost and are summarized based on what was recoverable and the researcher's best recollection. As the notes cannot be verified, names and personal identifiers have been removed, although all participants did originally provide consent to participate in the research.

Food Recovery Volunteer Organization

The organization is a volunteer-based harvesting group. Farmers will contact the organization when they have unharvested food on the field that they do not intend to send to market. The organization will arrange to have volunteers go to the farm and harvest the products for donation to a food bank. This is responding to a potential food loss, as it is still towards the start of the food supply chain.

Municipal Waste management

  The representative from the municipal waste management site was willing to share photos of a delivery of organic waste collected from two grocery stores in the county (Figure 30) The representative informed us that the food collected from the grocery stores is typically produce, with nothing that was prepackaged or meat products. He stated that he had heard that one (or more) of the stores donate unsalable food to the zoo located in the county and the packaged products are sent out of the region for recycling. The photos show large quantities of fresh produce and floral waste.

Figure 30: Food waste collected by Valley Waste 08/02/18

  They also reported that within their region industrial, commercial and institutional (ICI) waste accounted for 14% of the organic waste collected during the 2016-17 year (Table 13). This number (reported in metric tonnes) has actually been decreasing since 2012. The

representative did not believe that retailers were depackaging on site, and thought that there might be a private company that was offering depackaging somewhere in the Halifax area. We were unable to confirm if there were any such operations.

Table 13: Valley Waste's Organic Waste Amounts 2012-2017

YEAR	ICI ORGANICS	TOTAL ORGANICS	ICI %
2012-13	1873	10206	18%
2013-14	1948	10488	19%
2014-15	1813	10764	17%
2015-16	1663	10788	15%
2016-17	1434	10580	14%

The figure presented in the table above may not actually be representative, as one of the haulers the municipality has, collects three streams of recyclables at one pick up. As a result, trucks that come in containing paper products, recyclables and organic waste are weighed and recorded as a recyclable load, and not measured out based on the stream collected. This suggests that the ICI contribution to the organic waste amounts could be much higher. It was however noted that the number of the total organic is correct regardless of what hauler brought in the waste. The representative assumes that the ICI contribution is somewhere between 15-20% of the total organic waste collected.

Additionally, the representative reviewed four separate grocery chains in their area for their three-month waste collected from their on-site compactors. The four stores averaged 18.06 metric tonnes for the months of November, December and January. The representative noted there may be some impact of the season in these numbers. He also noted that one store was much lower than the other three, generating 11.08 tonnes during the three-month span. He was unsure of whether this was due to the busyness of the store,

management practices, or if they have an alternative destination for their organics that the other stores do not have in place.

Composting Facility

Household collections are the larger concern when it comes to compost contaminants. There is a larger frequency of inorganics when compared to commercial (or ICI) collections. There is a fine associated with the presence of contaminants for commercial customers. The largest issue they see from grocery stores are that plastics on some of the produce is not being removed, most commonly on cucumbers. The waste they see largely comes from the produce and bakery sections of the store, but they do not conduct a detailed review of the composition of the waste delivered.

Non-Profit Non-Government Organization (NGO)

RecyclingWorks Massachusetts is a non-profit organization that provides businesses and institutions with resources and assistance to improve their recycling practices and divert waste from landfill disposal. It is a sub-organization of a larger non-profit called the Center for EcoTechnology.

> "For more than 40 years, our innovative non-profit organization has offered practical solutions to save money, increase the health and comfort of our homes, and help businesses perform better."
> - Center for EcoTechnology, About CET, 2019

The organization uses the same waste hierarchy presented within this research for their initiatives. The representative said the prevention stage of the waste hierarchy is where they see the most innovative solutions, with a variety of technology-based platforms

that aim to reduce food waste at the source and empower the retailers to employ tactics in store with relative ease.

The organization is based in Massachusetts. This state has put an organic ban on commercial waste generators. The state, along with consultation from this organization opted to focus on the commercial waste generators rather than household producers, even though they are the largest generator. They felt that this would allow for commercial entities to absorb some of the cost of building the infrastructure so that a household organic waste ban and collection system could begin at a later date.

The representative also stated that Kroeger, a US grocery chain, recently began collecting their unsaleable food and placing it back on delivery trucks after they deliver fresh food. The truck then returns the food waste to the distribution centre, where it is placed in their on-site anaerobic digester. This solution doesn't add any miles to the food's footprint, given that the truck would be returning to the centre regardless, and they are now able to generate their own renewable energy. This is similar to the larger system previously mentioned when discussing Ontario's new pilot program for commercial food waste reduction.

Meeting Notes with Provincial Agency

In 2017, the provincial recycling board expressed interest in having research be conducted to look at the feasibility of adding depackaging equipment to the provincial waste management system. This was intended to benefit retail food waste generators, and offer them an option to have their unsaleable food depackaged mechanically in the attempt to increase food waste diversion from landfill.

As mentioned previously, due to a fire which occurred on campus during this research, many of the meeting notes were lost. We met with the research coordinator twice throughout the duration of the report. First to discuss what their objectives of the research were, and how our proposal could meet those objectives. The second meeting occurred following the submission of the report after they had concerns about the findings presented in the paper.

Initial objectives of the proposed research were to quantify the amount of food waste occurring in Nova Scotia, speak with retailers and issue surveys to employees, and conduct a cost-benefit study of depackaging equipment within Nova Scotia. Contacts were given for representatives from the main grocery store chains, yet we were only able to speak with one representative from a chain that only has two locations within the province. As a result, we were unable to complete the employee survey proposed originally as Dalhousie's Research Ethics Board required letters of support from the stores in order to allow the survey to proceed.

Following the second meeting, the representatives noted that they would like more of a focus on the current landscape of depackaging in the province and within other regions as well as any legislative issues that may serve as a barrier for the equipment. They also asked for a survey of the food retailers be done to quantify the amount of waste occurring in the province. It was noted again that as we were unable to gain support from retailers to complete such as survey, we would be unable to do this. Additionally, they asked that logistical recommendations be made about the type of equipment. Several models had been listed in the report along with their specifications, but a formal recommendation was not

made. Although the most versatile and common North American model was used in the cost-benefit analysis presented.

Overall, they felt that the research presented did not accurately represent the goal as the province does not have the infrastructure to support anaerobic digestion and in their experience, it has been too expensive to be a viable option for Nova Scotia. This was taken into account when completing the report as the benefits were estimated based on the use of the output as compost, but the literature and discussions with compost and waste experts suggested that this would not be the most realistic use of the depackaging output.

Private Waste management hauler

The representative from the private waste hauler, Miller Waste, discussed issues that they see as a private company within the waste management system as well as opportunities they will be taking advantage of in the near future.

Some barriers he noted that restricts the amount of food waste diversion they can achieve are some industry-specific regulations. For example, there is a barrier preventing the re-use of collected waste for animal feed. The representative stated that the Canadian Food Inspection Agency (CFIA) considers that food becomes garbage once it has entered the waste haulers' truck, and then becomes unusable as feed for animals.

The company has investigated potentially re-using the collected food waste for use as feed in the local mink and fisheries industry but are unable to do so as a result of this ruling by the CFIA.

Additionally, within the Halifax Regional Municipality (HRM), waste haulers are unable to offer depackaging services to their commercial customers. The representative

stated that stores are required to instead separate the packaging and food waste manually. He said that while depackaging equipment would save money for the stores there wouldn't be an increase in waste diversion since stores are already required to sort within their store.

Some opportunities the company has identified as being advantageous is the use of anaerobic digestion for organic waste that is not ideal for composting. Commercial organic waste accounts, by the representatives, estimate, for approximately 50% of the waste they process. This commercial waste has an increased amount of leeching and needs more fans to dry it out for proper composting as it is often wetter than household (consumer) waste. Yard waste and green bin waste is very good for composting, while high liquid waste would be better suited for anaerobic digestion. Additionally, many of the depackagers most commonly used with mixed product organic waste will produce an output that would require additives to become suitable for composting as it is too wet.

Regardless of these barriers, the company is moving forward to meet these opportunities by investing in the new equipment. They will be having a depacker delivered to support their on-farm digestor. This is also a move for the company to match its Ontario location that has similar technologies in place. They have also been in talks with the HRM to seek an amendment to the restriction of offering depackaging to their clients.

He did note that anaerobic digesters are not perfect, but that there have been substantial improvements, with some systems being able to handle higher contaminant levels, something that has been an issue within agricultural digesters in the past. A manufacturer in Germany has developed a system that will float the plastic so it can be removed, as well as remove any grit daily.

Recycling and waste sorting employee

The waste sorting facility that the employee worked at is focused on the sorting of recyclable materials, not food waste. They did note the issue of contaminants is quite severe. Employees are instructed to dispose of any bags that are contaminated with organic waste or are wet. The facility does not have the time or resources needed to see to the complete resorting and cleaning of any contaminated recyclables. As a result, these bags end up going for landfill disposal.

Store Manager Questionnaire response

One grocery store manager completed the questionnaire that was distributed with the consumer and employee survey. The questions for the questionnaire were sourced from the Food Waste Reduction Alliance's questionnaire for US food retailers.

The store reported having three full-time employees and four part-time employees and was located near Vancouver. The company had no company mandate for waste diversion. The manager was asked to report the amounts of food wasted per week, food that was donated for human consumption, and amounts sent to animal feed, organic waste collection, depackaging, and landfill/incineration.

The store donated a total of 60kg of food for human consumption in the past calendar year. The manager was able to report the amount of food donated with a very high degree of confidence. The barriers for the donation of the food was noted as the presences of liability concerns, insufficient refrigeration onsite, transportation costs, and onsite sorting and packaging costs. Additional barriers were also identified for the reuse and recovery of food waste were food safety concerns and transportation barriers.

The respondent also provided a quote.

> "The best solution is for food to be more expensive. Anything else just shift the problem around to different unintended consequences."
> - Store Manager (Male, 31-40 years old)

4.5.2 Consumer Survey Results

A total of 189 surveys were completed. Of this sample size, 81% of respondents were female, 18% male, and 1% other.

Survey participants were asked their education level. This was asked to see if education level had any influence on the behaviours and perceptions of the survey respondents. Over 86% of respondents had above high school level education with 65.4% reporting that they were either married or had a common-law spouse.

Participants were also asked where they lived (rural, urban, or suburban). The infrastructure and resources available to respondents could be different depending on the types of communities they live in. The literature suggests that more rural areas might have limited access to green bins and municipal pick up but may also be more likely to compost at home.

The distribution over all the participants showed that 43% of respondents live in a rural setting. This was skewed by the large proportion of Nova Scotian's who completed the survey. When looking at Canada, excluding Nova Scotia, over half the respondent lived in the city. The responses to this question were further broken down and viewed by province. Once again, Nova Scotia respondents were largely rural based, where the other

provinces (excepting British Columbia) respondents were more likely to live within a city. A full breakdown is shown in Figure 31.

Where do you live? By Province

	Alberta	British Columbia	Manitoba	New Brunswick	Newfoundland & Labrador	Northwest Territories	Nova Scotia	Ontario	Prince Edward Island	Quebec	Saskatchewan
Suburb	4	1	1	2	0	0	28	7	0	1	1
Rural	3	5	0	3	0	1	62	3	2	1	0
City	9	3	3	6	1	0	22	10	2	5	2

Suburb   Rural   City
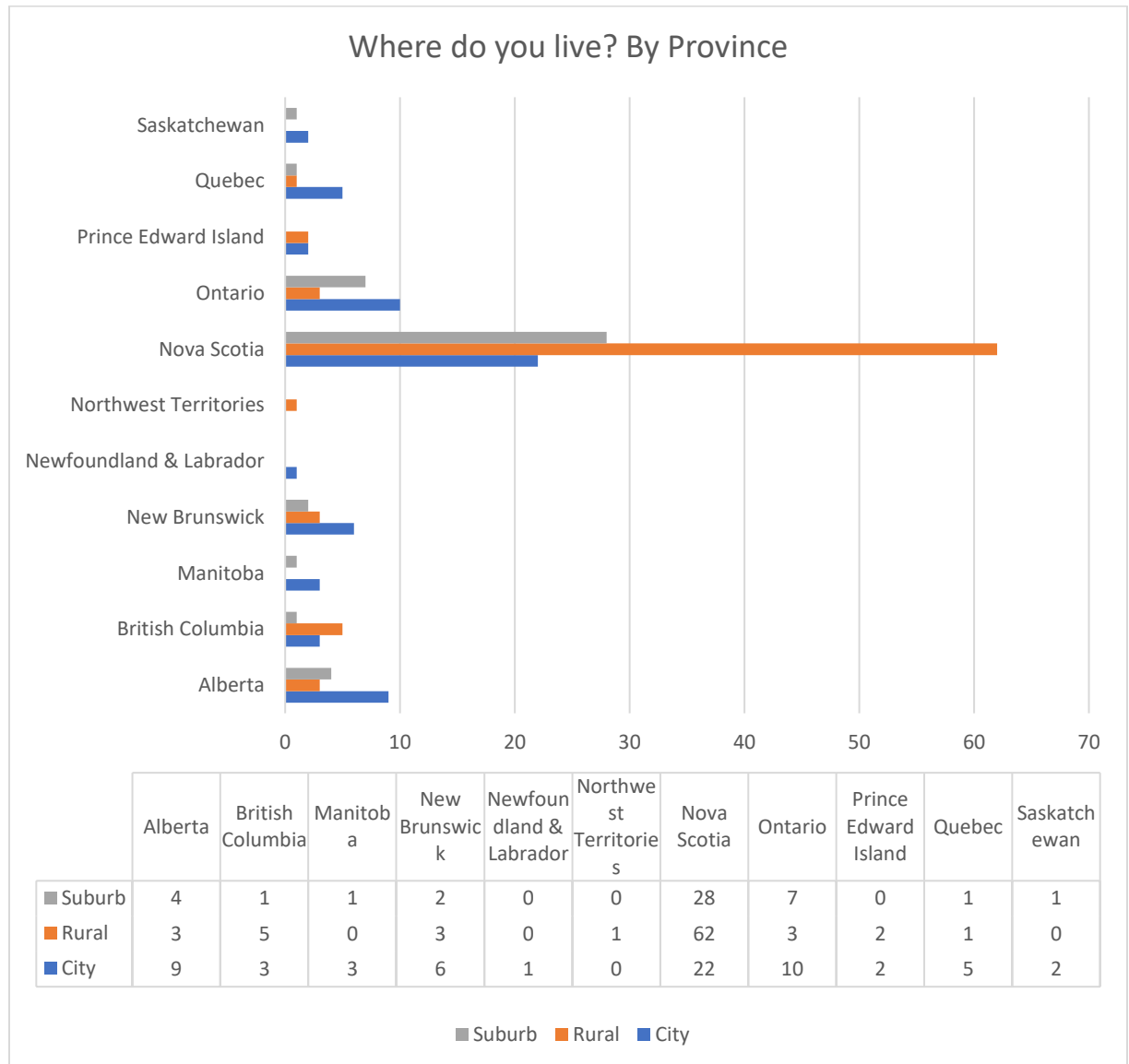
Figure 31: Bar Graph of Community type for Consumer Respondents by Province

Survey respondents were asked their average weekly food expense (Figure 32). Food waste is sometimes related to consumers not placing a high enough value on their food, meaning that they do not see the financial cost when the food is wasted. This question was asked to gauge the investment that consumers put into their food. The responses for

weekly grocery expense varied from $1- $600, with a median of $100 per week and a mean of $128.53. Statistics Canada averages a cost of $164 per week (Statistics Canada, 2017).
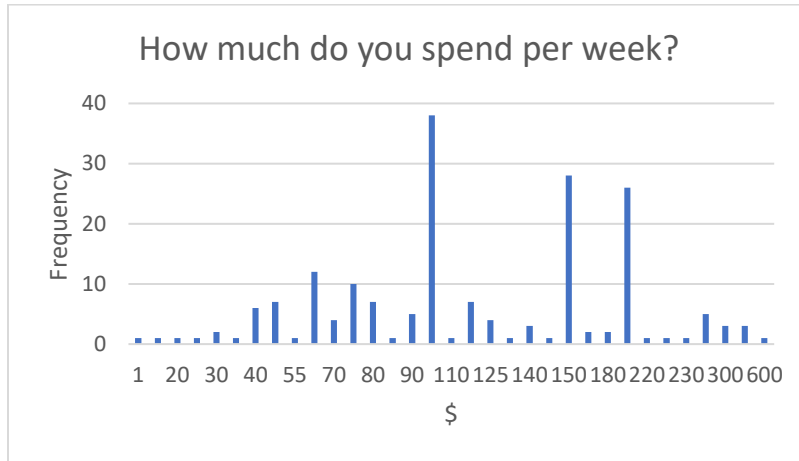
Figure 32: Weekly Food Expenditure of Respondents

Additionally, 42.6% of respondents work more than 35 hours per week, with 26.6% reporting a household income of $25,001 – 75,000 and 25% reporting $75,001- 110,000. Ages of respondents ranged from under 20 years old up to 71-80 years old. 38% of respondents were within the 21-30 age range, with an average age of 35.

Analysis of Constructs

When developing the survey, questions were categorized into four theoretical constructs: 1 purchasing behaviour (PB); 2 waste separation (WS); 3 household waste belief (HB), 4 environmental concerns (EC). To evaluate the reliability of these constructs, survey questions pertaining to each potential construct were evaluated based on their Cronbach's Alpha scoring. Questions that did not contribute to the scale were removed as needed, to strengthen support of the construct. The resulting Cronbach's alpha scores for each construct are shown in Table 14. A score > 0.70 is deemed strong.

Table 14: Cronbach's Alpha results for Experimental Constructs

Construct	Cronbach's Alpha
Purchasing Behaviour	0.699
Waste Separation	0.888
Household waste belief	0.761
Environmental Concerns	0.841

Question 2 was removed from purchasing behaviour, this question asked participants how often they buy produce and place it in a bag. This would be the fruits and vegetables in the bulk bin sections. Within the household waste belief construct questions 24 and 38 were removed. These two questions were asked if they thought there was too much packaging and that throwing away food is dirty. There were also two questions removed from environmental concern. Questions 48 and 49 asked respondents if they agreed that automobiles and/or factories are the largest pollution source. No questions were removed from waste separation. All of the questions removed did not contribute to the reliability of the construct. Upon review of the questions, it was decided that it did not weaken the defined construct to remove them in order to strengthen the reliability (Cronbach's alpha).

Aggregated mean variables were then created for each construct using the questions that supported the construct. A correlation test was then conducted to identify the relationships between the variables, as well as test validity.

Table 15: Correlation of Experimental Constructs

	PB	WS	HB	EC
PB	1			
WS	-0.015	1		
HB	0.271**	-0.169*	1	
EC	-0.048	0.196**	-0.177*	1

** Correlation is significant at the 0.01 level
* Correlation is significant at the 0.05 level

Table 15 shows that there is a very strong positive correlation between purchasing behaviour and household waste belief, and waste separating behaviour (p-value of 0.000). This means that as there is a statistically significant linear relationship between the two variables and given that the relationship is positive when one value increases so do the other. There is also a very strong positive correlation between waste separation and environmental concern (p-value of 0.007).

The table also shows a strong negative correlation between waste separation and household waste perception with a p-value of 0.021. The negative relationship means that when one variable increases the other will decrease. It is important to note once again that a high household waste perception score signifies undesirable waste perceptions. The results also show a strong negative between purchasing behaviour and education level (p-value of 0.15). There is no desirable or undesirable value for purchasing behaviour the questions are merely asking how often they purchase a certain type of product.

Figure 33 shows the histogram with a normal distribution curve for the purchasing behaviour of the consumer survey participants. The mean line has also been added to the chart. The scale used when asking these questions were using the frequency 5-point Likert scale, from Never to Always. The mean value for purchasing behaviour is 2.80 with a 0.535 standard deviation. This shows that consumers are purchasing packaged food sometimes (value of 3).
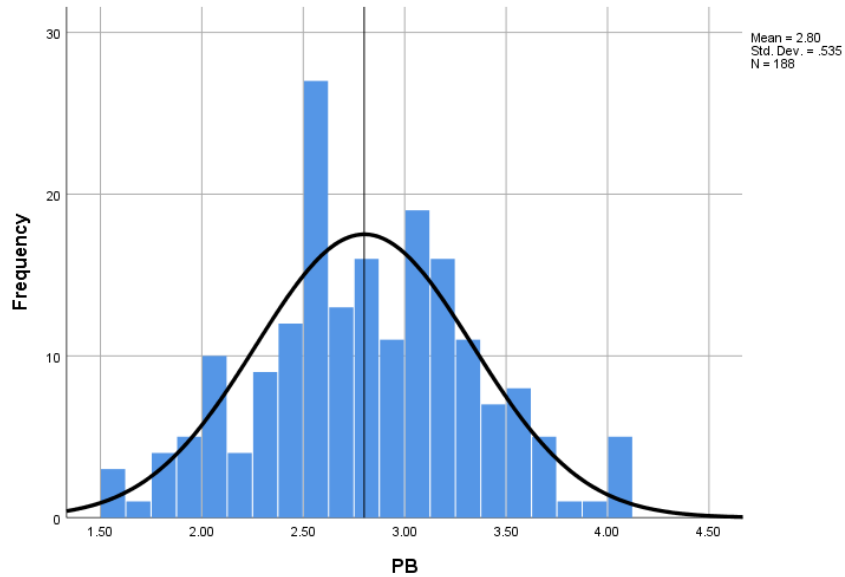
Figure 33: Histogram of the Purchasing Behaviour of Consumer Survey

To determine the food waste and packaging separation of consumers, participants are asked how they deal with their food waste once it has spoiled or passed its expiration (best-by) date. These questions used the same frequency scale used for the purchasing behaviour construct. If they responded that they separated the food from its packaging for compost or green bin collection, this was considered to be a positive outcome. Questions where they stated they did not separate and instead disposed of the products in the garbage, this is considered to be a negative outcome. In other words, if they replied that they put the food and packaging in the garbage, these were reverse scored statements.

The waste separation behaviour of consumers is shown in Figure 34. The construct has a mean value of 3.22 and a standard deviation of 1.062. This shows that survey participants sometimes separate their food waste from its packaging.
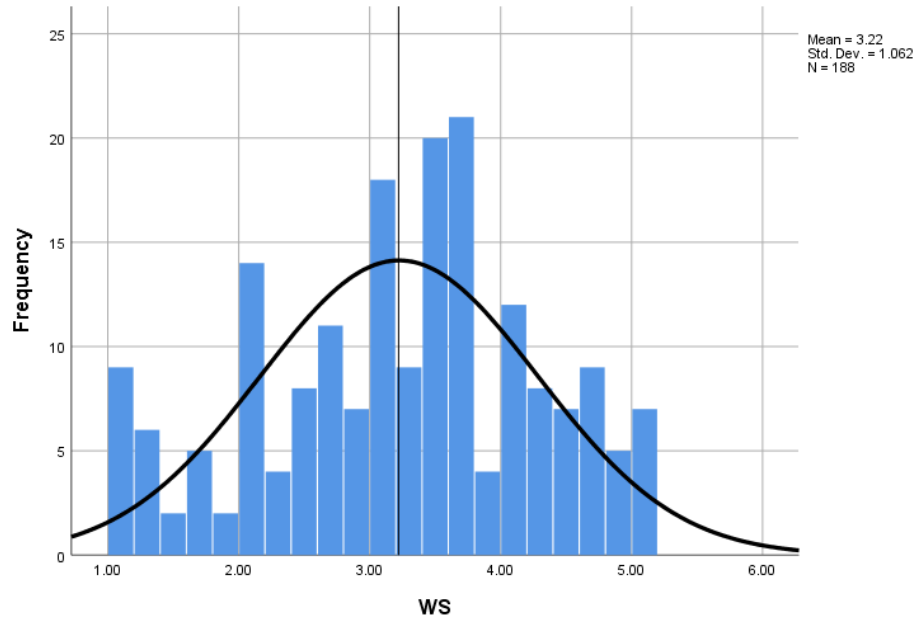
Figure 34: Histogram of the Waste Separating Behaviour of Consumers

The third construct developed was the household waste perceptions held by the survey participants. Consumers were asked how strongly they agreed or disagreed with statements related to food waste. Statements that showed a positive waste behaviour or perception were reverse scored in this construct. The histogram for household waste perception is shown in Figure 35. The construct has a mean value of 2.31 with a standard deviation of 0.502. This can be interpreted to be that to 'disagree' is associated with a negative household waste behaviour.
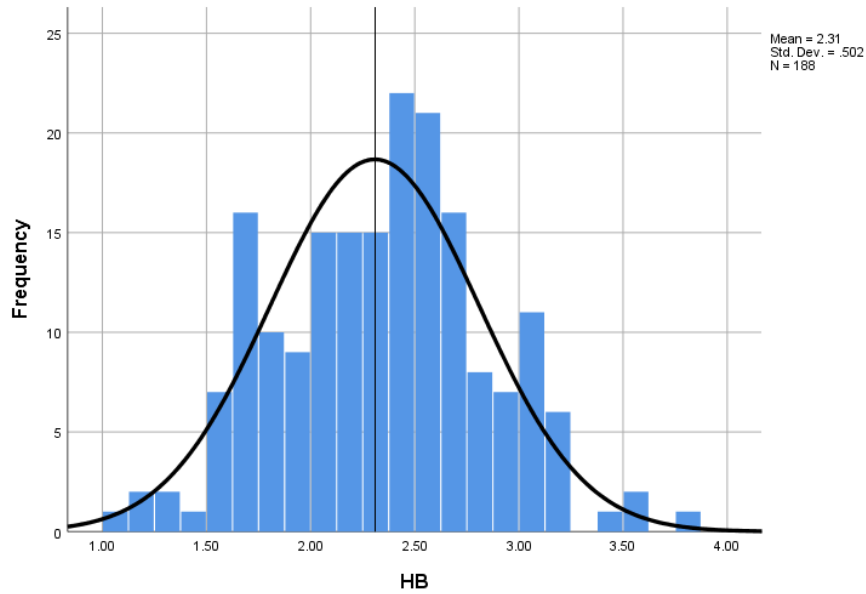
Figure 35: Histogram of the Household Waste Perceptions of Consumers

The final construct is the level of environmental concern among the survey participants. These questions also asked participants how strongly they agreed or disagreed with statements related to environmental issues. One of the statements was reverse scored as it was not in line with the other statements that were environmentally conscious. The larger the value, the more environmentally concerned the survey participant is. The histogram shown in Figure 36 shows the level of environmental concern among survey participates. The construct has a mean value of 3.65 with a standard deviation of 0.826. This shows that survey participants agreed with the statements related to environmental concern.
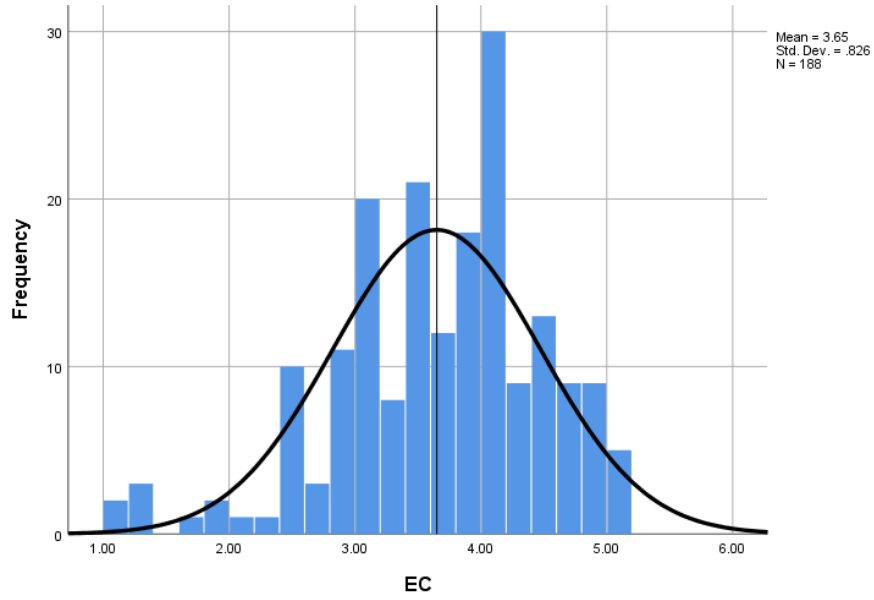
Figure 36: Histogram of the Environmental Concern of Consumers

The survey questions were all on a 1-5 scale. Figure 37 shows the box and whisker plot for the four experimental constructs. The household waste behaviour box is comparatively short suggesting that consumers are in agreement with each other within this subject. Waste separating behaviour, in contrast, is comparatively tall, suggesting differing practices of survey participants when it comes to the separation of food waste and packaging.
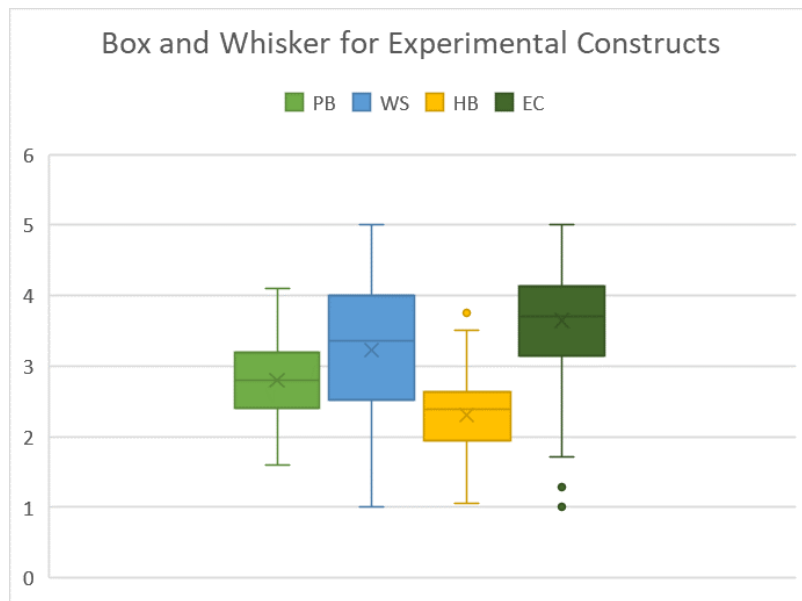
Figure 37: Box and Whisker plot for the Four Experimental Constructs

The statistically significant difference shown between the waste sorting behaviour (WB) of Nova Scotians suggests that the source-separated waste management system used within the province does have an impact on consumers behaviour. Particularly since there were no significant differences between the two groups in any of the other three constructs.

The higher mean rank within the waste separation construct signifies a favourable waste sorting outcome. Given the significantly higher score for the Nova Scotian group, it can be concluded that Nova Scotians are better at sorting their organic material from waste and diverting it from landfill disposal. This conclusion is in line with what is known about the waste management system in Nova Scotia, and how the waste rates of this province compared to the rest of Canada.

Mann-Whitney Test

Mann-Whitney tests were conducted to identify if there were any statistically significant differences among the four education levels and the experimental constructs. The results of these tests are summarized shows the resulting p-values in Table 16.

Table 16: Mann Whitney Results of Education level

		College	Undergrad	Graduate
PURCHASING BEHAVIOUR	High school	.255	.295	.016
	College		.848	.118
	Undergrad			.071
WASTE SEPARATING BEHAVIOUR	High school	.081	.299	.084
	College		.331	.871
	Undergrad			.303
HOUSEHOLD WASTE BELIEFS	High school	.016	.134	.154
	College		.129	.122
	Undergrad			.977
ENVIRONMENTAL CONCERN	High school	.506	.125	.168
	College		.453	.481
	Undergrad			.960

H_0: There is no significant difference between consumers based on their education level.

H_A: There is a significant difference between consumers based on their education level.

The results show there was a statistically significant difference in purchasing behaviour of those with graduate degrees and those with high school diplomas, with a significance value of 0.016. There was also a significant difference seen in the household waste beliefs between high school graduates and those who held a college degree. Although because there was not a significant difference across all levels of any educational level, the null hypothesis can not be rejected.

A second Mann-Whitney test was conducted to evaluate whether there was a difference in the purchasing behaviour, waste separating behaviour, household waste

beliefs, and level of environmental concern, depending on the community type the survey respondent lived in. The hypothesis listed below. Table 17 is the summary of the results, showing the resulting p-value for each of the combinations.

H_0: There is no significant difference between consumers depending on the type of community they live in.

H_A: There is a significant difference between consumers depending on the type of community they live in.

Table 17: Mann Whitney results for Difference between Community types on Experimental Constructs

		Rural	City	Suburb
Purchasing behaviour	Rural	NA	0.593	0.749
	City	0.593	NA	0.913
	Suburb	0.749	0.913	NA
Waste separating behaviour	Rural	NA		
	City	0.000	NA	
	Suburb	0.308	0.005	NA
Household waste beliefs	Rural	NA		
	City	0.265	NA	
	Suburb	0.696	0.196	NA
Environmental concern	Rural	NA		
	City	0.089	NA	
	Suburb	0.751	0.228	NA

When comparing the different community types, there are statistically significant differences in rural communities compared to the city in terms of waste separation and environmental concerns, and there is a significant difference in the waste separation of city residents and suburban residents. Again, due to there not being a significant difference seen across all factors in any given region, we fail to reject the null hypothesis.

Given that a large proportion of the survey participants were living in Nova Scotia, a comparison between Nova Scotia and the rest of Canada was conducted. As mentioned, Nova Scotia is unique as there is a provincial wide waste management system in place that includes required recyclable separation and a province-wide organic ban for households and ICIs. Given this, it was hypothesised that there may be a difference between consumers within Nova Scotia and those living outside of Nova Scotia. Using the four constructs that have been developed, this hypothesis was tested.

H_0: There is no significant difference between consumers in Nova Scotia and those living outside of Nova Scotia.

H_A: There is a significant difference between consumers in Nova Scotia and those living outside of Nova Scotia.

Table 18: Test Statistics of Mann Whitney test for NS vs Canada

	PB	WS	HB	EC
Mann-Whitney U	3881.500	1072.000	4039.500	3872.000
Wilcoxon W	6807.500	3998.000	10367.500	6798.000
Z	-1.025	-8.703	-.592	-1.051
Asymp. Sig. (2-tailed)	.306	.000	.554	.293

a. Grouping Variable: Nova Scotia or Other

As shown in the test statistics in Table 18, we failed to reject the null hypothesis for consumers' purchasing behaviour, household waste behaviour, and environmental concern. We were, however, able to reject the null hypothesis for waste separation. Nova Scotian consumers waste separation behaviour is statistically significantly different than those living outside of Nova Scotia.

Table 19: Mean Ranks for Mann Whitney test of Nova Scotia vs Rest of Canada

	Nova Scotia or Other	N	Mean Rank	Sum of Ranks
Purchasing Behaviour	nova scotia	112	97.84	10958.50
	other	76	89.57	6807.50
	Total	188		
Waste Separating behaviour	nova scotia	112	122.93	13768.00
	other	76	52.61	3998.00
	Total	188		
Household waste beliefs	nova scotia	112	92.57	10367.50
	other	76	97.35	7398.50
	Total	188		
Environmental Concern	nova scotia	112	97.93	10968.00
	other	76	89.45	6798.00
	Total	188		

The descriptive statistics for this test (Table 19) show a higher mean rank for the Nova Scotian group. Within this construct, a higher mean score signifies a more favourable behaviour. Indicating that Nova Scotian's are more likely to divert organic material from landfill disposal.

Regression Model for Waste Separating Behaviour

Following the developmental of the four experimental constructs, a regression was conducted with waste separating behaviour as the dependent variable. Descriptive statistics for the 25 variables are shown in Table 20. This table shows the results of the variables after the type of community (rural, city or suburbs), province, and gender had been transformed into binomial variables. An initial correlation analysis of all of the variables was conducted. These results are shown in Table 21.

Table 20: Descriptive Statistics for Consumer Survey Variables

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
How much per week do you spend on groceries?	188	1	600	128.53	74.934
MALE	186	.00	1.00	.1828	.38754
FEMALE	186	.00	1.00	.8172	.38754
EDUCATION	188	12.00	20.00	16.0213	2.66480
RURAL	188	-1.00	1.00	.1862	.79599
SUBURB	188	.00	1.00	.2394	.42783
CITY	188	-1.00	1.00	.0957	.75387
NS	188	-1.00	1.00	.5798	.52633
NB	188	-1.00	1.00	.0426	.27027
PE	188	-1.00	1.00	.0053	.19340
QU	188	-1.00	1.00	.0213	.23026
ON	188	-1.00	1.00	.0904	.33878
MB	188	-1.00	1.00	.0053	.19340
SK	188	.00	1.00	.0160	.12565
AB	188	-1.00	1.00	.0691	.31112
BC	188	-1.00	1.00	.0319	.25129
NWT	188	-1.00	1.00	-.0106	.14586
NL	188	-1.00	1.00	-.0106	.14586
INCOME	159	5000.00	200000.00	85094.3396	53059.76955
AGE	188	20.00	75.50	39.7633	15.67803
WORKHRS	188	.00	35.00	22.0080	14.89908
Purchasing Behaviour	188	1.60	4.10	2.8007	.53510
Waste Separating	188	1.00	5.00	3.2240	1.06151
Household Waste Beliefs	188	1.06	3.75	2.3077	.50201
Environmental Concern	188	1.00	5.00	3.6486	.82612

Table 21: Correlation table of Consumer Survey

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1 WEEKLY $	######	74.93	1																								
2 MALE	0.18	0.39	-0.013	1																							
3 FEMALE	0.82	0.39	0.013	-1**	1																						
4 EDU	16.0	2.66	-0.015	0.084	-0.084	1																					
5 RURAL	0.19	0.80	0.104	0.017	-0.017	-0.098	1																				
6 SUBURB	0.24	0.43	-0.016	-0.105	0.105	0.108	-0.838**	1																			
7 CITY	0.10	0.75	-0.082	0.160*	-0.160*	-0.081	0.371**	-0.818**	1																		
8 NS	0.58	0.53	-0.055	-0.126	0.126	0.121	0.188**	0.022	-0.235**	1																	
9 NB	0.04	0.27	-0.035	-0.075	0.075	0.085	0.013	-0.042	0.059	-0.062	1																
10 PE	0.01	0.19	-0.007	-0.085	0.085	0.083	0.098	-0.080	0.033	0.127	0.303**	1															
11 QU	0.02	0.23	0.016	0.016	-0.016	0.017	0.007	-0.052	0.081	0.030	0.243**	0.358**	1														
12 ON	0.09	0.34	-0.033	0.128	-0.128	0.045	-0.122	0.071	0.008	-0.206**	0.133	0.237**	0.181*	1													
13 MB	0.01	0.19	0.045	-0.013	0.013	0.062	-0.006	-0.015	0.033	0.127	0.428**	0.358**	0.303**	0.237**	1												
14 SK	0.02	0.13	-0.006	0.050	-0.050	-0.065	-0.083	0.028	0.063	0.040	-0.383**	-0.493**	-0.664**	-0.411**	0.237**	1											
15 AB	0.07	0.31	0.007	-0.017	0.017	-0.053	-0.083	-0.004	0.063	-0.019	-0.148*	0.156*	0.093	0.154*	0.260**	-0.664**	1										
16 BC	0.03	0.25	0.157*	-0.005	0.005	-0.097	0.104	-0.071	0.012	0.290**	0.216**	0.327**	0.265**	0.203**	0.260**	-0.524**	0.177*	1									
17 NWT	0.03	0.15	0.067	0.035	-0.035	0.056	0.109	-0.071	0.012	0.290**	0.418**	0.571**	0.571**	0.327**	0.260**	-0.866**	0.370**	0.447**	1								
18 NL	-0.01	0.15	-0.028	-0.060	0.060	0.111	0.063	-0.045	-0.039	0.290**	0.418**	0.484**	0.484**	0.265**	0.260**	-0.866**	0.370**	0.447**	0.749**	1							
19 INCOME	85094	53060	0.355**	0.187*	-0.187*	0.219**	0.054	-0.027	-0.011	-0.208**	-0.096	-0.044	-0.148	0.022	0.067	0.129	0.008	-0.039	-0.024	-0.137	1						
20 AGE	39.76	15.68	0.141	-0.113	0.113	0.053	0.199**	-0.022	-0.173*	0.363**	0.014	0.126	-0.062	0.022	0.067	0.129	0.008	-0.039	0.080	0.056	0.084	1					
21 WORKHRS	22.0	14.90	-.192**	0.076	-0.076	0.169*	0.199**	-0.055	0.073	-0.158*	0.015	-0.048	0.025	0.080	-0.015	0.068	-0.008	0.026	0.022	0.010	0.302**	-0.334**	1				
22 PB	2.80	0.54	0.162*	-0.001	0.001	-0.186*	-0.016	-0.008	0.030	0.096	0.072	0.015	0.001	0.041	0.080	0.032	0.068	0.026	0.000	0.000	0.077	-0.054	0.054	1			
23 WS	3.22	1.06	-0.013	-0.102	0.102	0.084	0.137	-0.062	0.103	-0.248**	-0.127	0.110	0.001	-0.136	-0.077	-0.151*	0.072	0.011	0.085	0.076	-0.142	0.418**	-0.160*	0.271**	1		
24 HB	2.31	0.50	0.113	-0.034	0.034	-0.020	0.004	-0.062	0.103	-0.077	-0.126	-0.055	-0.208**	-0.060	0.086	0.091	0.072	-0.126	-0.083	-0.065	0.105	-0.024	0.050	-0.015	0.196**	1	
25 EC	3.65	0.83	-0.031	0.117	-0.117	-0.117	-0.042	-0.016	0.071	0.112	-0.018	0.146*	0.180*	-0.058	0.069	-0.071	-0.172*	0.087	0.045	0.039	-0.054	-0.132	0.068	-0.048	-0.169*	-0.177*	1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

A regression analysis was conducted. Variables that did not contribute to the model were removed. Other variables were grouped together with similar variables in an attempt to strengthen and simplify the model.

Waste separating behaviour was selected as the dependent variable, with the hypothesis being that the waste separating behaviour of an individual would not be different as a result of the independent variables.

Table 22: Regression Model Summary for Waste Separating Behaviour

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.750ᵃ	.562	.536	.72507

a. Predictors: (Constant), EC, AGE, EDUCATION, NB.NL, HB, INCOME, QU.ON, MB.AB.SK, NS.PE

Table 22 shows the results of the regression. There was a resulting r-squared value of 0.562. This indicates that the model can explain 56.2% of the variability in the responses from the survey participants. The histogram shown in Figure 38 shows that the model meets the assumption of normal distribution.
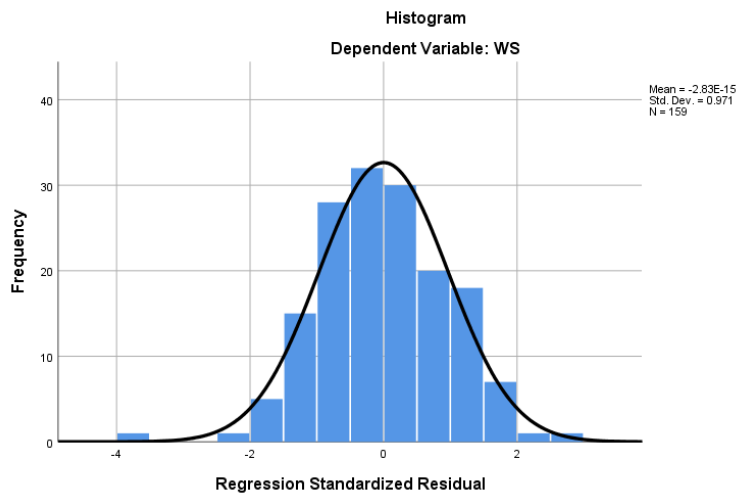
Figure 38: Histogram of Residuals for Waste Separating

Table 23: Coefficients of the Regression Model

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.013	.585		3.440	.001
	INCOME	-1.105E-6	.000	-.055	-.926	.356
	EDUCATION	.017	.023	.043	.748	.456
	AGE	.019	.005	.258	4.144	.000
	NS.PE	.890	.118	.483	7.545	.000
	NB.NL	-.455	.200	-.140	-2.273	.024
	QU.ON	-.056	.151	-.022	-.372	.710
	MB.AB.SK	-.603	.165	-.226	-3.657	.000
	HOUSEHOLD WASTE BEHAVIOUR	-.230	.122	-.108	-1.888	.061
	ENVIRONMENTAL CONCERN	.101	.078	.074	1.299	.196

Aside from age, socioeconomic factors that are typically significant predictors of behaviour such as education and income level are not significant in this model, as shown in the coefficient results in Table 23.

The results showed that the province was a significant variable when determining waste separating belief. Provinces were grouped with Nova Scotia and Prince Edward Island, as they are the only two provinces that currently have province-wide organic waste bans in place, and New Brunswick and Newfoundland as the rest of Atlantic Canada group. Ontario and Quebec were grouped as Central Canada, with Manitoba, Alberta, and Saskatchewan as the Prairies. British Columbia was used as the base when transforming the original data into binomial (dummy) variables.

Of the three independent constraints, purchasing behaviour (PB) was removed from the model as it was deemed insignificant. Level of environmental concern (EC) and household waste beliefs remained in the model as they did marginally contribute. Additionally, it was decided that these experimental constructs were more linked to waste separating behaviour where purchasing behaviour was not.

4.5.3 Employee Surveys

A total of seven employee surveys were completed. While this number does not allow for in-depth statistical analysis, employee responses are still very valuable and contribute to the conversation surrounding the food waste phenomenon.

Table 24: Descriptive Statistics for Employee Survey

	N	Minimum	Maximum	Mean	Std. Deviation
We separate plastic wrapped food from the bag and put it into a container for collection by the food bank, county, town or city	7	1	5	2.29	1.704
We do not separate the food from the plastic and we put in in the garbage (to go to the landfill)	7	1	5	3.00	1.732
If canned food expires we put the can in the garbage	6	3	5	4.50	.837
If canned food expires, we open the can and put it into a container for collection by the food bank, county, town or city	7	1	5	1.86	1.574
If cardboard packaged food expires we put the box in the garbage	7	1	5	4.14	1.464
If cardboard packaged food expires, we open the box and put it into a container for collection by the food bank, county, town or city	7	1	5	1.71	1.496
If frozen food expires we put the package in the garbage	7	1	5	4.00	1.528
If frozen food expires, we open the package and put it into a container for collection by the food bank, county, town or city	7	1	5	2.43	1.902
How much per week do you spend on groceries?	6	40	200	112.50	66.163

Employees were asked how often expired (or unsalable) frozen food was put in the garbage without separating the food from its packaging. Although there were very few respondents, over half stated that the frozen food and packaging is always thrown in the garbage (Figure 38). They were asked about their waste packaging separation for green bin collection. Again, over half the respondents answered in agreement, that they never separate plastic wrapping from food waste and place it for green bin collection (Figure 39).

If frozen food expires we put the package in the garbage

■ Never   ■ Sometimes   ■ Very Often   ■ Always
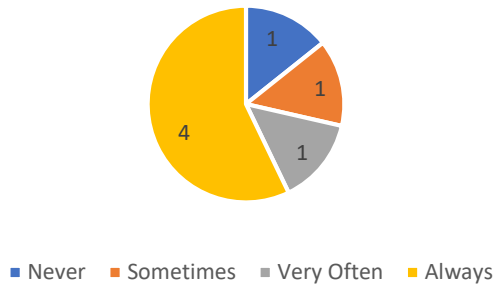
Figure 39: Frozen Food and Packaging Disposal

We separate plastic wrapped food from the bag and put it into a container for collection

■ Never   ■ Sometimes   ■ Very Often   ■ Always
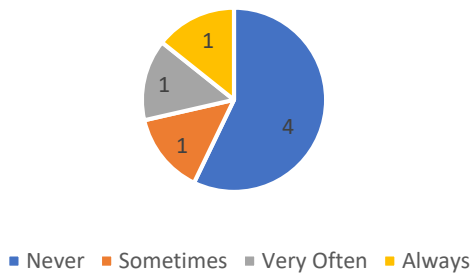
Figure 40: Frequency of Plastic Wrap Separation

Employees were asked whether they agreed the received a sufficient amount of training with regards to a variety of workplace factors. With regards to waste management, four employees disagreed (57.1 %), one was undecided, and two agreed that they had received sufficient waste management training.

Survey participants were also asked to rank the most common causes of food waste within the store. Damaged packaging was ranked as the most common cause, best-before labelling was the second most common, with stock management practices coming in

ranked least common of the five options given. One participant provided an additional comment stating "We received produce from a warehouse and sometimes it comes in already expired or close to the expiring date or comes in and is unfit for sale i.e. rotten or mouldy. Or when our order is assembled it isn't properly packed correctly and some items are squished or falling off." – Respondent #7834794

Participants of the employee survey were also asked how their store deals with unsalable food. They were given the options of green bin collection, redistribution for animal use, redistribution for human consumption, third party collection, and garbage disposal, with the option to write in their own response. Below are the responses from the seven respondents.

- Third party collection

- Garbage disposal

- Garbage disposal

- Green bin some organic waste, packaged stuff to the garbage.

- Green bin collection

- Garbage disposal

- Some of our produce scraps anything we are throwing out we give to pig farms or is tak(en) away by a contracted person to the dump

Six of the seven participants responded when asked what efforts their store was taking to reduce food waste. Two said that no efforts were being made, and two others said they do not know what efforts are being made. One of the respondents stated that their company

tries to sell everything and will reduce prices as products come close to "expiring". The response from the sixth respondent is quoted below.

> "Any effort to reduce waste is purely for-profit driven reasons, my company has no problem throwing things out, or wasting other resources as long as it's not towards labour." – respondent #7648530

Respondents were asked to identify what internal or external barriers were present, preventing the donation of unsalable food. One of the respondents opted out of this question, stating that they were not aware of what the policies were. The other six identified liability concerns, refrigeration on-site and regulatory constraints as three barriers preventing food donation. Additionally, one employee noted that labour is tight and that prepping food for donation would take time. Another respondent stated that anything past its "expiration" date must be thrown in the garbage. A final note on this topic was that they felt donation took too much effort with regards to regulations and quality assurance.

A similar question was asked with regards to barriers preventing the recycling of food waste. They were asked to select all the barriers that they believe apply. Five respondents identified food safety concerns regarding collection and storage as a barrier. Four respondents cited liability concerns, two selected insufficient recycling options, with one noting that transportation costs were a barrier to the recycling of food waste. Two of the respondents also commented that the availability of time limits the ability of employees to put in the effort required to allow for recycling. One respondent said that their location will sometimes give local farmers expired food but are not allowed to give it out to the average person if they were to ask.

The employees were offered the opportunity to add additional comments to researchers at the end of the survey. Two of the respondents left comments, these are shown below.

"Between potential liability issues and the logistics of giving close code food to the food bank makes it seem an impossible task given the state of things in grocery stores. Labour is tight and stores don't make money having employees process food they aren't going to sell."

- Respondent 7648530

"I (w)as an employee would love to be able to sell expired produce a lot of our packaged salads, spinach, when it reaches expiration is still very much food to eat I think items should not have an expiring or best before date it should be up to the consumer or employee to check said item for anything that would cause it to be no good to eat. I just worked December 27 and the amount of food we threw away after being closed for two days was crazy! I wish there was more I could do to salvage it or use it for something it seems like such a waste and we all say the same thing in every department except for meat as it's only fresh for so long."

- Respondent 7834794

Questions asked to consumers when evaluating the behaviour constructs for the household waste behaviour and environmental concern was also asked to employees. Although the low number of respondents prevent the results from being statistically valid, the reliability of the constructs was still tested as a means of comparing the results with those of the consumer group.

Below the statistical results for the household waste beliefs (HB) and environmental concerns (EC) construct for the grocery store employees are shown. The household waste beliefs has a mean of 2.53 and a standard deviation of 0.42, and the environmental concern construct has a mean value of 3.60 and a standard deviation of 0.58 (Table 25). The Cronbach's alpha for household waste belief is 0.772 and environmental concern is 0.847, showing that the constructs are strong (Table 26). The Pearson correlation for the two constructs shows that there is almost no correlation between the variables meaning there is no relationship between the two variables (Table 27).

Table 25: Descriptive Statistics for Employee household waste behaviour & environmental concern

	Mean	Std. Deviation	N
HOUSEHOLD WASTE	2.5397	.42397	7
ENVIRONMENTAL CONCERN	3.6032	.58393	7

Table 26: Cronbach's Alpha Results for Employee Constructs

	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
Household waste behaviour	.735	.772	18
Environmental concern	.820	.847	9

Table 27: Pearson Correlations of Employee Experimental Constructs

		HB	EC
Household waste behaviour	Pearson Correlation	1	.024
	Sig. (2-tailed)		.959
	N	7	7
Environmental concern	Pearson Correlation	.024	1
	Sig. (2-tailed)	.959	
	N	7	7

Given the small sample size, a regression analysis was not completed, but the correlation table shown in Table 27 shows that there is no significant correlation between the two constructs for the employee group of respondents.

Chapter Summary

In this chapter, the results of the five methods of analysis have been reported. This began with the seven case studies completed in the jurisdictional review. An initial profile of both Canada and the United States were completed with more specific focus being placed on provinces and states that have interventions and initiatives in place for food waste reduction and/or management. Both Canada and the United States have national organizations that advocate for waste reduction and innovated management strategies. Both countries lack national regulations and instead allow for states/provinces to legislate independently.

Within Canada, Nova Scotia and Prince Edward Island are the only provinces with province-wide organic waste bans in place. Ontario has undergone a preliminary food waste policy framework. This framework suggests that the province will have an organics ban in place for the whole province in 2020. Vancouver in British Columbia has put a city-wide organic ban in place and has also provided resources for businesses for adapting to the change in policy. The four states profiled from the United States also have differing approaches to dealing with their food waste management and reduction. The most active, Massachusetts, has placed a state-wide organic ban on industrial, commercial, and institutional waste generators.

The results of the thematic content analysis and social media discourse analysis are also reported in this section. There were two social media awareness campaigns that were conducted during the Twitter data collection period. An overview of these two campaigns is also reported in this section. The thematic content analysis of the publications showed that Food Waste, Supply Chain, Recovery, Disposal, and Food Packaging were the top five most frequent themes present in the selected text. The results of the social media thematic discourse analysis showed similar themes ranking in the top frequent themes with Food Waste, Supply Chain, Europe, Developing World, and Packaging ranking in the top five and Recovery coming in at sixth most frequent.

The results of the industry stakeholder interviews are reported in this section along with the results of the consumer and employee survey. Within the consumer survey analysis, the experimental constructs and results of the regression model are also reported. The resulting regression model had an r-squared value of 0.562. This suggested that the model can predict 56.2% of the variability in the data. Socio-economic factors that are often considered to be essential for modelling human behaviour were removed from the model. Education level and income were shown not to be significant predictors of waste separating behaviour.

The results of the interviews and employee surveys show a mismatch in what stakeholders in waste management and industry believe is occurring in retail stores and what employees report is actually occurring. Recycling and waste management has long been a focus of stakeholders within Nova Scotia yet there is limited mention of waste reduction methods.

CHAPTER 5: DISCUSSION

Having shown the results of the various methods of analysis in the previous chapter, the implications of these results will now be discussed. Each of the results of the five methods of analysis will be discussed, being followed by how the results related to the four objectives set out at the start of this research.

5.1 Jurisdictional Review

The jurisdiction review showed that while the food waste issue is being investigated in several regions throughout the developed world, no one initiative has been adopted throughout. Several regions have taken a voluntary approach when engaging with waste generators, while others focus on specific waste generators as seen in many states within New England who have placed restrictions on industrial, commercial, and institutional organizations (ICIs).

France has also targeted their interventions to ICIs, yet rather than requiring recovery over disposal, they have instead required re-use. This shows a commitment to the higher levels of the waste hierarchy not seen in other regions.

Retailers in any industry are more receptive and cooperative to a 'light-touch' regulatory approach to interventions that may impact the way they do business. The same can be said for those within the food supply chain and the issue of food waste. 'Light-touch' places more of the responsibility on the private market rather than on the regulatory body (Blevins, 2019). The benefits of this are that the industry is in control of the actions taken and said actions are more informed by industry knowledge. This can alleviate the cost to government and, if done correctly, the industry would police from within.

When managing relations between government and businesses, it is often ideal to take a 'light-touch' approach. This requires businesses to be aware of societal and political situations and adapt to impending issues before it becomes an issue that requires regulatory intervention. An example of these sorts of responses is already occurring within the retail food industry. Organizations such as WRAP and NZWC, along with consumers have signalled to retailers that change is coming to the way they do business. By committing to change voluntarily before the change is demanded, the retailers have more control over the changes asked of them.

While opting to allow the retail industry to 'self-regulate' when dealing with food waste allows the governments to take a back seat and allow the public and retailers to shape to change, initiatives are bound to be disjointed. As the results and literature to this point show, the objectives of the various stakeholders are not necessarily in line with each other or with the reality of the status of the phenomenon.

Several retail chains have committed to shifting to a zero-waste model or setting food waste goals in their corporate social responsibility reports. Some organizations have also partnered with NGOs like National Zero Waste Council (NZWC) and with provincial recycling boards. These organizations can benefit from the social goodwill while also signalling to regulators that they are willing to take the initiative to address the issue without requiring the government to regulate. This in itself can be considered a social benefit as regulations and policies are a costly endeavour to not only form but also to police.

Within Canada, NGO's such as the NZWC have noted the need for a nationally coordinated effort to combat food waste. Given the separations of federal and provincial powers waste management falls within the provincial jurisdiction. Many provinces

increase the separation even further into municipalities and county. Given the vast regions across Canada, the capacity of regions is often very different, and the infrastructure can be limited.

Ontario has taken an approach that engages retailers in the creation of solutions. Similar partnerships have been seen within Nova Scotia as well. This once again highlights the power retailers have within the food supply chain. Their participation and engagement in food waste reduction are seemingly essential to enact effective and noteworthy change.

5.2 Thematic Content Analysis of Food Waste Publications

It was surprising that re-use was not a more frequent code, given that, when reviewing the literature, there was a substantial focus placed on food donation and redistribution. Some of this research suggested that redistribution would be a solution to food insecurity as well as food waste (Alexander & Smaje, 2008; Cicatiello et al., 2016). Prevention, however, was often dismissed as unachievable given that it relies heavily on behavioural change, with prevention initiatives being recommended as secondary activities to larger recovery or re-use goals (Dou et al., 2016; Graham-Rowe, Jessop, & Sparks, 2014).

The varied definitions of 'food loss' and 'food waste' poses an issue for further research into this phenomenon. If solutions and strategies are to be developed and shared throughout the globe, it is essential for consensus to be made among researchers and the public alike. Efforts are being made across the globe to highlight the issue and determine solutions.

The food waste hierarchy sets out the four steps of food waste: prevention, re-use, recovery, and disposal. With each step down the hierarchy being less desirable than the last, the research focused more heavily on the recovery stage, as shown in the content analysis. This is the second to least desirable option. Researchers noted that prevention was difficult given that it requires behavioural change, and re-use is being promoted at the retail level with the encouragement of food donation, with all other recommendations being made to collect and recover food waste for compost or anaerobic digestion.

Several researchers noted that supermarkets and retailers hold significant power within the food supply chain in enacting change, although retail food waste has not been heavily featured in the research. Given that the aim of the retailer is to maximize profits, reduction of food waste would be inherently for their benefit. The economic benefit is essential to motivate change, which is why several regions have been encouraging food donation in return for a tax incentive, this in partnership with the retailers now being able to transfer the responsibility of the food products' disposal, make food donation a viable solution for edible retail food waste.

5.3 Social Media Discourse Analysis

Social media is a huge resource for activism and marketing, but also for researchers. While the success of a movement or campaign cannot be wholly measured by the social media conversation, the conversation can be analysed. The impact of the public discussion can be seen through many examples, including within our food system.

The use of hashtags by large organizations as a means of building awareness is an important factor in said conversation. Social media can clearly have an impact on our food systems, as we know that public perception is often a significant driver in public policy.

By utilising social media as a resource not only in building awareness around these issues but also in this research, a huge participation pool with limited barriers of access was available.

The results of the social media content analysis showed that retweets were significantly more common than original tweets and replies (Figure 40). This is considered to be a more passive form of engagement. While the users are still engaged in the conversation surrounding the hashtag, they are not adding anything other than spreading the sentiment or information provided in the original tweet.

Type

77.8%

1.4%

20.8%

Retweet
Tweet
Reply

Food Waste Tweets
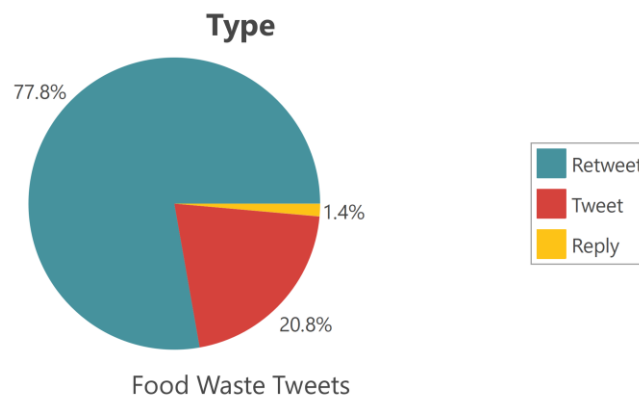
Figure 41: Type of Tweet collect in November 2018

The disproportion in the types of tweets is not necessarily negative. In the case of the awareness campaigns, the spreading of their information or even their external links might be their prime objective. In this instance, users are helping to complete this task. As stated in the literature review, the ease of retweeting can sometimes be a more passive interaction when compared to a reply. Twitter does offer the function of retweeting with comment. This allows users to not only share the original author's tweet but also add their own comment. In this instance, a retweet can be an active contribution to the conversation

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being had. The MaxQDA software does not currently allow for the distinction between retweet with or without comment to be made.

When comparing the results of the thematic content analysis of the academic and grey literature to the same themes within the social media analysis, there are some similarities within the top two themes. There was a notable difference however when we look to the third and fourth most frequent themes within the social media analysis. The themes and their respective rank are shown in Table 28.

'Europe' and 'Developing World' were ranked markedly higher within the collected tweets than they were in the literature. The keywords used in the theme for Europe were the most commonly mentioned European countries in the literature. A potential cause of the increase in European instances may be due to the search terms linked with the Love Food Hate Waste campaign which is a UK based organization.

Table 28: Rank of Content Analysis Themes in Tweets and Literature

	% in Tweets	% in Literature	Rank in Literature
Food Waste	24.88	28.67	1st
Supply Chain	21.71	12.89	2nd
Europe	16.98	5.70	7th
Developing World	8.23	1.75	12th
Packaging	6.80	6.68	5th
Recovery	4.67	12.73	3rd
Canada	4.31	1.55	13th
Policy	3.87	6.39	6th
Commercial Food Waste	3.50	4.93	8th
North America	1.62	3.94	9th

It is possible that the increase in mentions of the developing world may relate back to the misuse of the term's food loss and food waste. As noted throughout the research, food loss is most common in the developing world, due to losses during production or poor harvesting and storage techniques. As was seen in the grey literature, non-academic authors are more likely to use the terms interchangeably. Both within the grey literature and on Twitter, this might also have been done purposefully as the general population would not necessarily be educated on the difference. Food waste is a more easily understandable term.

5.4 Social Media Awareness Campaign

Zero hunger was the second most frequent of the seven hashtags and was pointedly higher than any of the other hashtags related to social awareness campaigns. This is likely a result, not only of the much larger number of followers that the FAO twitter account has compared to the other group but also because the FAO is focused on a global reach, where the other organization is based in the UK with some reach into North America.

The FAO's zero hunger campaign did not just focus on reducing food waste or food scarcity. Their tweets often included other issues related to the food system. They included information on social issues and environmental issues within the food system as well. This is different than LFHW's approach where they focus quite closely on the objective of reducing food waste.

Given that the two organizations are very different in not only scope but also reach, it would not have benefited LFHW to expand their topic range as FAO did.

Example tweets from the FAO twitter account are shown below. The tweet shown in Figure 41 combines the hashtags #foodwaste and #zerohunger. It was accompanied by a short video containing a variety of photos of misshapen carrots. It brings attention to the pressure placed on food producers and processors by consumers for picture perfect products. This desire for the ideal carrot will lead to food waste as a result of consumer purchasing behaviour and demand. There has been an expectation placed on products to be valued based on their appearance rather than whether or not they are edible.
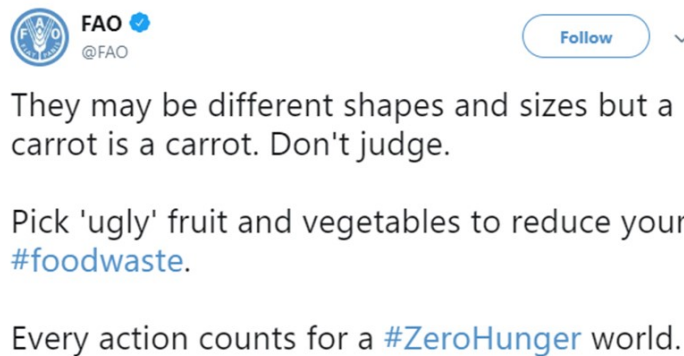
Figure 42: @FAO's highest engagement tweet

It can be difficult to gauge the actual reach of these two social media campaigns, but there is a limiting cost to having them in place aside from time. The use of social media by organizations is quickly becoming a necessity as it offers such an ease of access to the public. But it requires skill and understanding on the platform to see effective implementation and a return with the public.

5.5 Interviews and surveys

5.5.1 Interviews

The interviews with stakeholders strengthened the initial findings of the two content analyses, showing that there is an expressed concern about food waste as a whole, but the focus is largely placed on the lower levels of the waste hierarchy.

Retailers are actively donating unsalable food when they are able and have in store initiatives in place, but waste haulers and composting facilities are not seeing this translate into a reduction in the amount of food waste they are collecting from these retailers.

The provincial recycling board showed interest in researching a similar system which Ontario had proposed by having a consolidation site for all waste to be gathered and sorted from there. However, instead of having a consolidation site, they felt that FeedNS would be their preferred organization. Similar to the proposed Ontario framework mentioned previously, FeedNS would take the place of the consolidation site and would sort the unsaleable food from the commercial and institutional waste generators and either redistribute the food for human consumption or depackage it for recovery. It was their intention that the output from the depackager would be used for compost.

While the literature and other interviews have shown that this would not be the ideal use of the depackaged output, FeedNS would now become the middleman between the waste generators and the waste haulers. FeedNS is currently the client of the private waste hauler that was interviewed. FeedNS would still be required to hire the waste haulers to transport the food waste. Some of the literature suggested that similar systems were often

passing the cost of waste disposal from the commercial waste generator to the non-profit charity group (Mourad, 2016).

It was suggested by the research team that there may be a potential for FeedNS to adopt a similar setup to that being used by Kroger. The technology of smaller on-site anaerobic digestors has shown it to be a potential opportunity for a more circular approach to food waste. Systems have been designed specifically for industrial, commercial, and institutional use. One example of this is QUBE Renewable's 'bioQUBE'. The system is built in a repurposed 20 ft shipping container and can process 500-950 metric tonnes of organic waste per year (QUBE Renewables, 2017). The representatives from the province felt that anaerobic digestion was not well suited to Nova Scotia and would not work.

5.5.2 Surveys

The strength shown within the constructs signifies that the constructs are valid measures of a consumer's purchasing behaviour, waste separating practices, household waste behaviour, and environmental concerns.

The purchasing behaviour of survey participants asked how frequently the participant purchased a particular form of a food product (i.e. fresh fruits and vegetables, canned food products, etc.). These questions allowed for analysis to be conducted relating to the types of products that are most frequently purchased. It also shows how commonly packaged food products are purchased. This is important when considering the need for food waste to be depackaged or source separated in the home.

A notable result from the consumer survey was that socio-economic variables that are typically an indicator in human behaviour research were no shown to be an important

factor in this model (Table 29). In this model, age was the only significant socio-economic variable. Income and education level are commonly linked to positive human behaviour.

Table 29: Socioeconomic Variables of Regression Model

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
	INCOME	-1.105E-6	.000	-.055	-.926	.356
	EDUCATION	.017	.023	.043	.748	.456
	AGE	.019	.005	.258	4.144	.000

The provincial grouping shows that central Canada (ON & QC), the prairies (MB, SK, & AB) and the rest of Atlantic Canada (NL & NB) are all negatively correlated with waste separating behaviour, but the Nova Scotia and Prince Edward Island grouping was positively correlated and very significant with a p-value of 0.

Nova Scotia and Prince Edward Island are the only provinces in the country that have a province-wide organics waste ban in place. Although other provinces have some municipalities with bans in place. The significance shown for the provinces suggests that where the survey participant lives accounts for a large portion of the variance in waste separating behaviour.

Of our four constructs, purchasing behaviour was removed from the model as it did not support the model. While environmental concern and household waste belief were not considered significant in the regression, they were kept in the model as the existing knowledge of the topic supported the inclusion of these variables when evaluating the waste separating behaviour of a consumer.

The model had an r-squared value of 56.2%. This result is considered to be valuable in social science and human behaviour research. When dealing with human behaviour, it is near impossible to reduce all the associated 'noise' and produce a model that can reliably predict the dependent variable (Brace, Snelgar, & Kemp, 2012).

The mean scores of the employees for environmental concern and household waste behaviour were very close to the means scores for the non-grocery retail employee participants. This suggests that working within the food supply chain and familiarity with different food products, does not impact the behaviours and perceptions or set them apart from the rest of the population. Unfortunately, a conclusion on this cannot be made given to the limited number of grocery store employee surveys.

5.6 Objectives

As mentioned in Chapter 1, there are four objectives of this research. The findings related to each of these objectives and how the research has contributed to the understanding of each aspect will be discussed in this section.

5.6.1 Practices and motivations of stakeholders in the food supply chain

The analysis has shown that the motivations of the various stakeholders involved are varied on the issue of food waste. Those within the waste management industry are focused on the diversion from landfill and recovery of organic waste. Stakeholders in this field do not have significant power at any of the higher levels of the waste hierarchy given their position and expertise place them at the end stages of the hierarchy.

Stakeholders need to shift their focus to include all levels of the food waste hierarchy. The review of the academic literature and discussions with industry stakeholders

shows that there is a preference on the end levels of the waste hierarchy when researching new technologies and intervention strategies. While these practices are essential for the avoidance of terminal waste, an emphasis must be placed on the higher levels of the food waste hierarchy to see a noteworthy reduction in food waste generation across the globe.

As noted in the literature, retailers hold a significant amount of power within the food supply chain. They are well positioned to promote change from both ends. Retailers are dividing their focus across multiple levels of the hierarchy with varying levels of intervention efforts.

Many retailers are offering consumers incentives, such as discounts for products nearing their best-before date, and encouraging them to purchase 'imperfect' produce and baked goods. There is a concern that these bargains may just be passing the food waste further down the supply chain, as consumers are potentially being encouraged to purchase food they do not need because it is a bargain.

The results of the employee survey and stakeholder interviews show there is a mismatch between what the retailers are publicizing and what employees are reporting. While only a limited number of employees were surveyed, the results showed that food waste reduction strategies are not being effectively implemented in stores. This along with the fact that corporate representatives from two of Canada's largest grocery chains were unwilling to participate in the research suggests that a closer look is needed to fully understand what practices are actually being done in-store compared to what the companies are claiming.

Grocery chains like Kroger and Sainsburys are taking the circular approach with their food waste, by keeping the unsalable food and food waste within their organization. By 'back-hauling' their food products they avoid adding transportation costs and mileage to the environmental cost of the food. They are also able to recover the food waste at the third most desirable level of the hierarchy by using it for on-site energy generation at their distributors. This model shows that there is a potential for other retailers to adopt a similar approach, with depackaging and on-site vessels for energy generation becoming more efficient and accessible as the renewable energy and recycling industry grows.

Within the thematic content analysis and stakeholder interviews, it was concluded that government and non-government organizations focus more on the waste management side of the food waste hierarchy (recovery and disposal) rather than the waste mitigation side (prevention and re-use). Although there is evidence that there is a growing interest in redistributing unsaleable food for human consumption. This would be a positive shift in focus, provided they do not consider re-use as a means of solving two problems at once, food waste and food insecurity. Food insecurity, while often discussed alongside food waste, is a separate problem entirely, and the two should not be viewed in tandem. If we were to rely on the recovery of food waste as a means of solving food insecurity, we would never see an end to food waste.

5.6.2 Policies and Legislations

There does not seem to be a definitive policy mechanism in common throughout the regions reviewed within this research. From the review, organics waste bans appear to be the first essential step that a region needs to take when combatting food waste. The banning of organic material from garbage disposal forces individuals and ICIs to re-

evaluate their waste behaviour and adapt said behaviour to fit the new policies. There are differences in the methods that regions take in regards to the banning of organics. Where Nova Scotia imposed an all-out ban for all waste generators, Massachusetts opted to ban ICI organic waste disposal. The benefits of an organics bans have been seen over the past two decades in Nova Scotia. There has been an overall waste reduction, with the province generating almost half the waste per capita of the rest of the country. The amount of greenhouse gas emissions from landfills has reduced over 230,000 tonnes in CO_2-eq. Methane has a much larger global warming potential than carbon, so the removal of organic material from landfills reduces the methane emission substantially.

Government agencies and policymakers should provide support for retailers and manufactures in infrastructure and knowledge resources (as seen with CET, DivertNS, and Metro Vancouver). CET and DivertNS are well situated between government and private companies to influence policy while also offering resources and support to commercial stakeholders. It appeared that CET had a higher level of engagement with ICI waste generators in Massachusetts, while DivertNS is well connected within the waste management and recycling industry in Nova Scotia. They serve as a hub of resources and knowledge for all involved and can serve an essential purpose to connect networks and allow for knowledge transfer among and within the industries.

The jurisdictional review and thematic content analysis showed that the role of policymakers is to incentivize and motivate commercial food waste generators to reduce their waste amounts. A combination of a mandatory policy, such as an organics ban, and supports that offer resources and infrastructures to adjust to the ban and reduce their food waste generation will be needed.

5.6.3 Behaviours and perceptions of consumers and retail employees

The behaviours and perceptions of consumers and retail employees show that there is an expressed interest in the issue of food waste. Consumers show a desire to combat food waste. Figure 46 shows the frequency of each of the five responses consumers were given when identifying their waste separating behaviour. The figure is using the responses after the statements requiring reverse scoring were adjusted. 'Never' shows the least desirable behaviour with 'Always' showing the most desirable behaviour.
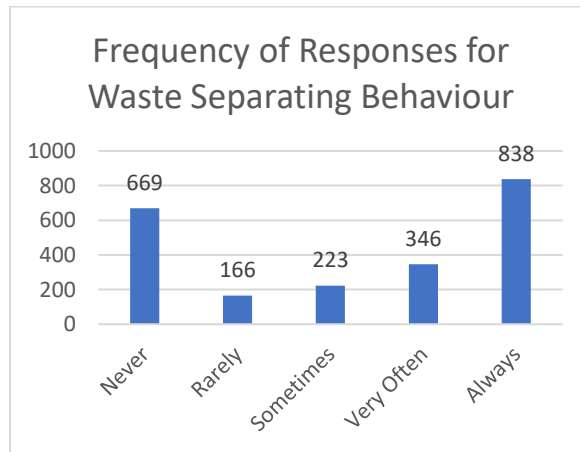

Figure 43: Frequency of Responses for Consumer Waste Separating Behaviour

Consumers responded 'Always' 7% more frequently than 'Never', the difference between the two suggests that while there are many who are actively separating the food waste from its packaging, there are nearly just as many who are not.

This finding relates to the results shown in the Mann-Whitney U tests, that show that Nova Scotians are significantly more actively separating their food waste from its packaging material and diverting it from landfill disposal. This is supported by the literature showing that Nova Scotia is producing nearly half the waste per capita than the rest of Canada.

Consumers show an interest in the issue of food waste, but there are clear gaps in their knowledge and understanding of the issue as a whole. This presents a barrier. Given that consumers are the largest contributor to food waste generation, they have the largest potential for change. As discussed, the highest level of the hierarchy, prevention, relies heavily on behavioural change, yet if consumers are not aware of the facts related to the food waste phenomenon, the changes they are encouraged to make are not likely to be ideal or complete.

The results of the social media analysis showed that there is a large discussion occurring with regards to food waste within the public discourse. But, as was seen in the analysis of publications, the focus is skewed towards the lower level of the hierarchy.

The responses from the employee surveys received do not reflect the sentiments that the corporate publications have publicized. Employees stated that the motivations of the company are just to make money, and they are not concerned about their food waste generation. Employees also stated that it is against the company's policies, in some cases, to donate unsaleable food. Damage packaging and best-before labelling were the most common causes of food waste in the grocery store according to the survey respondent.

Damaged packaging could be considered to be an unavoidable loss for the retailer, but that product could still be re-used as animal feed (depending on the restrictions of the region) or recovered for composting or energy generation. Given the responses for packaging separation and disposal, it seems that the package and the organic matter are more likely to end up in the garbage, thus increasing the amount of terminal waste generated by the retail store.

Waste resulting from the best-before date labelling highlights the need for better labelling practices as well as presents an opportunity to educate retail employee, and more importantly, consumers on what the best-before date signifies. One of the respondents noted that they are often throwing away food that is still fit for human consumption, but because of the date on the label, they are unable to sell or donate the product.

5.6.4 Barriers to retail food donation

The responses from the employee surveys should that there is a perception among retail employees that restricts the donation of unsalable food to food banks and charities due to liability concerns. Every province, with the exception of Quebec and Nova Scotia, have a Food Donation Care Act that removes any liability from the donor for the food that they donate. These acts extend those protections to corporate donors as well. This shows a knowledge gap is present. Potentially, policymakers and outreach organizations have not made this information clear to commercial food waste generators, causing them to believe that they may be held responsible if some harm were to be caused by the food they donate. These beliefs may also be due to the spread of misinformation within the organizations themselves. Upper-level management may be aware of the Act, but that information has not been or has been inaccurately disseminated to the staff at the lower levels of the organization. The concern regarding the liability of donors is a barrier to re-use of unsalable food for human consumption, even if in some circumstances it is only a perceived barrier.

Additional barriers identified are a lack of storage both in-store and at the donation centre. Donation centres do not always have access to the equipment required to safely store the food products prior to their redistribution, particularly refrigeration.

Responses from the employees also suggest that there is not enough labour or time to allow for food the be diverted from disposal in stores. It is easier and less time consuming for the employees to simply disposed of the unsaleable food products, rather than sort, storage and arrange to pick up the food for donation.

The availability of transportation of the food products to the donation centre is also a barrier. Some organizations will offer to pick up to retailers for their donations, but the time of pick up may not be convenient for retailers and may add costs to them if they have to store it for any period of time.

Chapter Summary

This chapter discussed the results of the five methods of analysis and the objectives of the research. The jurisdictional review showed the different regions profiled were all looking at food waste interventions differently. The varied approaches show that there is an active interest in managing terminal food waste. It is difficult to determine which of the interventions is superior at this stage, but the methods could be evaluated in the future.

The results of the thematic content analysis and the social media analysis suggested that there is an increased focus on waste management compared to food waste reduction. In other words, there is more activity, intervention, and investigation within the lower levels of the hierarchy (composting and energy generation). There are also discrepancies with the use of 'food waste' and 'food loss' within both the collected tweets and the selected publications. In some cases, such as the tweets and new articles, 'food waste' may have been purposely chosen to describe the larger phenomenon of 'food loss and waste' as it is easier for the layperson to understand.

The results of the interviews supported the results of the content analyses that waste management has more concentration. The interviews suggested that there is more interest in throwing the food away better (improved composting and digestion), than preventing throwing it away at all. The employee survey results showed that employees are uncomfortable with the amounts of food still being thrown away. Retailers do have some methods of food waste reduction in place, but a lack of available employees and resources act as a limit to what they can reasonably do.

The first objective was to determine the practices and motivations of stakeholders throughout the food supply chain in regards to food waste prevention and reduction and waste management practices. The thematic content analysis and stakeholder interviews were the largest contributors to this objective. The results suggest that there is a larger focus on waste management rather than waste reduction among the stakeholders, although there are retailers taking initiative in the waste reduction within their own organization. The is more interest in shifting towards a circular economy with early adopters taking steps towards achieving this goal.

The second objective was to examine the legislation and policies being implemented. This was completed through a jurisdictional review focusing on states and provinces that are actively engaged in food waste initiatives. There is no common mechanism in place throughout the cases. Organics wastes bans are a common step being taken among the jurisdictions review, although they range in intensity, with some being province-wide, or by the municipality. Other regions have only imposed an organics ban on commercial waste generators and not household generators. The varied approach to

legislation will allow for the evaluation of the effectiveness of the different approaches in the future.

To accomplish the third objective set through this research, the behaviours and perceptions of consumers and retail employees were identified. This objective was achieved through the analysis of the social media discourse and the survey results. The social media analysis showed that there is a similar misuse of the term 'food waste' throughout the tweets collected. Europe and the developing world were themes that were more frequently discussed than in the content analysis of the publications. Given this, food waste may have been used purposefully as it could be considered to be a more understandable term for the general public, compare to 'food loss'. The consumer survey results show that typical socioeconomic indicator, education level and household income, were not significant in the model for waste separation practices. Province of residence was significant, and this is likely due to two of the provinces (NS & PEI) having province-wide organic waste bans in place. The resulting model had an r-squared of 56.2%, being the model was relatively strong at predicting human behaviour, in this case, how likely the participant is to separate their waste properly. Due to a lack of retail employee responses, statistical analysis was not able to be completed, but the qualitative analysis showed that there is a mismatch between what corporate leaders are stating through publicly available reports and what employees say is happening within the stores.

The final objective was achieved through the interviews conducted with stakeholders, employee surveys and the jurisdictional review. These methods allowed for the barriers surrounding food donation to be identified. There is a belief among retailers and retail employees that they are prevented to donate unsaleable food by liability

restrictions. Larger retailers will put contracts in place to allow for food donation to occur, but stores are still limited by the availability of appropriate refrigeration and storage while they wait for the food to be moved to the donation centre. The employee surveys showed that within the stores there are some employees stating that food past expiration date must be thrown out. This is the case if the food is actually labelled with an expiration date, but most products have best-before or sell-by dates which do not have the same regulations as expirations dates. The results show that while barriers to food donations are present, some are either self-imposed by the retailer or a result of a misunderstanding of the regulations surrounding donation.

CHAPTER 6: CONCLUSIONS

A variety of methods and initiatives have been taken globally in an effort to combat food waste, yet there are still discrepancies in fundamental understandings of the phenomenon. Confusion surrounding the meaning of the terms and inconsistence use throughout the variety of means of communication can lead to more confusion and misinformation. Additional disagreements over the ranking of certain interventions and means of recovery present an issue. While stakeholders may all have different motivations and goals when it comes to combatting food waste, the agreement is necessary on these foundational aspects to ensure that all step being taken are in the same positive direction.

Within the social media content and the grey literature, the term food waste may have been used as it could be seen as more accessible for the average reader. Unfortunately, this practice can skew the conversation. As noted, there is a substantial difference in the causes and prevention strategies of food loss when compared to food waste. Using food waste interchangeably in some text, but very specifically in others (mainly academic and government publications) can create confusion, which muddles the conversation and objectives of those involved.

The content analyses showed that there is a disproportionate focus on the two lower levels of the food waste hierarchy. This is in-line with what was shown throughout the interviews and the employee surveys. The literature suggests that this is often due to the higher levels of the hierarchy, prevention and re-use, being more costly and time-consuming. Focusing on every level of the waste hierarchy will allow for a more holistic approach to be taken in identifying opportunities for terminal waste mitigation.

In line with this focus on the recovery stages of the waste hierarchy, it is important to also ensure that stakeholders within the waste management sector are knowledgeable about new technological innovations. The recycling industry is growing at a very fast rate and new and advanced means of waste management are becoming available at a rate never seen before. It is important that these innovations are considered as a means of more efficiently and effectively handling food waste that reaches the recovery stage of the hierarchy. An unwillingness to investigate alternatives could be detrimental to the successful recovery of food waste.

A shift in the interpretation of the waste hierarchy may aid in having all stakeholders take a more holistic approach to the food waste mitigation efforts. Rather than viewing each level as a single step, they must stand on, the waste hierarchy should be viewed as a tower or pyramid, with prevention providing the foundation for the other levels (Figure 46). The reworking of the hierarchy would hopefully better show the importance of prevention. Each of the other levels of the hierarchy can be eliminated if we were able to achieve successful prevention of food waste.

Through shifting the focus of an individual or organization to first look at 'Prevention' and view the pyramid holistically before jumping to the level they may feel would be the easiest to have some impact the amount of terminal food was should decrease. While capturing the food waste at the last step prior to landfill disposal has been effective, the results of the survey suggest that the public is capable of behavioural change. Residents of Nova Scotia, where source-separated waste management has been in place for over two decades, showed that they are more likely to separate their food from packaging before disposing of it. If the public is able to change their behaviour at a waste management stage

of the pyramid, they may also be able to change it during the waste reduction stages as well.
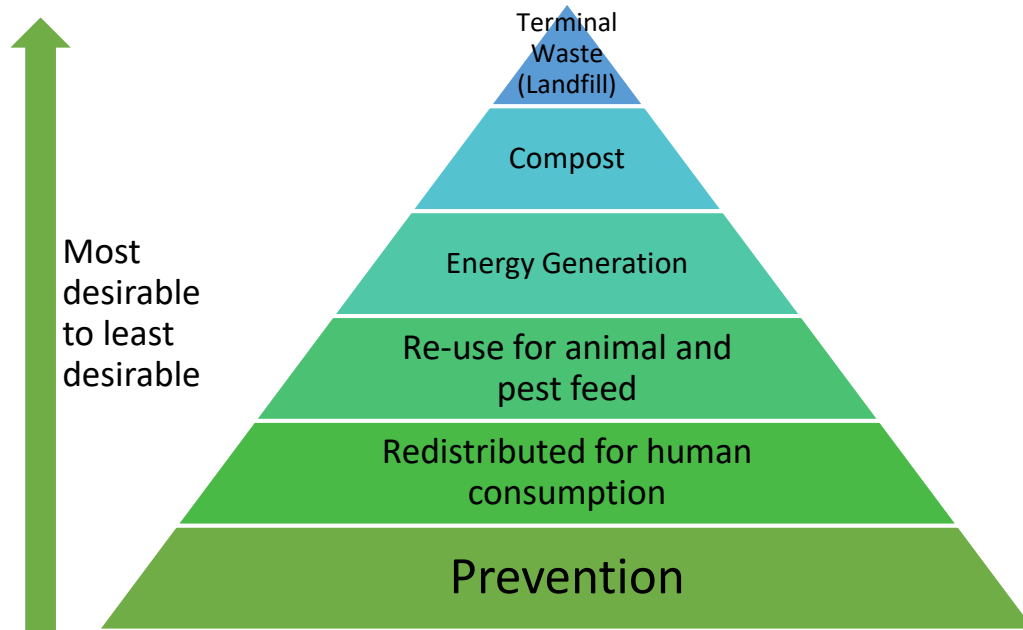

Figure 44: Revised Food Waste Hierarchy with Prevention as Foundation

There was a focus within the twitter data on the UN sustainability goals that were not seen in any of the other sources of data analyzed. While there was some mention within introductory sections of academic research, the goals were largely used to set the stage for the rest of the research that was being conducted. This can be considered an indicator that the reach of the UN and the FAO has little uptake within the early stages of the food supply chain and are better known by end users (consumers).

We can see that there are some efforts being made to slowing shift from our current linear economy to a more circular one, with companies like Kroger and Sainsbury taking the initiative to build a closed loop system within their operations. Ontario has also shown that they are investing in a potential food waste collection cooperative with the objective

of better source separation and recapturing of reusable resources. Provided organizations like DivertNS, NZWC, LFHW, CET, and WRAP continue in their efforts to engage and educate individuals and ICIs, this shift in ideology and practices should continue. However, given that the threat of climate change is only increasing, these organizations require more support for change to occur in time.

The Nova Scotian model has made a substantial impact on the separating behaviour of residents. The only construct that showed any statistically significant difference between Nova Scotia and the rest of Canada was the waste separation behaviour of survey participants. The Nova Scotian participants scored significantly more desirable for their waste separation practices. This would suggest that if similar source separation requirements were put in place throughout Canada, consumers would score higher (or more desirable) in the waste separation practices.

While the Nova Scotian source sorted waste management system is shown to be a strength of the province, there is a clear gap in the province as well. The lack of a Food Donation Care Act serves as a barrier (perceived or real) to the donation of unsaleable food by retailers. By passing this act, Nova Scotia would be more in line with the practices of the rest of Canada and eliminate a barrier that has been cited as a reason for retailers to not donate food.

The global situation with regards to the food waste phenomenon is not a simple problem with a simple solution, but the cost to society is undeniable. As shown within this work, there are opportunities to aid in the prevention, reuse and recovery of food waste. Recommendations are presented below for Canada as a whole, as well as Nova Scotia. Additional research in this area is necessary as the population continues to grow, resources

scarcer, and the impacts of climate change become more evident. The ultimate goal is to achieve a sustainable global food future and eliminating avoidable terminal food waste is an attainable step in building this future.

6.1 Recommendations

Canada

The consumer survey results showed that consumers in Nova Scotia are more actively participating in the separation of food waste from packaging. This is likely a result of the strict source separated waste management system that has been enforced in the province since 1996. It is recommended that a similar approach be considered for other provinces within the country, using the success of the Nova Scotian program as an exemplary case. It should be noted that the exact model may not be suitable for every region, given that the Canadian population is spread out and certain communities may not have the access to the infrastructure necessary for the successful implementation. For these locations, the approach that Massachusetts has taken, by first placing the system on ICI waste generators, to help to build the infrastructure to reduce the capital costs to the public.

The NZWC should continue their efforts in encouraging the country to set a National Waste Reduction target, but given that waste management is among provincial powers and is often left to the individual municipality, they should also target retailers. Empowering retailers to leverage the power they hold in the food supply chain is of benefit to everyone involved. The retailer will also benefit from the goodwill they are able to gain among consumers while also reducing their own food costs. Organizations like the NZWC and provincial recycling board should serve as a resource to businesses (similar to CET in

Massachusetts) and provide them with support and access to technology and information they may not otherwise be willing or able to seek out.

An active partnership among the government, NGOs and businesses benefit all involved as the government is able to know what is and still needs to be done, NGOs are able to transfer knowledge among all involved, and businesses are able to take action for themselves based on the knowledge provided.

Nova Scotia

The goal of any policies put in place by the Nova Scotia government should focus on incentivising industry to share the responsibility of food waste reduction without placing all of the cost of collection/disposal onto non-profits or government. Young (2018) specifically stated that the responsibility of policymakers is to offer economic incentives to retailers.

A potential incentive for retailers is to offer a tax credit to grocery chains that mirrors the farmers' tax credit that was adopted in Nova Scotia in 2016. The farmers' tax credit offers 25% of the fair market value of the food product as a tax credit. An analysis would need to be conducted to confirm if the same percentage is suitable for grocery retailers as well. Policymakers can look to similar tax credit programs that are offered to retailers in the United States, to identify not only the appropriate tax credit but also any avoidable pitfalls other regions have already experienced.

Eligible food banks could issue donation receipts to grocers when a donation is made, and they could use that in addition to the appropriate tax form during tax season. Grocery stores would be responsible for ensuring their food waste reaches a food bank.

This can be accomplished by them having their own trucks deliver the food, having a third-party pick, or the food bank pick up the food. It would be up to the grocery store to determine which method would be preferable for their particular situation.

To ensure that donations of inedible food are not being made to boost the amount of tax credit received, food banks would only issue a tax credit for the food that can be eaten. All other food would be sorted by food bank employees and sent to the appropriate waste collection streams. Although the grocery chain would not receive a credit for this food waste, they would be relieved of the responsibility of properly disposing of the goods. This would also offer the food bank access to organic waste that could serve as a feedstock to an aerobic or anaerobic digester, potentially allowing them to generate renewable energy with the collected food waste.

Going forward in Nova Scotia, a four-step program is recommended. This program would focus on educating to avoid regulating. The literature suggests that while some regulations are necessary, Nova Scotia already has waste regulations in place. Going forward, rather than increasing regulations it would be better to encourage the engagement of retailers, as they are so well positioned in the food supply chain.

1. Develop a food waste reduction target – NZWC recommended a national target similar to that of the USA, with a 50% reduction by 2030. Given that NS has historically been a leader in waste management, it is not necessary to wait for a Canada-wide adoption. It is necessary to determine what value is realistic and achievable for NS. This would require an evaluation of the current waste amounts and what initiatives are currently in place, and a commitment from all stakeholders on what steps they are willing to take going forward.

2. Work with commercial retailers to determine the level of food currently being wasted. The amount being wasted is not easily quantified without retailer participation but understanding the actual amount of waste occurring in stores will allow for more accurate solutions and recommendations to be made. Additionally, a review of the current waste reduction strategies already in place in each of the companies would be helpful for knowledge transfer between the grocery chains to ensure the adoption of best practices, as well as understand how that knowledge is distilled from corporate management to frontline staff.

3. Work with food banks to improve the collection of food donations. As stated previously, food insecurity and food waste are two separate issues, but through encouraging the redistribution of food for human consumption we can reduce food insecurity while also capturing food waste at a more desirable tier of the food waste hierarchy. The literature also suggests donations could allow retailers to pass on the burden of waste disposal. Developing a mechanism for tracking what food is most commonly donated as well as if that food is suitable for the communities they serve, would help address this issue. Another option would be to have retailers responsible for transporting their unsaleable food to the donation centres themselves, similar to the approach France has taken. The cost to retailers could be offset by the donation tax credit they would receive.

6.2 Limitations

There are limitations within this research that should be noted. The first of these is that personal bias and differing interpretations of the qualitative data. The research was all completed by one individual and the data of much of the qualitative is subjective in nature.

Had another researcher completed this same study, they may have had different interpretations of the results. It is the hope of the researcher that the conclusions would have, however, been similar.

Additionally, all the coding was completed by one individual. Ideally, there would have been more than one researcher going through the source data, coding individually, with any conflicts being resolved either by a third party or through discussion among the researchers. This is useful in ensuring that a researcher is not unintentionally coding to validate a preconceived belief or concept from the literature review. A result of this, coding reliability cannot be guaranteed and there are likely to be some gaps within the coding.

In July of 2018, the Cox Institute building at Dalhousie Agricultural Campus experienced a large roof fire. As a result, several research materials were lost. Included in the items lost were the notes from interviews that had been conducted to this point of the research. As a result, questions and notes from the interviews were lost. However, summaries of the interviews were recovered from the computer hard drive and backups.

The university's research ethics board required letters of support for the targeted distribution of the grocery store manager questionnaire and employee surveys. A partner at the provincial recycling board had initially thought that they would be able to leverage their position to gain researchers access to corporate representatives. Ultimately researchers were unable to gain retailer support. Surveys were not able to be distributed as researchers had originally intended, and were instead shared through social media sites Twitter, Reddit and Facebook. The lack of access to these populations resulted in the completion of only one store manager questionnaire and seven employee surveys.

An additional limitation with regards to the survey was that the sampling was not a random sample. Given the recruitment method, the survey was voluntary and people who were more invested in the topic of food waste are more likely to participate in the survey. This is likely to skew the results as more positively to food waste reduction and diversion.

Given that the social media analysis only sourced tweets that were using hashtags related to food waste, some tweets within the conversation may not have been included if they did not use one of the selected hashtags.

6.3 Further research

The coding that was completed in the content analysis of the publications and social media analysis would be more valid if the coding had been conducted by more than one researcher. A review of the publications and social media, with multiple coders to identify and confirm coding would mitigate errors and help to overcome researcher bias. This could be done using a systematic literature review approach. The addition of retailer publications would add a useful layer of understanding to the content analyses as well.

The published media by grocery store chains suggested that they are actively participating in food waste diversion and prevention. The responses of employees suggest that this may be an empty gesture, and initiatives are not being implemented at grocery store locations. This signals an opportunity to closer review the environmental and waste diversion mandates published by the grocery retailers and identify how they are being adopted and interpreted in stores.

In addition to the review of the corporate mandates, a more complete employee survey should be conducted. This should be done with management participation and

support so that the survey can be targeted and promoted to encourage a larger response rate. This would allow for any discrepancies to be identified between what the grocery chain is reporting and what employees are doing on the job. Even with the small number of responses received in this study, there is clearly a mismatch among the corporate managers and the frontline staff when it comes to food waste diversion and mitigation.

A secondary social media analysis should also be completed that would use focused keyword searches in addition to hashtag searches to ensure that a complete view of the online conversation is captured. An initial exploratory hashtag search to determine the overall landscape of the online conversation would allow for the development of targeted search terms and/or phrases. This would hopefully avoid the limitation presented in this work and would better capture the conversation surrounding the issue as a whole. The targeted search would also allow researchers to evaluate specific subsets within the online conversation and meet targeted research objectives and/or test hypotheses.

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APPENDIX A

Consumer Survey

How many people in your household? (drop down box, choices 1-8, other [box for entry of other number]

How much per week do you spend on groceries? (for the number of people above) [box for numeric]

The next set of questions us the following Likert Scale:

- *Always*
- *Very Often*
- *Sometimes*
- *Rarely*
- *Never*

Thinking about a normal trip to the grocery store

1. I buy ready to eat meals
2. I buy fresh fruit and vegetables that I put in a bag.
3. I buy prepackaged fresh fruit or vegetables
4. I buy canned fruit or vegetables
5. I buy canned soups or stews
6. I buy other canned food
7. I buy food in glass jars
8. I buy food in cardboard boxes
9. I buy frozen vegetables
10. I buy frozen fruit
11. I buy other frozen food

   After you have brought the food home, some of it may spoil or pass its expiry date (same scale used)
12. I separate plastic wrapped food from the bag and compost the food at home
13. I separate plastic wrapped food from the bag and put it into a container for collection by the county, town or city
14. I do not separate the food from the plastic and I put in in the garbage (to go to the landfill)
15. If canned food expires I put the can in the garbage
16. If canned food expires, I open the can and put the food in the compost
17. If canned food expires, I open the can and put it into a container for collection by the county, town or city
18. If cardboard packaged food expires I put the box in the garbage
19. If cardboard packaged food expires, I open the box and put the food in the compost
20. If cardboard packaged food expires, I open the box and put it into a container for collection by the county, town or city
21. If frozen food expires I put the package in the garbage
22. If frozen food expires, I open the package and put the food in the compost
23. If frozen food expires, I open the package and put it into a container for collection by the county, town or city

Thank you for continuing along on our survey, the section is looking for your opinion on a few issues

New scale:

- *Strongly Agree*
- *Agree*
- *Undecided*
- *Disagree*
- *Strongly Disagree*

24. There is too much packaging on food
25. I think we should only buy fresh fruits and vegetables
26. I buy local whenever I can
27. My family wastes more food than it should
28. We buy too much food
29. There is food left on the plate after the meal
30. We cook/prepare too much
31. We throw out food from previous meals that we initially saved but didn't get around to eating/using up
32. Some products we opened and used but didn't finish (e.g. deli foods, sauces, cans/jars, spreads)
33. Some products we bought but didn't open
34. Some products spoiled in the fridge or cupboard before we used them
35. Throwing away food is a waste of my money
36. Throwing away food is bad for the environment
37. Throwing away food is makes me feel guilty
38. Throwing away food is dirty/makes the bin smell
39. Throwing away food makes me feel that I haven't planned very well
40. I can't afford to throw away food
41. Throwing away food makes me feel like I've wasted my time
42. Throwing away food is a waste of good food

General questions

43. Global warming is an issue important to me personally
44. I am concerned about food waste producing greenhouse gasses
45. I am concerned about farming producing greenhouse gasses
46. I am concerned about food production producing greenhouse gasses
47. I am concerned that we do not have enough food to feed our growing world population
48. Automobiles are the biggest pollution source
49. Factories are the biggest pollution source
50. Livestock (dairy, beef, and other animals) farming produces a lot of greenhouse gasses
51. Global warming is a natural effect of the Earths cycles

Demographic questions (all information is confidential, the demographics are used to see if we get a reasonable mix of people answering our survey)

52. What is your gender?
    a) Male

b) Female
c) Other
d) Prefer not to say

53. How many children do you have?
   a) 0
   b) 1
   c) 2
   d) 3
   e) More than 3

54. What is your marital status?
   a) Married/ common law
   b) Divorced/ widowed
   c) Single
   d) Prefer not to say

55. What is your education level?
   a) Elementary school
   b) High school diploma
   c) College diploma
   d) University degree
   e) Graduate degree

56. Where do you live?
   a) City
   b) Suburb
   c) Country

57. What is your country of birth? (drop down menu of countries)

58. Where do you live? (drop down menu of Canadian provinces)

59. What is your household income?
   a) $0- 10,000
   b) $10,001-25,000
   c) $25,001-75,000
   d) $75,001-110,000
   e) $110,001-200,000
   f) More than $200,000

60. Are you currently employed?
   a) Employed Full time
   b) Employed Part Time
   c) Self employed
   d) Out of work

    e) Homemaker
    f) Student
    g) Military
    h) Retired
    i) Unable to work

61. Type of employer?
    a) For-profit
    b) Non-profit
    c) Government
    d) Healthcare
    e) Education
    f) Other

62. What is your age?
    a) Under 20
    b) 21-30
    c) 31-40
    d) 41-50
    e) 51-60
    f) 61-70
    g) 71-80
    h) Over 81

63. How many hours a week do you typically work at your job?
    a) Less than 10
    b) 10.1- 20 hours a week
    c) 20.1-25 hours a week
    d) 35 a week or more
    e) I am currently unemployed

64. Is there anything else you think is important for the researchers to know?

APPENDIX B

Store Manager Survey

If you are a store manager or owner operator, please respond for your store, if you operate more than one store, please answer for only one store, if you wish you may respond more than once to this survey.

If you are a grocery executive, please estimate your answers for all of the stores of your system.

Location _____ (feel free to put a code name if you do not wish the researchers to know your location)

Annual Sales _____   Fiscal Year _____

Number of employees: Full-time _____   Part-time_____

1. Does your company have a corporate mandate for waste diversion/reduction? Yes no

2. If yes, when was the policy implemented and what does it entail?

3. What is the total weight in kg of unsaleable food donated for human consumption by your location during the past calendar year? If you of not know the exact amount, please provide as accurate an estimate as possible.

4. Please indicate how accurate your answer above is. 1 being based on experience but not measured data, 5 based on some measured data, and 10 being the actual measured amount.

    1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10

5. What are the barriers, either internal or external preventing the donation of more unsaleable food?

    Please check all that apply.

    ☐ Liability concerns
    ☐ Regulatory constraints

          ☐   Insufficient refrigeration and/or storage onsite
          ☐   Insufficient refrigeration and/or storage at Food Bank
          ☐   Transportation costs
          ☐   Other Barrier (please specify)

6. Please provide an explanation of how (or if) these barriers have changed in the past 2 years. What is your company doing to overcome these barriers and are these barriers resulting in more unsaleable food?

Food Waste Reuse and Recovery

For the purpose of this survey, food waste is defined as food which was originally intended for human consumption but is now being disposed of. This includes damaged or spoiled food, as well as scraps from pre-prepared products and food deemed unsaleable.

7. How many pounds of non-perishable food waste do you generate per week?

8. Please indicate how accurate your answer above is. 1 being based on experience but not measured data, 5 based on some measured data, and 10 being the actual measured amount.

    1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10

9. How many pounds of pre-consumer prepared/whole food waste do you generate per week?

10. Please indicate how accurate your answer above is. 1 being based on experience but not measured data, 5 based on some measured data, and 10 being the actual measured amount.

    1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10

11. How many pounds of pre-consumer trim waste do you generate per week?

12. Please indicate how accurate your answer above is. 1 being based on experience but not measured data, 5 based on some measured data, and 10 being the actual measured amount.

    1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10

13. How many pounds of post-consumer plate waste do you generate per week?

14. Please indicate how accurate your answer above is. 1 being based on experience but not measured data, 5 based on some measured data, and 10 being the actual measured amount.

    1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10

15. What is the total weight (in kg) of food waste sent away for reuse or recycling by your location during the calendar year 2017? If you of not know the exact amount, please provide as accurate an estimate as possible.
    a. Animal Feed: _____
    b. Municipal Organic Waste collection: _____
    c. De-packaging (separation of organic material from packaging): _____
    d. Other (please specify) _____ : _____

16. Please indicate how accurate your answer above is. 1 being based on experience but not measured data, 5 based on some measured data, and 10 being the actual measured amount.

    1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10

17. What are the barriers, either internal or external preventing the reuse or recycling of more food waste?
    ☐ Liability concerns
    ☐ Food safety concerns regarding collection and storage
    ☐ Insufficient recycling options
    ☐ Transportation constraints
    ☐ Other   barriers   (please   specify)
    _____

18. Please provide an explanation of how (or if) these barriers have changed in the past 2 years. What is your company doing to overcome these barriers?

Food and Solid Waste Disposal

19. What is the total weight (in kg) of food waste or organic material that is sent to incineration or landfill disposal in the calendar year of 2017? If you do not know the exact amount, please provide as accurate an estimate as possible.

20. Please indicate how accurate your answer above is. 1 being based on experience but not measured data, 5 based on some measured data, and 10 being the actual measured amount.

    1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10

Comparison Data

21. Over the last 2 years has your company invested time and/or resources to more accurately measure any of the following
    ☐ Food waste generation
    ☐ Food Waste disposal
    ☐ Food Recycling (anaerobic digestion, composting, etc.)
    ☐ Food Donation for human consumption
    ☐ Food donation for animal consumption

☐ Others (please specify) _____

22. If you answer yes to any above, please explain what investments have been made.

As you, yourself are also a consumer, we'd now like to ask you a few questions on a few issues related to what is happening at home.

New scale:

- *Strongly Agree*
- *Agree*
- *Undecided*
- *Disagree*
- *Strongly Disagree*

23. There is too much packaging on food
24. I think we should only buy fresh fruits and vegetables
25. I buy local whenever I can
26. My family wastes more food than it should
27. We buy too much food
28. There is food left on the plate after the meal
29. We cook/prepare too much
30. We throw out food from previous meals that we initially saved but didn't get around to eating/using up
31. Some products we opened and used but didn't finish (e.g. deli foods, sauces, cans/jars, spreads)
32. Some products we bought but didn't open
33. Some products spoiled in the fridge or cupboard before we used them
34. Throwing away food is a waste of my money
35. Throwing away food is bad for the environment
36. Throwing away food is makes me feel guilty
37. Throwing away food is dirty/makes the bin smell
38. Throwing away food makes me feel that I haven't planned very well
39. I can't afford to throw away food
40. Throwing away food makes me feel like I've wasted my time
41. Throwing away food is a waste of good food

General questions

42. Global warming is an issue important to me personally
43. I am concerned about food waste producing greenhouse gasses
44. I am concerned about farming producing greenhouse gasses
45. I am concerned about food production producing greenhouse gasses
46. I am concerned that we do not have enough food to feed our growing world population
47. Automobiles are the biggest pollution source
48. Factories are the biggest pollution source
49. Livestock (dairy, beef, and other animals) farming produces a lot of greenhouse gasses
50. Global warming is a natural effect of the Earths cycles

Demographic questions (all information is confidential, the demographics are used to see if we get a reasonable mix of people answering our survey)

51. What is your gender?
    e) Male
    f) Female
    g) Other
    h) Prefer not to say

52. How many children do you have?
    f) 0
    g) 1
    h) 2
    i) 3
    j) More than 3

53. What is your marital status?
    e) Married/ common law
    f) Divorced/ widowed
    g) Single
    h) Prefer not to say

54. What is your education level?
    f) Elementary school
    g) High school diploma
    h) College diploma
    i) University degree
    j) Graduate degree

55. Where do you live?
    d) City
    e) Suburb
    f) Country

56. What is your country of birth? (drop down menu of countries)

57. Where do you live? (drop down menu of Canadian provinces)

58. What is your household income?
    g) $0- 10,000
    h) $10,001-25,000
    i) $25,001-75,000
    j) $75,001-110,000
    k) $110,001-200,000
    l) More than $200,000

59. What is your age?
   i) Under 20
   j) 21-30
   k) 31-40
   l) 41-50
   m) 51-60
   n) 61-70
   o) 71-80
   p) Over 81

60. How many hours a week do you typically work at your job?
   f) Less than 10
   g) 10.1- 20 hours a week
   h) 20.1-25 hours a week
   i) 35 a week or more

Feedback

61. Please provide feedback regarding any difficulties encountered with completing this survey or any suggestions for improving future surveys. General feedback also welcomed.

<u>Source</u>

Alliance, F. W. R. (2016). <u>Analysis</u> of US food waste among food manufacturers, retailers, and restaurants. *Food Waste Reduction Alliance, USA*.

EPA. (2009). Food Waste Management Cost Calculator. *United States Environmental Protection Agency.*

APPENDIX C

Grocery Employee Survey

Job Title _____

Time in Position _____

Are you Full-time or Part-time

First 3 digits of your Post Code: __ __ __

Food waste handling

After the store receives the food, some of it may spoil or pass its expiry date

Scale

- *Always*
- *Very Often*
- *Sometimes*
- *Rarely*
- *Never*

We separate plastic wrapped food from the bag and put it into a container for collection by the food bank, county, town or city

We do not separate the food from the plastic and we put in in the garbage (to go to the landfill)

If canned food expires we put the can in the garbage

If canned food expires, we open the can and put it into a container for collection by the food bank, county, town or city

If cardboard packaged food expires we put the box in the garbage

If cardboard packaged food expires, we open the box and put it into a container for collection by the food bank, county, town or city

If frozen food expires we put the package in the garbage

If frozen food expires, we open the package and put it into a container for collection by the food bank, county, town or city

{The next three sections are intended to assess the level of employee satisfaction with their employment and commitment to the employer. Negative affect may impact via a halo effect the employee's actions with regard to food waste or opinion of his employer's commitment to food waste reduction}

Job Characteristics (same scale)

How much variety is there in your own job?

How much are you left on your own to do your own work?

To what extent do you find out how well you are doing on the job as you are working?

How much of your job depends upon your ability to work with others?

How repetitious are your duties?

To what extent are you able to act independently of your supervisor in performing your job function?

To what extent do you receive information from your supervisor on your job performance?

How similar are the tasks you perform on a typical work day?

To what extent are you able to do your job independently of others?

New Scale

- *Strongly agree through strongly disagree*

Organizational Reaction

I never feel I'd would be better off working under different supervision

I feel very satisfied about the supervision I receive.

From my experience, this company treats its employees well

I think this organization considers employee welfare more important that sales and profits.

I often finish a day's work feeling I've accomplished something worthwhile.

I generally like the employees I work with.

For the job I do, I feel the amount of money I make is extremely good.

Considering what it costs to live in the area I live, my pay is more than adequate.

I feel very good about my future in the organization.

I feel I am making a great deal of progress are getting ahead in the company.

Job Roles

I have things that I do, that should be done differently.

I have to ignore a rule or policy to complete some tasks.

I receive incompatible requests from two or more people.

I work on unnecessary things.

I receive assignments with inadequate resources and materials to execute.

1. Do you feel you received a sufficient amount of training provided in the following areas: (5 pt. Likert Scale)

   1-Strongly disagree   3- neither agree nor disagree   5-strongly agree

- —   Customer service
- —   Food Safety
- —   Point of Sale
- —   Product Knowledge
- —   Loss Prevention
- —   Health and Safety
- —   Waste Management
- —   Administrative Skills

2. How was this training provided?

☐ Classroom

☐ eLearning

☐ In store/ One-on-One Coaching

3. What do you consider to be the most common cause of food waste at your store? (rank 1 being most common, 6 being the least common)

     ☐ Damaged packaging
     ☐ Unappealing or ugly product
     ☐ Best-before labelling
     ☐ Stock management policy
     ☐ Food no longer edible
     ☐ Other (please specify)

2. How does your store deal with unsaleable food? (select all that apply)

     ☐ Green Bin collection
     ☐ Redistributed for use as animal feed
     ☐ Donated for human consumption (food bank)
     ☐ Third party collection
     ☐ Garbage disposal
     ☐ Other (please specify)

4. What efforts are your store making to reduce food waste?

5. What are the barriers, either internal or external preventing the donation of more unsaleable food?

Please check all that apply.

     ☐ Liability concerns
     ☐ Regulatory constraints
     ☐ Insufficient refrigeration and/or storage onsite
     ☐ Insufficient refrigeration and/or storage at Food Bank
     ☐ Transportation costs
     ☐ Other Barrier (please specify)

6. What are the barriers, either internal or external preventing the reuse or recycling of more food waste?

     ☐ Liability concerns
     ☐ Food safety concerns regarding collection and storage

☐ Insufficient recycling options
☐ Transportation constraints
☐ Other   barriers   (please   specify)
_____

As you, yourself are also a consumer, we'd now like to ask you a few questions on a few issues related to what is happening at home.

New scale:

- *Strongly Agree*
- *Agree*
- *Undecided*
- *Disagree*
- *Strongly Disagree*

7. There is too much packaging on food
8. I think we should only buy fresh fruits and vegetables
9. I buy local whenever I can
10. My family wastes more food than it should
11. We buy too much food
12. There is food left on the plate after the meal
13. We cook/prepare too much
14. We throw out food from previous meals that we initially saved but didn't get around to eating/using up
15. Some products we opened and used but didn't finish (e.g. deli foods, sauces, cans/jars, spreads)
16. Some products we bought but didn't open
17. Some products spoiled in the fridge or cupboard before we used them
18. Throwing away food is a waste of my money
19. Throwing away food is bad for the environment
20. Throwing away food is makes me feel guilty
21. Throwing away food is dirty/makes the bin smell
22. Throwing away food makes me feel that I haven't planned very well
23. I can't afford to throw away food
24. Throwing away food makes me feel like I've wasted my time
25. Throwing away food is a waste of good food

General questions

26. Global warming is an issue important to me personally
27. I am concerned about food waste producing greenhouse gasses
28. I am concerned about farming producing greenhouse gasses
29. I am concerned about food production producing greenhouse gasses
30. I am concerned that we do not have enough food to feed our growing world population
31. Automobiles are the biggest pollution source
32. Factories are the biggest pollution source
33. Livestock (dairy, beef, and other animals) farming produces a lot of greenhouse gasses
34. Global warming is a natural effect of the Earths cycles

Demographic questions (all information is confidential, the demographics are used to see if we get a reasonable mix of people answering our survey)

35. What is your gender?
   a) Male
   b) Female
   c) Other
   d) Prefer not to say

36. How many children do you have?
   a. 0
   b. 1
   c. 2
   d. 3
   e. More than 3

37. What is your marital status?
   a. Married/ common law
   b. Divorced/ widowed
   c. Single
   d. Prefer not to say

38. What is your education level?
   a. Elementary school
   b. High school diploma
   c. College diploma
   d. University degree
   e. Graduate degree

39. Where do you live?
   a. City
   b. Suburb
   c. Country

40. What is your country of birth? (drop down menu of countries)

41. Where do you live? (drop down menu of Canadian provinces)

42. What is your household income?
   a. $0- 10,000
   b. $10,001-25,000
   c. $25,001-75,000
   d. $75,001-110,000
   e. $110,001-200,000
   f. More than $200,000

43. What is your age?
    a. Under 20
    b. 21-30
    c. 31-40
    d. 41-50
    e. 51-60
    f. 61-70
    g. 71-80
    h. Over 81

44. How many hours a week do you typically work at your job?
    a. Less than 10
    b. 10.1- 20 hours a week
    c. 20.1-25 hours a week
    d. 35 a week or more

45. Any other comments or things you feel the researchers should know or should have asked.

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