A mixed-methods study of retail food waste in New Zealand

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\textbf{ABSTRACT}

Little is known about the amount of food wasted in the retail sector. This study aimed to quantify retail food waste in New Zealand (NZ) and identify key drivers for food waste reduction, using a mixed-methods, observational study design that consisted of three parts: onsite food waste audits undertaken in 16 selected stores (complete data from 11 stores); semi-structured interviews with key retail staff from each store; and obtaining existing data from retailers. Retail food waste in NZ was estimated at 13 kg/capita/year for all food waste and diverted product (i.e., all food not sold or utilised at retail level), which included 5 kg/capita/year designated as food waste (i.e., food directed to landfill, protein reprocessing and compost), with 3 kg/capita/year of this sent to landfill. Fresh vegetables (27%), bakery (23%), meat and fish (19%) and fresh fruit (17%) contributed the most to discarded product. The motivators for encouraging food waste reduction were: concern for the environment; making profit; caring for the community; and doing the ‘right’ thing. The barriers to food waste reduction were: training and educating staff; food safety concerns; quality standards; availability and capacity of waste diversion avenues; and lack of available resources. Audit data and food waste data recorded by retailers were similar. NZ has a number of policies and practices that successfully divert retail food waste away from landfill, in particular, retailers have established relationships with various groups that use their waste as a resource including protein reprocessors, local farmers, and food rescue charities.

1. Introduction

The Food and Agriculture Organisation (FAO) of the United Nations estimate that one third of all global food production is wasted. This waste has significant social, environmental and economic implications (FAO, 2011). The Sustainable Development Goals (SDG) were established to work towards a fairer, more environmentally friendly future (United Nations, 2017a), and were ratified in 2015 at the United Nations General Assembly by 193 nations including New Zealand (New Zealand Ministry of Foreign Affairs and Trade, 2015). SDG 12 focusses on responsible consumption and production with SDG 12.3 aiming to “halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses” (United Nations, 2017b). A three-step process was proposed to achieve this goal: target, measure, act (Lipinski et al., 2017).

Food waste has been defined in different ways, however, in 2014, a collaborative European project with 21 partners across 13 countries called Food Use for Social Innovation by Optimising Waste Prevention Strategies (FUSIONS) developed a definition of food waste designed to harmonise earlier definitions, which has been used in this study (see Table 1) (Östergren et al., 2014). Food can be wasted anywhere along the food supply chain. In high-income countries, most food is wasted by consumers, while in low-income countries more food is wasted at the start of the chain, during production (Lipinski et al., 2013). The proportion that retail food waste contributes to total global food waste has been under researched (Parfitt et al., 2010), but is estimated to be approximately 5% of total food waste in high-income countries (Lipinski et al., 2013); the commercial sensitivity of this data to retailers may explain the limited literature in this area. Nonetheless, qualitative data is crucial to inform effective ways to reduce and divert food waste and quantitative data are needed to identify specific food categories to target and, subsequently, to monitor the effectiveness of reduction initiatives to address the ‘measure’ and ‘act’ steps of SDG 12.3 (Lipinski et al., 2017). Some key studies have been undertaken internationally in an attempt to generate baseline data for the retail sector including studies in the United Kingdom (UK) by the Waste and Resources Action Programme (WRAP) (Whitehead et al., 2013; Parfitt et al., 2016), in Sweden by Eriksson (2012), in Austria by Lebersorger and Schneider (2014), and in the United States (US) by Buzby et al. (2015). However, to date, there are no publicly available quantitative data on retail food waste available for New Zealand.
Table 1
Definitions for food waste.

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food waste</td>
<td>Any food, and inedible parts of food, removed from the food supply chain to be recovered or disposed (excludes food that is donated to humans or animals)</td>
</tr>
<tr>
<td>Retail food diversion</td>
<td>Any food, and inedible parts of food, that do not serve the original purpose, to be sold to customers, but remain within the food supply chain (food that is donated to humans or animals)</td>
</tr>
<tr>
<td>Retail food waste and diversion</td>
<td>All food that is ‘wasted’ or ‘diverted’ at a retail level (including food waste and food that is donated to humans or animals)</td>
</tr>
</tbody>
</table>

1 Östergren et al., 2014.

Food waste quantification studies have analysed data from store databases, delivery records, and store sales data provided by retailers (Eriksson, 2012; Lebersorger and Schneider, 2014; Buzby et al., 2015; Cicatiello et al., 2016; Parfitt et al., 2016; Brancoli et al., 2017). Some studies have also included onsite waste audits to measure the quantity of food waste (Eriksson, 2012; Lebersorger and Schneider, 2014; Parfitt et al., 2016), whilst others have conducted interviews with retail staff to obtain estimates for food waste (Mena et al., 2011; Stenmarkar et al., 2011). Retailers are also beginning to publish their estimates for in-store food waste. In 2016, WRAP released a report containing comprehensive quantitative data on food waste and surplus in the UK manufacturing and retail sectors (Parfitt et al., 2016), based on data provided by the British Retail Consortium (British Retail Consortium, 2016), which estimated that retail food waste in the UK was 210,000 tonnes per annum (Parfitt et al., 2016). In 2016, FUSIONS quantified regional level food waste in terms of kilograms of food wasted per capita per annum, reporting that, on average, 9.4 kg/capita/year (range 3.9–29.8) was wasted at a retail level in the European Union (EU) (Stenmarkar et al., 2016).

In addition to quantitative studies, qualitative research can elicit the perspectives of retail staff on how in-store food waste is generated. Insights provided by retail staff are crucial for developing effective waste reduction initiatives because these staff will implement waste management procedures at the retail level. However, there are few qualitative studies undertaken within the context of retail food waste. Hocke (2014) studied the potential for retail food waste reduction in Dutch supermarkets involving five semi-structured interviews with retail staff. Increased profitability was identified as a driver for reducing food waste, as both disposal costs and loss of profit from unsold product would be reduced if less food was wasted. Filimonau and Gherbin (2017) conducted research into managerial attitudes towards food waste mitigation at a retail level in the UK. A series of 12 in-depth semi-structured interviews with retail managers were undertaken with the aim of uncovering attitudes held by key retail staff. Barriers to food waste reduction fell into five themes including: consumer awareness and purchasing behaviour; corporate policies; suppliers; employees; and supermarket size.

Direct public policy recommendations relating to the reduction of food waste at the retail level have been made in the literature. For example, Gruber et al. (2016) suggest two areas where policy can affect change in this sector: education (e.g. campaigns that raise the awareness of consumers to understand the value of food); and law (e.g. changing “use-by” labels to “best before” labels). In New Zealand, the three-year government-funded nationwide Love Food Hate Waste campaign, an application of the highly successful 20-year-old UK Love Food Hate Waste campaign (Quested et al., 2013), has shown some success in changing New Zealand consumers’ attitudes towards the value of food (Love Food Hate Waste New Zealand, 2019). In terms of law, although there is some related legislation in New Zealand, for example the Waste Minimisation Act of 2008 (NZ Parliamentary Counsel Office, 2008), that aims to reduce waste and its disposal, there is not a national food waste strategy nor specific policies that support food waste avoidance and reduction. However, a “good Samaritan” clause was included in the revised Food Act 2014 which provides immunity to businesses who donate food, considered safe at the time of donation, to food banks or food rescue organisations (NZ Parliamentary Counsel Office, 2014). While the food redistribution sector in New Zealand has flourished as a result of this legislation, it is important that public policy makers continue to consider the wider social implications of this activity: the politics of using food waste to feed hungry people are far from simple. A number of scholars have pointed out that these organisations self-perpetuate poverty and are inextricably entangled with the forces of neoliberalism and the industrialised food system (Cloke et al., 2017; Riches and Silvasti, 2014). Food redistribution, if subsidised by government, which has been the case in New Zealand, also runs the risk of using public funds to clean up waste created by the practices of retailers with the cost of disposing of food waste (e.g. transportation and landfill charges) shifted from commercial entities to the not-for-profit food redistribution operation. In 2015, France passed a food waste law (L. 541–15-3) that effectively bans large supermarkets from throwing out unsold food and obligates them to give this food to charities or food banks; similar policies have since been adopted in other European countries and further afield. In New Zealand, there appears to be no appetite from either the government or the retail sector to apply similar legal rules but there is a strong desire to find alternative (i.e. non-legislative) ways to further stimulate the sector.

In 2018, an Environment Select Committee was appointed to explore the quantity, impact, prevention strategies and redistribution methods of food waste in New Zealand; ideally the findings of this committee will be translated into policies supportive of addressing food waste in New Zealand. The aim of this study was to obtain both quantitative and qualitative data for retail food waste in New Zealand. The results will provide baseline data of retail food waste, i.e. the ‘measure’ step of the three-step process, which is needed to achieve the SDG target 12.3. The study will also identify key motivators and barriers to retail food waste reduction in order to inform future initiatives, i.e. the ‘act’ step. The findings of this study will make an important contribution in the development of food policies that focus on food waste in New Zealand.

2. Methods

2.1. Definitions

As stated earlier the FUSIONS definition of food waste has been used in this study (Östergren et al., 2014) (see Table 1). The FUSIONS definition was considered most appropriate because it is a broad and inclusive definition of food waste, which aligns with international harmonisation efforts (Östergren et al., 2014). The FUSIONS definition considers inedible parts of food (e.g. skin, bones) as food waste in order to support the development of resource efficient and sustainable food systems. The New Zealand Government encourages policies and methods that apply a ‘circular economy’ approach to waste and resource efficiency issues, thus adopting a definition that shifts beyond waste minimisation to designing processes that remove waste aligns with current government priorities. Lastly, this definition was adopted...
in order to be able to make comparisons with international estimates that have used the same definition. While providing the best alternative, there are acknowledged shortcomings in using the adopted definition at the retail level. Specifically, FUSIONS omit donated food or food that is fed to animals from their definition of food waste (Östergren et al., 2014). The reason for doing this can be explained by the food waste hierarchy that prioritises the management of food waste, first conceptualised by scholars Papargyropoulou et al. (2014) and adopted and widely promoted by organisations such as WRAP in the UK. The hierarchy recommends reducing food waste at the source as the most preferable management option, followed by redistribution to people, then to animals, then anaerobic digestion, followed by composting, incineration and lastly disposal at landfill. In this study, protein reprocessing has been counted as food waste which aligns with the food waste hierarchy. WRAP classify food that is donated to people or to animal feed as prevention or diversion rather than waste (Whitehead et al., 2013). However, WRAP highlight the importance of moving retail food waste further up the food waste hierarchy, with the main focus being reduction of waste at the source and the prevention of food going to landfill (Parfitt et al., 2016).

2.2. Study design

This research used a mixed-methods, observational study design to assess retail food waste in New Zealand supermarkets following the methodology used by WRAP and guidelines recommended by FUSIONS (Parfitt et al., 2016; Tostivint et al., 2016). The study consisted of three parts: onsite food waste audits undertaken in stores; interviews with key retail staff in stores; and obtaining existing data from retailers. In each participating store, food waste was measured over a 24-hour period and one store representative was interviewed.

2.3. Study population

In New Zealand there are two major food retail bodies, Progressive Enterprises and Foodstuffs. Three major retail chains are subsidiaries of these bodies including Countdown (Progressive Enterprises), and New World and Pak’n Save (Foodstuffs). In total there are 377 Countdown, New World and Pak’n Save stores across New Zealand, which represent the majority (i.e. > 95%) of grocery retail sales at full-service supermarkets nationally. Countdown stores are centrally owned and operated, whereas each New World and Pak’n Save store is independently owned and operated. This study audited stores from all three of New Zealand’s leading retail chains using a convenience sample of 16 supermarkets recruited across four urban centres (Auckland, Wellington, Christchurch, Dunedin). Retailers were asked to provide a range of small, medium and large stores to take part in the study and a mixture of stores participating and not participating in store waste minimisation programmes. Using a convenience sampling method was essential in obtaining buy-in and participation from both retail bodies. Head office contacts for each retail body were able to use their position within each organisation to encourage stores to participate in the study; these nominated retail representatives were also asked to provide existing data on food waste pertaining to their respective retail chains. Typically, sample sizes of fewer than 10 stores are audited in international retail food waste quantification studies (Eriksson, 2012; Lebersorger and Schneider, 2014; Parfitt et al., 2016) and most studies use existing retail food waste data provided by retail chains as their primary data source. Given the commercial sensitivity of the data, confidentiality agreements were signed by the University of Otago and each retail body.

2.4. Data collection

2.4.1. Onsite audits

The principles outlined in the Food Loss and Waste Accounting and Reporting Standard (Hanson et al., 2016), and the FUSIONS Food Waste Quantification Manual (Tostivint et al., 2016) were followed for quantification. Direct weighing was chosen as it is considered to be the most precise measurement of food waste (Hanson et al., 2016). For some waste destinations (i.e. animal feed), volume was used to obtain an estimate of the weight of the waste when bins were too deep to retrieve and measure food.

A pilot audit was conducted in one store to test the methodology and changes to the way food waste was to be grouped and recorded were made to streamline the audit process and reduce inconvenience for participating stores. All waste produced within a 24-hour period was measured during audits which typically began in the morning, taking 5–6 h to complete.

One member of the study team (FGS) conducted all onsite audits, with help, when needed, of a volunteer. The audit setup consisted of a tarpaulin which was laid on the ground, a scale (Seca Alpha 770), and small plastic bins used to separate waste. Food going to each destination (i.e. landfill, compost) was weighed separately. For all waste destinations (i.e. landfill, compost, food donation, animal feed and protein reprocessing (meat waste for reconstitution)), food was removed from each destination bin (one destination at a time) and emptied onto the tarpaulin for sorting. Food items were separated from non-food items (i.e. polystyrene, plastic, cardboard). Waste and diverted product were divided into eight food categories including: bakery, fresh fruit, fresh vegetables, meat and fish, dairy, staple foods, drinks (non-dairy) and other (i.e. all other food categories). Food was then sorted by hand into product type (i.e. bananas, savoury baking, tinned food, fish etc.). Once separated into piles of each product type, the scale was tared, and the food weighed. The weight of the food, weight of bin, store ID, date, waste destination, food category, and product type were recorded.

2.4.2. Semi-structured interviews

A qualitative interview outline, consisting of 12 semi-structured interview questions (see supplementary material), was developed by the research team to obtain information on the key motivators and barriers identified by retail staff (i.e. store managers, owners and compliance managers) to food waste reduction in New Zealand supermarkets. The interview questions covered the following topics: general store waste; waste management procedures; potential barriers and motivators to waste reduction; and implementation of future reduction initiatives. After obtaining permission from the interviewees, voice recordings were taken of the interview, which lasted 10–15 min.

2.4.3. Existing food waste data

Retailers were asked to provide any existing data on the weight of in-store food waste collected by each supermarket.

2.5. Analysis

2.5.1. Onsite audits

Data from onsite food waste audits were entered into Microsoft Excel on a password-protected computer. Each store was assigned a unique ID number. Data were triple checked by the research team against raw data collected during the audits. Data were coded according to the Waste Management Institute of New Zealand (WasteMINZ) classifications for food categories and food products that were used in the study of household food waste in New Zealand to allow for comparisons between retail food waste and household food waste (Yates, 2015).

Data were categorised by waste or diversion destination, and by food category, to provide estimates for food directed to each waste or diversion destination and for each food category. Descriptive statistics were used to report quantitative data. Inferential statistics were used to estimate retail food waste at a population level. Mean daily food waste and diverted material calculated from the retail food waste audits was multiplied by the total number of Countdown, Pak’n Save and New World stores in New Zealand (n = 377 stores) and then multiplied by...
365 days to generate an estimate for annual retail food waste and diverted material in New Zealand.

2.5.2. Semi-structured interviews

Audio recordings made during the interviews were transcribed into Microsoft Word. During transcription, personal identity and store identity were removed and replaced with the corresponding interviewee’s unique ID number. The interviews were transcribed non-verbatim; this method accurately represents the interview content and sentence structure without distracting elements such as filler speech, idiosyncrasies and false-starts (Opal Transcription Services, 2017). The transcribed interviews were then uploaded into a qualitative analysis software package, NVivo Version 11, which was used to extract sections of text and organise them into themes. A hybrid version of Braun and Clarke’s (Braun and Clarke, 2006) thematic analysis was used to code interview data which was neither purely inductive nor deductive in nature but more of a middle ground and pragmatic approach. Fig. 1 outlines the thematic analysis approach.

The coding process began by immersion in the data through in-depth reading of interview transcripts, and an initial coding structure was designed. The coding structure and broader dominant themes were discussed by the research team and the structure was refined with a focus on semantic themes using an essentialist/realist approach to identify motivators and barriers for waste reduction as the interviewee articulated them (Braun and Clarke, 2006). A final coding structure was agreed (see Fig. 2) and data were organised into nine themes including four motivators: concern for the environment; making profit; caring for the community; and doing the ‘right’ thing, and five barriers including: training and educating staff; food safety concerns; quality standards; availability of waste diversion avenues and capacity; and lack of available resources.

2.5.3. Existing food waste data

Data on the weight of in-store food waste were provided by retailers in the form of Microsoft Excel spreadsheets. Each spreadsheet was checked for missing data and anomalies, and months with missing data and apparent anomalies were excluded, such as when the weight for a waste stream was duplicated across many months rather than the presentation of an actual weight. This was particularly common for measurements of donated food or food diverted to animal feed. Data collected in the onsite audits in the present study were compared with self-reported data on food waste quantities provided by the retail bodies.

3. Results

3.1. Onsite food waste audits

Of the 16 stores that were selected to participate in the study, complete data was obtained for 11 stores. Four stores were excluded from the analysis because the stores process their protein (i.e. prepare their cuts of meat and fish) offsite, and thus meat and fish waste from these stores would be underrepresented compared to other stores. One store was also excluded because a measure of food waste sent to landfill was not obtained. Demographic information for the total sample and for the sub-sample of stores with complete data used for analysis is presented in Table 2. For confidentiality reasons, demographic variables for each retail body are presented anonymously. An equal number of stores from each retail body were recruited from four major urban centers and there was a mix of stores participating or not participating in a sustainability programme. The retail floor space did not differ significantly between the total sample (n = 16 stores) and sub-sample (n = 11 stores).

Weights of food directed to each destination were used to calculate the mean weight of food directed to each destination per store. The mean daily weight, standard deviation (SD), and percentage (%) of the total weight of waste and diverted product directed to each destination are presented in Table 3. Overall, 77% of all food measured during audits was diverted from landfill and of this, 46% was diverted to animal feed and 15% was donated to food rescue charities. Approximately 23% of all food measured was sent to landfill.

Table 4 presents data for the total weight of food for each of the
Table 2
Demographic variables of participating stores.

<table>
<thead>
<tr>
<th>Total sample (n = 16 stores)</th>
<th>Subsample (n = 11 stores)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Retail body A (n)</td>
</tr>
<tr>
<td>Location</td>
<td></td>
</tr>
<tr>
<td>Auckland</td>
<td>2</td>
</tr>
<tr>
<td>Wellington</td>
<td>2</td>
</tr>
<tr>
<td>Christchurch</td>
<td>2</td>
</tr>
<tr>
<td>Dunedin</td>
<td>2</td>
</tr>
<tr>
<td>Total number of stores</td>
<td>8</td>
</tr>
<tr>
<td>Mean retail floor space (m²)</td>
<td>2,742 ± 2,174</td>
</tr>
</tbody>
</table>

1 Exclusive of one store which did not provide complete data and four stores which processed protein offsite.

Table 3
Mean daily weight and percentage of retail food waste and diverted product sent to each destination (n = 11 stores).

<table>
<thead>
<tr>
<th>Destination classification</th>
<th>Destination</th>
<th>Mean ± SD (kg)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food diversion</td>
<td>Animal feed</td>
<td>204 ± 195</td>
<td>46</td>
</tr>
<tr>
<td>Food waste</td>
<td>Landfill</td>
<td>101 ± 80</td>
<td>23</td>
</tr>
<tr>
<td>Food diversion</td>
<td>Food donation</td>
<td>67 ± 67</td>
<td>15</td>
</tr>
<tr>
<td>Food waste</td>
<td>Protein reprocessing</td>
<td>63 ± 36</td>
<td>14</td>
</tr>
<tr>
<td>Food waste</td>
<td>Compost</td>
<td>4 ± 14</td>
<td>1</td>
</tr>
</tbody>
</table>

1 Standard deviation. 2 Percentages do not add to 100 due to rounding.

eight food categories measured in all 11 stores that was directed to ‘food waste’ destinations (i.e. landfill, protein reprocessing, and compost), to animal feed, and to food donation, separately. For food directed to destinations considered as ‘food waste’, meat and fish made up 50% of total food waste. Dairy was the next most common food category, contributing 14% to total food waste, followed by 12% for bakery. For all food not sold or used at a retail level (i.e. total), fresh vegetables contributed to 27% of the total weight of food waste and diverted product, bakery contributed 23%, meat and fish 19%, fruit 17%, and dairy 6%.

Food waste sent to landfill was comprised of a diverse range of food categories. Fig. 3 depicts the percentage contribution of each food category to the total amount of food waste sent to landfill. Of total food waste directed to landfill, dairy contributed 23%, followed by 21% for bakery, and 21% for meat and fish products.

Sample data was also scaled up to estimate retail food waste at a national level for the three leading supermarket chains in New Zealand (n = 377 stores). Considering all food measured during onsite audits, it was estimated that approximately 60,500 tonnes or 13 kg/capita/year of food delivered to the shop floor is not sold by New Zealand retailers. Each year, approximately 23,300 tonnes or 5 kg/capita/year of this food is wasted (i.e. not donated as animal feed or to food rescue charities) and approximately 14,000 tonnes or 3 kg/capita/year of this food that is not donated is sent to landfill.

3.2. Semi-structured interviews

Of the 16 retail staff recruited to participate in the interviews all agreed to take part, and complete data was obtained from all interviewees. The demographic characteristics of interviewees are presented in Table 5. Interviewees names were removed from their responses and replaced with their job title.

Nine dominant themes were identified in the semi-structured interviews which were separated into two broad categories: motivators for food waste reduction and barriers to further food waste reduction. Themes that were classified as motivators were: concern for the environment; making profit; caring for the community; and doing the ‘right’ thing. Themes that were identified as barriers to further food waste reduction were: training and educating staff; food safety concerns; quality standards; availability and capacity of waste diversion avenues; and lack of available resources.

3.2.1. Motivators

The frequency (i.e. number of times the theme was mentioned) and source (i.e. the number of participants that mentioned the theme) are displayed in Table 6.

Many interviewees were highly motivated to reduce food waste in their supermarkets due to their concern for the environment. Interviewees associated food waste directed to landfill with environmental damage and they expressed commitment to mitigating this damage through good waste management in-store. One retailer commented that “...if there was something I could do with any of the food waste I would do it, because we are big into recycling. Anything that can be diverted from landfill, we are prepared to do” (Operational Support Manager). Along with the sense of commitment to minimising food waste to reduce environmental harm, retailers also felt that it was their responsibility to lead by example and embed environmental responsibility in their organisational and wider community culture.
stating "...if we’re going to teach our colleagues and our children what we want to do moving forward ... you want to start off the way you want to carry on, and that’s doing right by the environment" (Assistant Store Manager).

Increasing store profitability was another key motivator for reducing food waste because “the more you recycle, and save, and make less, obviously the more profitable it is for the business (Store Manager). This awareness of the cost of sending food to landfill was a driver for changing in-store practice such as selling product at reduced cost because “if you don’t have any wasted product then it’s not coming off your bottom line” (Store Owner). One interviewee commented that “if we can manage to sell something slightly cheaper instead of putting it in the waste then it becomes more profitable for us” (Assistant Store Manager).

Being able to care for their local communities by donating food was also a strong motivator for retail staff to reduce food waste. Retailers expressed a sense of pride and satisfaction from donating food to vulnerable members of their community, one interviewee stated “I too am a citizen of this planet, I care, my team do care, we actually take a lot of pride in how much we divert ... we literally divert tonnes of food to the local community. We are really proud of this achievement. We do support it, it would be the easiest thing in the world to throw it in the bin, there is actually effort involved in not throwing it in the bin, but we definitely see the value in it” (Store Manager). Retailers were willing to put in extra effort to ensure that food that was unable to be sold in-store was going to a good cause.

It was clear that retailers were motivated by “doing the right thing” and that good food waste management practices were an output of taking their corporate social responsibility seriously. One interviewee stated that as retailers “we are morally obliged to … do the ‘right’ thing. That kind of goes hand-in-hand that if we’re doing the ‘right’ thing as a business, our shrink and wastage will come into line as well” (Assistant Store Manager).

3.2.2. Barriers

Training and educating staff was the barrier articulated the greatest number of times and by three quarters of interviewees, as presented in Table 7. Retailers commented on the challenge of obtaining buy-in from staff to manage waste responsibly and that “the biggest barrier of any kind of system ... is the people side of it. People being on board and making sure that we are doing it for the right reasons, it’s not just about making money, it’s about the environment as well” (Assistant Store Manager). Without sufficient training and education staff lack clarity and purpose for why they are required to carry out waste minimisation processes. Many retailers commented that they have waste

### Table 5
Demographic variables of key retail staff interviewed (n = 16 staff).

<table>
<thead>
<tr>
<th>Number of interviewees</th>
<th>Retail body A (n)</th>
<th>Retail body B (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auckland</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Wellington</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Christchurch</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Dunedin</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>On a waste minimisation programme</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

### Table 6
Frequency and source that each motivator for food waste reduction was articulated across the data set (n = 16 staff).

<table>
<thead>
<tr>
<th>Frequency (n)</th>
<th>Source (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protect the environment</td>
<td>22</td>
</tr>
<tr>
<td>Increase profitability</td>
<td>19</td>
</tr>
<tr>
<td>Caring for community</td>
<td>14</td>
</tr>
<tr>
<td>Doing the ‘right’ thing</td>
<td>11</td>
</tr>
</tbody>
</table>

1 Number of times the theme was articulated across the entire data set.
2 Number of interviewees that articulated the theme.

### Table 7
Frequency and source of each barrier to further food waste reduction was articulated across the data set (n = 16 staff).

<table>
<thead>
<tr>
<th>Frequency (n)</th>
<th>Source (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training and education</td>
<td>30</td>
</tr>
<tr>
<td>Food safety concerns</td>
<td>22</td>
</tr>
<tr>
<td>Quality standards</td>
<td>18</td>
</tr>
<tr>
<td>Diversion avenues and capacity</td>
<td>17</td>
</tr>
<tr>
<td>Resource availability</td>
<td>10</td>
</tr>
</tbody>
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1 Number of times the theme was articulated across the entire data set.
2 Number of interviewees that articulated the theme.
management systems in place, however, “the biggest challenge would be [the] team not using the process correctly...What we have in place has worked and does work when used correctly” (Assistant Store Manager). Retailers also mentioned the negative consequences of increased food waste quantities from insufficient training of staff, for example, “if you get someone new and they don’t understand our training patterns, then they could potentially over order, and if it’s fresh product, it’s going to land in the bin because there is only so much we can give away” (Store Manager). The need for continual training and education in relation to waste management practices was also highlighted. It was suggested that training should be an ongoing process that is regularly implemented and "that steady flow of seeing that everything moves in the right direction would be a way towards changing" (Compliance Manager).

Concerns about food safety when diverting food waste to animals or charities was another major barrier identified to further food waste reduction, raising questions such as “if [the farmers] are feeding it to their animals and their animals got sick, how does that affect us?” (Assistant Store Manager). Retailers argued that they tend to be more cautious when it comes to food safety, as causing sickness could result in negative consequences for the business. This cautiousness can be translated into a barrier, preventing people from diverting food waste and instead sending it to landfill. One interviewee stated that “I would rather it be thrown away than someone get sick...obviously we don’t want to hurt people, but we could be a headline as well” (Maintenance Manager).

Another barrier identified to food waste reduction was the quality standards maintained for food on the shelves of supermarkets. Retailers feared that customers would be dissatisfied if imperfect food remained on the shelves and that this may deter them from purchasing produce from the store altogether. One store manager commented that “it would be facetious for me to blame customers for how hard we have to grade produce, but the reality is that New Zealand shoppers have got very high expectations about what ‘fresh’ looks like. They always seem surprised at what we have to throw away but the reality is, the reason why we throw it away is because if we don’t throw it away, they won’t buy any of our produce, it’s a vicious circle” (Store Manager). Staff are trained to grade produce in particular to a very high standard, to maintain the image of having good quality produce which contributes to an increased rate of disposal of fresh products. One retailer highlighted that “produce is probably our biggest focus area at the moment. We’ve got pretty high standards throughout the company for quality, so we grade three times a day, so there’s a pretty wide variety of stuff that will be taken off” (Store Manager).

Knowledge of what food waste diversion avenues (i.e. organisations, charities, businesses) are available and the capacity of these avenues to receive surplus food from retailers was another key barrier. They would like to donate more food than they are doing already but may not know how, one interviewee questioned “what do I do with the dairy product?” (Operational Support Manager), and another commented “butchery and seafood, [we] can’t do anything [with that]” (Office Administrator). Retailers also have little control over the product that organisations are willing to take, and the diversion avenues available in their area. A major barrier is “the willingness for people to actually take product off us … unfortunately that means that anything the pig farmer doesn’t take and the food rescue people don’t take has to go in the bin. There is no option for compost, which isn’t ideal” (Store Manager).

A lack of resources (i.e. time and storage space) were mentioned as a barrier to food waste reduction. It is crucial that waste management processes do not significantly add to the staff workload, or take up large amounts of space because “sometimes if it’s too much work, if someone suggested we have to unwrap a whole lot of things, or do a whole lot of stuff, if it was too much work, we wouldn’t do it because we just don’t have time” (Store Owner).

3.3. Existing retail food waste data

Data provided by retailers reported weight in tonnes for different waste streams (i.e. landfill, food donation, protein). However, retailers tend to measure food and non-food items together, thus certain waste streams (i.e. landfill) contain non-food items as well. Although some waste streams are directly weighed (i.e. landfill and protein) other waste streams (i.e. food donation) are estimates of usual tonnage. In the onsite audits in this study actual weights were collected for all waste streams and food items were separated from non-food items. Due to inconsistencies in audit procedures and reporting methods it was only possible to make a direct comparison between one store that was audited and the corresponding data recorded for that store by the food retail body. For this store, estimates for retail food waste generated in this study were 92% of average daily food waste generated over a 7-month period reported by retailers.

4. Discussion

This is the first study to quantify retail food waste in New Zealand and to use qualitative methodology to identify motivators and barriers to reducing retail food waste. We estimated that, on average, 3 kg/capita/year of food is sent to landfill by the retail sector, substantially less than the 29 kg/capita/year by New Zealand homes (Yates, 2015). An important motivator for reducing retail food waste is a concern for the environment, but maximising profit also motivates many retail staff.

The most common barrier to further reducing retail food waste was a lack of staff training.

4.1. Food waste and diverted product by food category

Fresh vegetables were the most discarded product by weight, contributing to 27% of all food wasted or diverted at a retail level in New Zealand by retailers; fresh fruit (17%) combined with vegetables to 44% of total wasted and diverted product (see Table 4). Lebersorger and Schneider (2014) found that 68% of total food wasted or diverted that was measured during onsite audits was attributable to fresh fruit and vegetables in Austrian supermarkets, with 89% of the fruit and vegetables discarded due to apparent imperfections. Tesco excludes food donated to food rescue charities and as animal feed from their estimates, therefore it is only possible to make comparisons between food directed to ‘food waste’ destinations, including anaerobic digestion, a disposal method highly utilised in the UK but not in New Zealand. Approximately 35% of total food waste in UK stores was produce (Tesco PLC, 2018a), slightly higher than the 34% in Central European stores (Tesco, 2018) and 31% in Irish stores (Tesco Ireland, 2018). When diverted food was subtracted from estimates in this study only 7% of food waste was fruit and vegetables (see Table 4), well below the Tesco estimates, suggesting that New Zealand retailers are diverting significant quantities of fresh vegetables and fruit.

In the present study bakery goods contributed to 23% of total food waste and diverted product (see Table 4). Tesco report that bakery waste made up 26% of total waste in Central European stores (Tesco, 2018), 25% in Irish stores (Tesco Ireland, 2018) and 15% in UK stores (Tesco PLC, 2018a). When donated and diverted food is excluded, as is done by Tesco, only 12% of retail food waste in New Zealand is bakery goods (see Table 4), similar to the UK estimate and less than half that of Central Europe and Ireland. Dairy only makes up 6% of total food waste and diversion in New Zealand stores (see Table 4), less than the 11% and 10% in Tesco stores in the UK and Ireland, respectively (Tesco PLC, 2018a; Tesco Ireland, 2018), and similar to the 8% reported by Tesco in Central European stores (Tesco, 2018) and the 6% reported by Lebersorger and Schneider (2014) in Austrian stores.
4.2. Food diverted to animal feed

In this study, nearly half of all food not sold or used at a retail level was diverted to animal feed (see Table 3). Diverting food waste to feed livestock is a popular way of managing waste in New Zealand, and preferred over sending food to landfill, while this practice is less common in the UK and countries throughout Europe (Salemdeeb et al., 2017). There are concerns in the UK about using waste to feed animals and the increased risk of disease, with the 2001 epidemic of African Swine Fever and Foot and Mouth (Salemdeeb et al., 2017) a good example of how food waste contaminated with disease-causing bacteria and viruses fed to pigs was spread to people. In most countries across the UK and EU donation of waste to feed animals is illegal, unless the waste has been certified as safe (i.e. no risk of contamination with animal product) or temperature treated (Salemdeeb et al., 2017). From WRAP’s figures we estimate that ~0.5 kg/capita/year of food waste is diverted to feeding animals in the UK (Parfitt et al., 2016), which is considerably less than the estimated 6 kg/capita/year in the New Zealand retail sector reported in this study. However, feeding food waste to omnivorous livestock such as pigs and chickens has been touted as a ‘win-win’ for farmers and for the environment and there is an international movement to explore how to safely allow the recycling of more categories of food waste into animal feed. For example, the UK’s Department of Environment, Food and Rural Affairs is currently considering removing its current ban on processing meat-containing food waste to feed pigs. According to New Zealand’s Biosecurity Regulations (NZ Parliamentary Counsel Office, 2005) meat-free waste can be fed to pigs without further treatment, but food waste that has come into contact with meat, must heated to 100 °C for one hour to destroy any disease-causing bacteria and viruses before being fed to pigs. Given that New Zealand is successfully converting food waste to animal feed in a safe and economically viable way, there is merit for regulators in countries where legislation still currently prohibits this practice to take note of the New Zealand example.

4.3. Food diverted to food donation

In New Zealand, we estimate that approximately 15% of all food not sold or used at a retail level is donated to charities for human consumption (see Table 3). This is more than double that of the 7% of food donated by retailers in Austria (Lebersorger and Schneider, 2014). The smaller proportion of donated food observed in Austria could be attributable to store policy, where some retailers do not allow donation of food to charities (Lebersorger and Schneider, 2014). In this study, the research team felt that much of the food diverted to animal feed was of sufficient quality to be diverted to charities for people to consume. Determining what food can go to food rescue charities can be difficult. Most New Zealand supermarkets use the “would I eat it?” criteria, where the staff member only directs food to donation that they would eat themselves and diverts anything else to other destinations. Gruber et al. (2016) comment that understanding food waste is very subjective, and that ‘the meaning of waste lies in the beholder’. Clear guidelines, communication and training staff to determine food as waste or as edible product is required to minimise unnecessary waste. WRAP estimated that 17,000 tonnes of food currently donated for animal feed in the UK are suitable for human consumption, and that a further 93,000 tonnes of food wasted per year in the UK could be donated to food rescue organisations (Parfitt et al., 2016). Better guidelines for handling product and deciding its fate are needed at a retail level.

4.4. Food diversion

Results from this study indicated that an estimated 77% of all discarded food in the New Zealand retail sector is diverted away from landfill (see Table 3), similar to the 72% of food diverted in the US retail sector reported by the Food Waste Reduction Alliance (2016). These results suggest that New Zealand retailers are keeping pace with international efforts to divert food waste from landfill. Retailers in New Zealand have invested significantly in establishing relationships with groups who can use their waste as a resource (e.g. protein reprocessors, local farmers, commercial composters and charities). Establishing these relationships and managing the logistics involved with diverting food from landfill requires significant process and infrastructure changes (i.e. separate bins, storage space and staff training). It also requires buy-in from staff to ensure that the correct processes are carried out in-store to divert food waste. Organisational culture is an extremely important component in embedding diversion into usual waste management practices and these high diversion rates show that New Zealand retailers are successfully building this culture. Fillimonau and Gherbin (2017) noted that food recycling and donation are also a priority for UK retailers. Tesco retail chain in the UK diverts 73% of their unsold food that is safe for human consumption to charities and animals (Tesco PLC, 2018a). The Courtauld Commitment in the UK plays a major role in encouraging retailers to be accountable for their food waste (WRAP, 2017). In total, 85% of retailers in the UK have signed the Courtauld Commitment aiming for a 20% decrease in all food and drink waste by the year 2025 (WRAP, 2017). Retailers in New Zealand are following suit with the recent announcement by Countdown, one of New Zealand’s leading retail chains, to send zero waste to landfill by 2020 (Countdown, 2017). As this research shows, although New Zealand retailers are already diverting a large proportion of waste from landfill, there is still room for improvement with 14,000 tonnes of food estimated to be directed to landfill per year by New Zealand’s three leading supermarket chains.

4.5. Food waste to landfill

In total, it was estimated that approximately 23% of total food waste and diverted product is directed to landfill in the New Zealand retail sector (see Table 3), which is slightly less than the 28% estimated by the Food Waste Reduction Alliance to have been sent to landfill in 2016 by retailers in the US (Food Waste Reduction Alliance, 2016). As landfill is at the bottom of the food waste hierarchy, and the least favourable destination for food waste, it is crucial to gain an understanding of what products are being sent to landfill and how waste to this destination can be reduced (Whitehead et al., 2013). Dairy is the food category that made the biggest contribution (i.e. 23%) to food waste directed to landfill (see Fig. 3). Many supermarkets struggle with diverting dairy due to its shelf-life and temperature sensitivity. Dairy reprocessing (i.e. the collection of dairy waste for reformulation) is one available mechanism to divert dairy waste in New Zealand, however, this avenue was only utilised in one audited store, and more retailers could investigate this option. Managing dairy waste in-store should be a key waste management priority for retailers in New Zealand, given the role of the dairy industry in the New Zealand economy. Retailers could explore opportunities to donate dairy product that is close to its ‘best before’ date to the growing number of charities with refrigerated storage facilities. Stock rotation is also important in reducing waste of dairy products, where shorter dated product is brought to the front of the shelves and new product is stacked behind.

Bakery, and meat and fish each contributed to 21% of the total waste sent to landfill (see Fig. 3). Producing meat and fish is very resource intensive (i.e. 1 kg of beef consumes 14–32 kg CO2-e) (de Vries and de Boer, 2010), and sending this to landfill is an inefficient use of resources. Until recently, diverting meat and fish has been problematic in New Zealand. However, food rescue organisations are beginning to accept meat that has been frozen before its ‘use by’ date, an avenue that could be explored by more stores. Out-of-date product can also be removed from its packaging and placed in protein bins which are sent for reprocessing. This is a simple solution as most stores already have the necessary bins and processes in-store to divert butchery waste and could use the same bins for front-of-house meat waste. The relatively
short shelf-life of temperature sensitive foods such as dairy, meat and fish can be a large source of food waste as retailers have a short window of time that product needs to be sold within. In addition to exploring diversion avenues for these products and tweaking in-store processes, technological improvements to packaging (i.e. active packaging which controls the environment inside the packet) (Arias Bustos, 2017) will likely assist retailers to minimise waste by providing a more sensitive measure of deterioration, specific to the individual food item, rather than a date label, which may help to keep safe food from being prematurely discarded (Mehebi and Marquez, 2015). The introduction of smart packaging, however, should be coupled with circular economy packaging principles and constant improvements to in-store processes such as forecasting.

Bakery waste amounted to 21% of all food sent to landfill (see Fig. 3); bread is the number one wasted food product by New Zealand households (Yates, 2015). Cicatiello et al. (2016) and Brancoli et al. (2017) also identified bread as a problematic food product in their case studies of Italian and Swedish retail food waste, respectively. In the retail sector in Austria, it was found that bread was available for donation at a rate that exceeded the demand of the food rescue sector (Schneider, 2013); similar observations were made in this study. Bakery production schedules should be adjusted based on sales to reduce bakery waste. Issues with forecasting were also identified as a contributing factor to food waste by Stenmark et al. (2011). Re-framing the cost-benefit to retailers will be important as bakery product is very cheap to produce. In this study, one store manager commented that over-production can be profitable even when only one loaf in 20 is sold.

4.6. National estimates

This study has estimated that approximately 23,000 tonnes (i.e. 5 kg/capita/year) of food waste, excluding food donated to humans or as animal feed, are generated per annum by the New Zealand retail sector. This estimate excludes donated and diverted food in agreement with the FUSIONS definition (Östergren et al., 2014). In contrast, estimates generated by FUSIONS for retail food waste in Europe equate to approximately 9 kg/capita/year, and vary greatly between countries, with some producing 4 kg/capita/year, and others producing 30 kg/capita/year (Stenmark et al., 2016). Overall, the New Zealand retail sector appears to be performing well in terms of managing retail food waste, producing almost half the per capita food waste of estimates reported for Europe. The large range in values in the EU is likely attributable to different methods of quantification. Much of the data for retail food waste in the EU is self-reported by retailers and methods used to quantify food waste by retailers are likely to vary. The use of standardised quantification protocols such as the FUSIONS manual and the Food Loss and Waste Accounting and Reporting Standard (Tostivint et al., 2016; Hanson et al., 2016), as employed in this study, may reduce this variability as well as making comparisons between countries easier.

Estimates for food waste directed to landfill for New Zealand’s retail sector are approximately 3 kg/capita/year, compared to 29 kg/capita/year at a household level (Yates, 2015). This shows that household food waste is 10-fold more per capita than retail food waste, which is unsurprising considering the streamlined waste management procedures at a retail level (Eriksson, 2012). A 10-fold difference in consumer to retail food waste has also been reported in Europe and Australia (Stenmark et al., 2016; Arcadis Consultancy, 2019). The results of this study are important, providing further evidence that consumers and households need to take more responsibility for food waste.

4.7. Motivators and barriers to food waste reduction

Interventions to reduce food waste are unlikely to be successful unless they address both motivators and barriers (Graham-Rowe et al., 2014). In the present study, concern for the environment was a dominant motivator for food waste reduction in a retail setting. The ‘clean, green’ image of New Zealand may have heightened retailers’ awareness of the environmental impacts of their actions and their personal responsibility to protect the environment. This differs from interviews by Gruber et al. (2016) (study location not disclosed), and Hocke (2014) in the Netherlands, where environmental motivators were not articulated by retail managers in either study.

Financial motivators were also important drivers for food waste reduction. From a business perspective, reducing food waste will reduce loss of profit from wasted product, as well as costs associated with waste disposal. In the Netherlands, Hocke (2014) found profitability to be an important motivator for food waste reduction. A cost-benefit analysis conducted by Champions 12.3, a group dedicated to achieving SDG 12.3, showed that for every $1 invested by retailers in food waste reduction, an average of $5.1 of realised benefit would be gained (Hanson and Mitchell, 2017).

Non-financial barriers such as satisfying ethical responsibility and strengthening customer relationships were also noted as significant motivators for retailers to reduce food waste by Champions 12.3 (Hanson and Mitchell, 2017). Reducing food insecurity was important to business leaders across the food supply chain interviewed. In this study the corporate social responsibility for retailers to do the ‘right’ thing and reduce food waste was important. The benefits, including reputation and gaining customer loyalty through taking social responsibility to manage in-store waste and support the community by donating food, should not be underestimated (Arias Bustos, 2017).

The most important barrier to the reduction of retail food waste was training and educating staff. Clear systems and empowering staff to make the right decisions are crucial for the success of waste reduction initiatives, and this requires increased staff training. However, a difficulty with staff training noted by Gruber et al. (2016) is that many retail staff work part-time, on low wages, and staff turnover is high. Given this problem, the cost of throwing away food may be less than the cost of training staff on waste management procedures. This is a significant challenge for the sector. However, investment in training staff in the present is likely to embed good practice and reduce the need for formal training in the future, leading to both financial and non-financial benefits for retailers (Hanson and Mitchell, 2017). In terms of practical implications, this research recommends that retailers should determine processes and partnerships for redistribution, including guidelines for staff and systems for measurement. The ways in which stores deal with these issues could become a sustainability measure and performance indicator, potentially saving money for retailers as well as doing social and environmental good (Holweg et al., 2016).

Concern for food safety was also a dominant barrier to food waste reduction mentioned by retail staff. Often edible product was discarded due to store regulations around date labelling. The ‘immunity for food donors’ clause was introduced in New Zealand in the Food Act 2014 and aimed to protect a food donor from liability if the product was deemed fit for purpose at the time of donation (NZ Parliamentary Counsel Office, 2014). Despite this clause, retailers continue to act with caution when donating food. Issues concerning best before date labels and their contribution to food waste were also raised by Eriksson (2012), Lebersorger and Schneider (2014), and Mena et al. (2011).

The desire by both retailers and consumers for high quality products was another barrier to waste reduction identified in the present study. This barrier was also noted by Stenmark et al. (2011) and Gruber et al. (2016) during interviews with store managers. Stores overstock shelves in order to make displays full and appealing to customers. Stenmark et al. (2011) identified that some retailers over-cater by more than 7% to ensure that customers’ needs are met. In the present study, many stores commented that poorer quality product was removed from shelves to ensure that customers are satisfied with the standard in-store and to maintain customer loyalty. Hermsdorf et al. (2017) also conducted a study using qualitative interviews to determine the practices of German retailers to reduce food waste and suggested that retailers consider education campaigns that would inform consumers that...
visually imperfect food, despite being edible (and nutritionally sound), would be wasted if not purchased.

Donation of food to farmers or food rescue organisations was not available to every store, nor did food waste recipients have the capacity to receive all the food available for donation which was identified as another barrier to further food waste reduction. Focus needs to shift to reducing food waste at the source which would reduce demand for food diversion avenues and alleviate pressure on food rescue charities to handle, store and redistribute the quantity of food available to them (Schneider, 2013). Several retailers also mentioned they were unsure what avenues were available to them to divert food away from landfill (i.e. food rescue), and believed that some food products cannot be diverted, although this was not true. Mena et al. (2011) suggest that retailers need to be informed of avenues available for diverting food waste, and resources need to be invested in these alternate avenues to ensure that waste diversion can take place. Without expansion of the food rescue sector, it is not feasible to divert all edible food not sold in supermarkets to humans (Graham-Rowe et al., 2014).

4.8. Policy implications

This study has found that the quantity of food wasted in the retail sector in New Zealand is relatively low. Furthermore, supermarkets implement a wide variety of strategies, such as working with food rescue organisations and local farmers, that effectively divert a large proportion of retail food waste away from landfill. In terms of food rescue, as foreshadowed in the introduction section, the politics are complicated, with commentary that charitable responses to food insecurity have masked the broader contributing factors to poverty and absolved central government of the responsibility to address the root causes of hunger (Riches and Silvasti, 2014). While existing theorisations of food rescue in the academic literature that have applied either a food security lens or a political economy perspective have tended to emphasise the negativities of food rescue, most of the discourse from the retailers in New Zealand was focused on the positive benefits of this activity. Moving forward, we recommend a public policy approach of pragmatism. One of the study’s authors has previously reported on this approach elsewhere stating that “we too subscribe to the idea that in an ideal world, food would not be wasted to begin with and there would be no need for these food rescue enterprises”. There are much more economically viable and environmentally sustainable solutions for addressing both food waste and food insecurity. In the future, supermarkets, as focal points of local communities, could lead a change in the current food industry narrative of diverting food waste to charities as part of a coordinated, community-centric and multi-faceted strategy to reduce food insecurity in a culturally appropriate way. In the present, when many food retailers are still generating a large amount of waste each day and large numbers of people continue to go hungry, food rescue looks to be one of the short-term solutions to address food waste and food insecurity. So rather than subscribe to a politics of abandonment, “in the meantime” we should work to increase the social value that perishable food rescue social enterprises can create for both their stakeholders and the wider community, while longer term solutions to the problems of insecurity and waste are sought (Cloke et al., 2017; Mirosa et al., 2016). New Zealand retailers provide some financial support to food rescue charities to enable them to continue to deliver their services. However, sustained centralised funding for wraparound support is essential to ensure that food rescue is not used as a band-aid for much more complex social challenges (Mirosa et al., 2016).

In terms of diversion to animal feed, one surprising finding in the current study was the relatively large proportion of retail food waste diverted to pig farmers. As the Advisor’s report to New Zealand’s Parliamentary Select Committee’s briefing on food waste indicated (Mirosa, 2019), there are huge global environmental benefits of converting food waste to animal feed in terms of reducing the land use footprint for crops grown for animal feed. There are also a raft of economic benefits, including reducing feed costs as well as the potential to produce premium meat products from animals raised on this “eco-feed”, with some consumers viewing animals fed this way as healthier and more environmentally friendly (Kurushima et al., 2013). Given this, policy makers elsewhere in the world are encouraged to consider adopting legislation similar to New Zealand’s progressive regulations in this area.

The interviews revealed a number of barriers to waste reduction in-store where public policy could help enact change. For example, the quality standards maintained for food on the shelves of supermarkets and the need to keep shelves continually well stocked were touted as drivers for waste. In such instances, the recommendations made by Gruber et al. (2016) to focus policy efforts on consumer education would seem to be sensible. Given the retailers perceived need to respond to consumer demand, unless consumers understand why, and are prepared to accept, supermarkets experimenting with, for example, a policy of ‘running out’ rather than continual restocking, supermarkets will be unlikely to undertake such activities without understanding how customers will respond to these changes. Supermarkets could, however, leverage their lines of communication to consumers via educational campaigns about their restocking practices. Consumer-facing campaigns have been used as a vehicle by New Zealand retailers to communicate environmentally-minded retail changes to customers, for example, Foodstuffs had a reusable food storage container promotion encouraging the reuse of leftovers. The success of such campaigns demonstrates the value of education as a tool to take customers on the waste minimisation journey with the retailer. A number of supermarkets elsewhere in the world have adopted initiatives to further reduce food waste, many of which could be applicable to the New Zealand context. Moving the mishapen or visually impaired fruit and vegetable into the mainstream existing economy lines of produce in an attempt to normalise these non-uniform types of produce is one such example where a number of countries are further ahead of current practice in New Zealand. Another example where New Zealand retailers could learn from their counterparts is store policies to change practices that encourage overconsumption, for example, removing buy-one-get-one-free offers, and phasing out of products known to be the subject of high food waste, such as bagged salad.

In contrast to the relatively low quantities of wasted food in the retail sector, the quantity of food wasted by the New Zealand consumer is considerably higher. WasteMINZ, the representative body of New Zealand’s waste and resource recovery sector, undertook a nationwide audit of household food waste between 2014 and 2015 (Yates, 2015). Using the results of this national study, annually, 29 kg/person/year of household food waste goes to landfill in New Zealand, which is substantially higher than the 3 kg/person/year of retail food waste that goes to landfill. Given that governments have limited funds, policies that address consumer and household food waste will have a bigger impact on reducing overall food waste in New Zealand, than policies focusing on the retail sector, noting, of course, that these two sectors are intertwined and policies aiming to reduce waste in one sector will likely have spillover (either negative or positive) impacts on the other.

4.9. Strengths and limitations

The study was the first of its kind to quantify food waste at a retail level in New Zealand and used the gold standard definition for food waste (Ostergren et al., 2014). This was also the first study to use the Food Loss and Waste Accounting and Reporting Standard guidelines (Hanson et al., 2016) to quantify retail food waste in the Asia-Pacific region which enabled internationally comparable estimates. The recommended method of direct weighing was used to measure food waste. Using a mixed-methods approach to researching retail food waste in New Zealand allowed progress to be made towards both the ‘measure’ step and ‘act’ steps of SDG 12.3 by quantifying the amount of waste produced and understanding the key motivators and barriers to
future reduction.

A limitation of the study was the self-selected sample of stores by retail bodies, which could introduce bias if retailers suggested stores with better waste management practices (Eriksson, 2012), leading to an underestimate of retail food waste. A convenience sample was taken to ensure compliance and retention of recruited stores within the short timeframe available for the study. Due to the commercially sensitive nature of measuring retail food waste it was necessary to establish relationships with the retail bodies who could communicate the value and intentions of the study with the store owners and managers to obtain buy-in. Without this top-down approach it would have been challenging to recruit stores. This method is commonly used internationally in food waste quantification studies, for example in the UK and Spain, Sweden and US due to the aforementioned challenges (Mena et al., 2011; Eriksson, 2012; Buzby et al., 2015). Bias was reduced by emphasising that retailers recruit both well performing stores and poorer performing stores and, with clear guidance, this approach capitalised on each retail body’s institutional knowledge of waste performance across their stores. The variance in audit data collected within each retail chain indicated that the retail body representatives did provide a range of stores, however we were not able to present data for individual chains due to commercial sensitivity. Supermarkets located rurally are likely to have different waste patterns compared to urban supermarkets, due to a greater range and number of available waste diversion options in urban centres, and may overestimate food diverted to food donation and underestimate food sent to landfill and animal feed at a national level. Finally, as the stores included were not representative of all supermarkets in New Zealand, caution must be used when interpreting data scaled to obtain a national estimate, however, we felt that presenting retail food waste per capita was useful to place such data in context, as per capita consumer food waste in New Zealand has been widely publicised. Supermarkets are often blamed for contributing to food waste, when, in reality, substantially more food is wasted by the consumer.

5. Conclusions

New Zealand retailers appear to be making a significant effort to reduce the waste they send to landfill by diverting approximately 77% of waste to other destinations. Almost 50% of all food measured in this study was directed to animal feed, and 15% was donated to food rescue charities. The food waste hierarchy prioritises the reduction of the quantity of food waste, followed by redistribution, recycling and then disposal (Whitehead et al., 2013). At a retail level, the primary focus should be on reducing the physical quantity of food waste produced at the source. Of products sent to landfill, dairy, meat and fish, and bakery are the largest contributors and should be targeted in future food waste reduction initiatives in the sector. It is important that any intervention makes the most effective use of resources. Framing an intervention in a way that motivates retail staff and overcoming barriers is essential to reduce food waste in an informed and purposeful way. It is important for staff to be aware of the findings of Gobel et al. (2015) “that practices which lead to food waste often take effect across various levels of the food chain, so quality standards and requirements of the later stages of the food supply chain cause a downshifting of food waste along the food supply chain towards the earlier stages”. Therefore, investment in staff training and conveying the environmental, social and financial benefits of reducing food waste will likely lead to sustained and meaningful food waste reduction not only in the retail sector, but across the entire food supply chain.

Author contributions

FGS, MM, and SAS designed the research. FGS conducted the research, analysed the data and wrote the first draft of the paper. FGS, MM, and SAS were involved in interpreting the paper the results and editing the manuscript. SAS had primary responsibility for the final content. All authors read and approved the final manuscript.

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CRediT authorship contribution statement

Francesca Goodman-Smith: Conceptualization, Methodology, Validation, Investigation, Data curation, Writing - original draft, Writing - review & editing, Project administration. Miranda Mirosa: Conceptualization, Methodology, Validation, Investigation, Writing - review & editing, Supervision, Funding acquisition. Sheila Skeaff: Conceptualization, Methodology, Validation, Investigation, Writing - review & editing, Supervision, Funding acquisition.

Declaration of Competing Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Data Availability Statement

The datasets for this study are not publicly available because of commercial sensitivity. Requests for access to the data can be directed to Sheila Skeaff (sheila.skeaff@otago.ac.nz).

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.foodpol.2020.101845.

References


Filimonau, V., Gherbin, A., 2017. An exploratory study of food waste management