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Food waste in Australia and New Zealand

Authors
Miranda Mirosa <miranda.mirosa@otago.ac.nz>
David Pearson <d.h.pearson@cqu.edu.au>
Christian Reynolds <c.reynolds@sheffield.ac.uk>

Bios and ORCIDS

Miranda Mirosa is Associate Professor in the Department of Food Science, University of Otago. Miranda is a Consumer Food Scientist with a background in agri-food marketing and consumer behaviour. She conducts consumer insights and strategic marketing communications-type work for the New Zealand (NZ) food and beverage industry. She is most passionate about her work on waste. Miranda has represented NZ on the committee of a multi-year APEC project "Strengthening Public-Private Partnership to Reduce Food Losses". She also was awarded a government "Postharvest Loss and Food Waste Research Fellowship" to enhance business-research-government partnerships in NZ and China through commercially meaningful research. Miranda has recently served as the Specialist Advisor to Parliament's Environmental Select Committee's National Briefing on Food Waste. https://orcid.org/0000-0002-4476-3793

David Pearson is the Engage Program Leader in the Fight Food Waste Cooperative Research Centre. David's research expertise is in leading multidisciplinary collaborations addressing issues of concern in society. Most recently this has focused on encouraging consumers to make considered choices, such

as dietary options to improve personal health and contribute to a more environmentally sustainable global food system. In addition, he has considerable leadership achievements in tertiary education as well as significant engagements with industry, government and charity sectors. He is a Professor of Marketing in the School of Business and Law, and the Appleton Institute, at the Sydney campus of Central Queensland University.

Christian Reynolds is a Knowledge Exchange Research Fellow at the Department of Geography, University of Sheffield, a Technical Specialist in international food sustainability at WRAP, and an adjunct Research Fellow at the Barbara Hardy Institute for Sustainable Environments and Technologies, University of South Australia. Christian's research examines the economic and environmental impacts of food consumption; with focus upon food waste, and sustainable, healthy and affordable diets. He is a co-editor with Lazell, Soma, and Spring of the upcoming Routledge Handbook on Food Waste. https://orcid.org/0000-0002-1073-7394

Abstract

This chapter reviews the existing food waste research in Australia and New Zealand. It then examines the history and development of food waste policy in Australia and New Zealand, the drivers and composition of food waste in New Zealand, along with the economic and social impacts and what potential interventions might be helpful. This includes highlighting the potential of information campaigns, voluntary agreements and valorisation as possible future food waste reduction actions.

Introduction

Australia and New Zealand have two of the highest per capita food waste generation rates of any developed countries. This chapter reviews existing research into food waste in Australia and New Zealand; examines the history and development of food waste policy in Australia and New Zealand; discusses drivers and composition of food waste in New Zealand, and their economic and social impacts, and suggests some potential interventions including voluntary agreements and valorisation.

Food waste in Australia

Food waste has long been a background issue for Australian citizens and government. in the last decade however, it has gained prominence. Examples of this increased attention include separate food waste collections becoming standard in many local area councils (Zero Waste SA, 2005); food rescue organisations expanding their activity (Reynolds et al. 2015); the FOODWISE campaign (Do Something, 2013); and the Australian Broadcasting Corporation's production of two seasons of Craig Reucassel's War On Waste (2017 Season 1, and 2019 Season 2; https://www.abc.net.au/tv/programs/war-on-waste/). The remainder of this section will review the existing research and quantification of Australian food waste, and then report on recent Federal policy developments.

Research and Quantification

There is a history of broader waste and discards research in Australia with Hawkins (2006, 2007, 2012) publishing her foundational book on waste and ethics in 2007. Also in 2007, Edwards and Mercer (2007, 2012) published on the nascent Australian gleaning movement, examining how this youth subculture engages and reinterprets the ethics of food waste.

However, specific academic exploration and research concerning the food waste only developed after the publication of the 2009 report by The Australia Institute (Baker et al., 2009) that quantified the cost Australia's food wastage at approximately $5.2 billion dollars a year. Adding to the interest in food waste was the *Food Waste Avoidance Benchmark Study* (NSW Environment Protection Authority, 2009). This estimated that NSW households spent approximately $2.5 billion on food that was not consumed. This evidence base was further bolstered in 2011 by the National Food Waste Assessment (Mason et al., 2011), which collated multiple waste data sources to calculate that 7.5 million tonnes of food waste generated in 2008–09 – the landfilling of this volume of waste generating 6.8 million tonnes of CO2-e.

In response to a research need demonstrated by a 2009 report from the Australian Institute, the Australian Research Council funded "*Zeroing in on food waste: Measuring, understanding and reducing food waste"* a Linkage Project between Central Queensland University, University of South Australia, Flinders University from 2009-2013. This interdisciplinary research project engaged with food waste on many fronts. It quantified tonnages of food waste at the national level as well as economic and environmental costs of food waste in Australia (Reutter et al., 2017a, Reynolds et al., 2015a, Reynolds et al., 2014a, Reynolds et al., 2014b). Reynolds et al estimated that in 2008, 7.3 million tonnes of food waste were generated in Australia, making food waste the second largest category of waste generated. Australian households formally disposed of 9 kilograms of food waste per house, per week in 2008. Households generated 56% of food waste. The service sectors produced 20%, manufacturing sectors 10%, and the agricultural sectors 7%. Using Input-Output analysis, it was determined that every tonne of waste sent to landfill created economic activity worth $2.53, whereas every tonne of waste composted creates economic activity worth $47.37. Reynolds et al (2014a) also estimated that an additional 1.45 million tonnes of food waste per year (26% of total household food waste generated) were disposed of by informal routes such as home composting, feeding to animals, disposing via the sewer, donating to charity, or illegally dumping. This equates to an additional weekly average of 3.21 kilograms of food waste through informal methods.

The economic and environmental impacts of food rescue operations (Reynolds et al., 2015b), feeding food scraps to pets (Thompson et al., 2015), shifting to anaerobic digestion waste treatment methods (Zaman and Reynolds, 2015) and shifting to sustainable diets (Reynolds et al., 2015) (Reynolds, 2016; Reynolds et al., 2015) to reduce food waste were all examined. The estimated impact of food rescue operations is notable with 18,105 tonnes of food waste rescued in 2008, generating approximately six kilograms of food waste per tonne of food rescued, at a cost of US$222 per tonne of food rescued. It was also calculated that for every US dollar spent on food rescue, edible food to the value of US$5.71 (1863 calories) was rescued (Reynolds et al., 2015).

As discussed in Reynolds et al. (2015), in Australia there are four main food rescue organisations: Foodbank, Secondbite, Fareshare and OzHarvest. These food rescue organisations operate predominantly throughout the Eastern states and South Australia, but some have now expanded

Australia wide. These charities collect food "waste" that is still fit for consumption but is either close to becoming inedible (retail food that will soon reach its use-by date, and thus cannot be sold) or is surplus to requirements (food left unserved at the end of a banquet or event). Though each charity operates in its own unique manner some operation (ie there are differences in the foods each operation rescues, and how it distributes this food onward), generalisations are possible. The main industry sectors to donate food waste to charities are service (hospitality and events) and manufacturing. Charities receive the donated foodstuffs, transform the food into meals or food parcels and then supply these directly or through a secondary charity, Non-Government, or religious organisation. The recipients of this rescued food are people who are food insecure and usually live in poverty.

Zeroing in on food waste project (2009-2013) also provided foundational Australian food waste research beyond quantification of food waste tonnages, economic or environmental impacts. This project developed food waste theory and methods across multiple fields to create a socio-culturally aware public education and social marketing programme to reduce food waste behaviours. The project achieved the following. It improved metrics and measurement methods for the monitoring and evaluation of household food waste prevention interventions (Høj, 2012); provided the first Australian ethnography of household food waste (Mavrakis, 2014); developed interventions to reduce household food waste based on the trans-theoretical model of behaviour change (Davison, 2015, Davison et al., 2011); established Conceptual Foundations for food rescue and redistributed food (Vlaholias et al., 2015a, Vlaholias et al., 2015b); examined how food waste was portrayed in Reality Food Television (Thompson and Haigh, 2017). Finally, the history of food waste as a policy issue in Australia was also examined by this project (Reynolds et al., 2011).

In addition to *Zeroing in on food waste*, other Australian food waste research was published from 2010 onwards. Ridoutt et al. (2010) quantified the water footprint of fresh mango in Australia, and Pearson et al. (2013), provided foundation exploration into the drives of why food waste occurs in Australian households. In 2017 Reutter et al. (2017b) expanded upon the quantification of Australian food waste at the national level, finding that different estimation methods produced diverse results for food waste characterisation, and that some food waste estimates provide inconsistencies when compared. Pearson et al. (2017) also published work examining how to further improve and reframe communications that encourage individuals to reduce food waste; this took into account previous major consumer-focused communication campaigns from Australia and New Zealand. They conducted 29, 60 minute qualitative interviews to provide a deep understanding of the subjective experiences and perceptions of individuals regarding food behaviours. These interviews found that though most individuals thought food discards were highly undesirable, they were not aware of food wastes magnitude in terms of the amount discarded on a personal or a global scale. Nor are individuals knowledgeable about the impacts of food waste. Examining contemporary communications campaigns, they found that they needed to further incorporate broader context issues such as the systemic and structural issues rather than focus on individual choices alone. In 2018 Pearson and Perera (2018) then published a *Practitioner Guide for Integrated Social Marketing Communication Campaigns to Reducing Food Waste*. This provided the core advice of using Headline facts; concentrating on most impactful food waste reduction behavior changes; identifying specific groups of individuals to target (along with their motivations); and frame messages according to these individuals and their motivations.

Also in 2018, Benyam et al. (2018) surveyed residents of two Queensland communities (Rockhampton Regional Council and Livingstone Shire Council, n=17) on their views of their councils domestic food waste prevention and diversion policies. Residents, seemed to have knowledge of their food waste practice, but were unaware of other initiatives on food waste prevention. Interestingly believed that "other" groups (children) needed more education rather than themselves. Home/backyard composting was the favoured method for council supported food waste disposal, though many participants thought that local government would make their own policy choice irrespective of feedback from residents.

In July 2018, This groundswell of research from 2008-2018 in Australia culminated in the establishment of the Fight Food Waste Cooperative Research Centre - a $130 million industry led, government supported 10 year research program. Its aim is to tackle the growing international (and Australian) problem of food waste by reducing food waste throughout the supply chain, transforming unavoidable waste into innovative high-value co-products, and engaging with industry and consumers to deliver behavioural change. With around 60 industry partners across the complete food chain, this research has an ecology with the capacity to create transformative change (Fight Food Waste CRC, 2019).

Recent policy developments

Australia has a mixed historical relationship with food waste (Reynolds et al., 2011). It emerged as a public health issue, before becoming an environmental issue. Food waste has traditionally been a local government and State rather than a Federal policy issue in Australia. The various state level waste or environment departments providing un-harmonised policy direction of each state; while each local government council area provides direct support and services. The few federal or national level reports were less policy focused, and more focused on the harmonisation of data between the different states and territories (Environment Protection and Heritage Council and The Department of Environment Heritage and the Arts, 2010). Even then food waste was typically placed inside wider waste policy documents.

However, reducing food waste has recently become a priority on Australia's national agenda. The Australian Government launched a national food waste reduction policy in November 2017, followed, in April 2018, by an announcement of funding for a large industry led Fight Food Waste Cooperative Research Centre. Collectively these will assist the country in pursuit of the United Nations Sustainable Development goal of making a significant reduction in food waste by 2030. The National Food Waste Strategy (Commonwealth of Australia and Department of the Environment and Energy, 2017) emerged from extensive consultation with industry, Government (across all three tiers of Federal, State and Local), research community and activist organisations. It provides a framework for action across four priority areas.

The First of these areas is policy support. This encompasses national measurement of food waste, identifying areas to target with investment for food waste reductions, establishing a voluntary commitment program to reduce food waste and providing enabling legislation to support these activities.

The Second area is business improvements. These encompass identifying areas for improvement, supporting the adoption of technology, encouraging collaboration to identify solutions, and normalising food waste considerations into business practices.

The Third area is market development. This encompasses identifying food waste composition and nutritional value to develop new markets, encourage innovation, and connect food waste sources and users.

The Fourth area is behaviour change. This encompasses changing consumer behaviours and engaging the workforce to minimise food waste.

The Australian Government is leading implementation of this Strategy with guidance from a Steering Committee consisting of representatives of the food waste sector. Key to their approach is seeking a collective effort where 'everyone has a role to play.' Initial funding has been provided for measurement to create National Food Waste Baseline and associated identification of areas for targeted investment (Environment Protection and Heritage Council and The Department of Environment Heritage and the Arts, 2010)..

On 20 March 2019, Australia's National Food Waste Baseline was published (ARCADIS 2019). This provided a benchmark for measuring national performance against the reduction target by establishing a consistent framework to quantify food waste generation and track progress. It estimated that in 2016-17 (the base year), Australia produced 7.3 million tonnes of food waste across the supply and consumption chain. Of this, 2.5 million (34 %) was created in citizens' homes, 2.3 million tonnes (31%) in primary production and 1.8 million tonnes (25 %) in the manufacturing sector. It also found that Australians recycled 1.2 million tonnes of food waste, recovered 2.9 million tonnes through alternative uses and disposed of 3.2 million tonnes. To make this estimate, more than 300 organisations were engaged through a structured consultation process. Of these, 91 submitted some level of data, while others provided anecdotal and contextual information.

It is interesting to note that this quantity of food (7.3 million tonnes) is similar to previous estimates (such as Reynolds et al and Reutter et al, which reinforces the overall scale of the problem). However This estimate apportions food waste is to different parts of the supply chain than previous estimates. This could mean that Australian food waste has "flat lined", however as discussed by Reutter et al, there are many uncertainties regarding food waste quantification. This increase in quantification efforts, research and policy action is welcome, and Australia seems to now be on a strong trajectory to address and reduce food waste.

Food waste in New Zealand

Food waste has become a major issue in New Zealand though the total volume of food lost and wasted is not yet known. As an export-orientated agricultural nation that relies heavily on its 'clean green' reputation, New Zealand has every reason to be at the forefront of efforts to reduce food waste. New Zealand's large scale primary food production sector means that a significant amount of food is likely wasted at the production end of the supply chain. Given that in medium and high-income countries, food is wasted mainly at the later stages in the supply chain, the prospect of a 'double whammy' (excess food wastage from consumerism and large scale primary food production) may well exist in New Zealand. Though currently a lack of robust waste data particularly in the early stages of the supply

chain make this difficult to confirm, observer reporting for example shows that cancelled export orders and crop management are causes of significant volumes of food waste in the horticultural sector (WasteMINZ TAO Forum). Furthermore, New Zealand's strong reliance on exporting has meant that food from New Zealand is subject to very high international market requirements for aesthetic product perfection—also a driver for food wastage. Culturally, New Zealand is well positioned to be taking a strong stance on food waste reduction. Te Ao Māori recognises the traditional system in which nothing was wasted – everything was able to be returned back to Papatūānuku (mother earth) without detriment to the whenua (land), awa (river) or moana (sea) (Auckland City Council, 2018). There are a number of Māori organisations working to reduce wastage. Para Kore (http://parakore.maori.nz/para-kore/what-is-para-kore/), for example, aims to empower and support organisations across New Zealand to work towards zero waste.

Research and Quantification

Until 2013-2014 there was little academic research or quantification of food waste in New Zealand, nor was there any study into food waste behaviours or environmental impacts. There were, however, government reports that discussed food waste as part of the organic waste stream (Ministry for the Environment, 2010, 2009; Statistics NZ, 2008); media reports that valued New Zealand household food waste at $750 million dollars a year (Johnston and Davison, 2011; TVNZ, 2013); audits of hospital food waste (Goonan et al., 2013, Goonan et al., 2014); a master's thesis that investigated household food waste with an intervention case study (Parr, 2013); a literature review by the Waiheke Resources Trust (Waiheke Resources Trust, 2013); and a consulting report for WasteMINZ , the largest representative body of the waste and resource recovery sector in New Zealand (Yates, 2013). These final three documents provide a solid review of pre-2014 New Zealand food waste knowledge and opportunities, although there are large data gaps.

In 2013, WasteMINZ launched the National Food Waste Prevention Project. The first part of the project involved calculating estimates of nationwide household food waste. The main research methods used to collect this data were bin audits (audits of 1402 household bins were conducted across 12 different councils; food waste was separated and weighed (WasteMINZ and Love Food Hate Waste NZ, 2015)) and a nationally representative online survey of attitudes and behaviours that led to food waste (with 1365 households (WasteMINZ, 2014)). The audit of the formal municipal solid waste (MSW) stream found that 122,547 tonnes of food waste, or the equivalent to $872 million worth of edible food, is thrown away every year. This information is now being disseminated via infographics (Love Food Hate Waste NZ, 2015a, 2015b) and council websites (Shore, 2015) as part of a nationwide Love Food Hate Waste campaign (https://www.facebook.com/lovefoodhatewastenz). This is an application of the highly successful Love Food Hate Waste campaign that has been running in the United Kingdom (UK) for the last 20 years (WRAP, 2012). An evaluation of the three-year campaign was released in early 2019 which clearly demonstrated significant impact: results showed that New Zealand households are far more aware of food waste issues than they were three years ago and many households are taking actions to reduce their food waste. Households that had heard of the Love Food Hate Waste campaign and engaged more deeply with food waste were able to make significant reductions to the amount of food they were throwing away (WasteMINZ 2018).

Reynolds et al. (2016) undertook a study that aimed to estimate the tonnage, value, calories, and resources wasted as a result of food waste in New Zealand during 2011. Estimates for tonnage were

generated using input-output tables from the Ministry for the Environment's data on monthly landfill waste-levies. Estimates were inferred through calculations and no physical measurement of waste was undertaken. From these estimates, Reynolds et al. assumed that food waste made up 17 % of total waste in New Zealand, amounting to NZD 568 million or $131 per person. Reynolds et al. estimated that in 2011, New Zealand households generated over 224,000 tonnes of food waste, and New Zealand industry generated over 103,000 tonnes of food waste. They disaggregated New Zealand's food waste into 14 food-waste categories and found that 7% is related to "fresh" produce, and 93% "processed" food waste. Furthermore, New Zealand's food waste represents 163 $\times 10^9$ calories in total, and avoidable food waste would be able to feed between 50,000 and 80,000 people a year. New Zealand food waste embodies 4.2×10^6 tonnes of CO2-e, 4.7×10^9 m3 of water, and 29×10^3 TJ of energy. They found that compared to other nations, New Zealanders waste less food per capita by weight, value and calorie.

Research in 2016 focused primarily on food waste in a food service setting. Mirosa et al. (2016) examined the drivers of food left on plates through semi-structured interviews (n=50). It was found that plate waste was created through interactions related to an individual's hedonism and self-direction – i.e. the individual's enjoyment of the meal and meeting their health goals. Linking this theory to the existing intervention literature they identified effective intervention might include pre-ordering meals, reducing food options provided, reducing plate size, removing food tray and finally, information campaigns to raise awareness.

From a quantification perspective, researchers and WasteMINZ have jointly conducted site audits to understand how food waste is generated. They found that New Zealand's cafes and restaurants throw away 24,372 tonnes of food annually with the drivers of this related to spoilage (7%), preparation waste (70%) and plate waste (33%) (Mirosa et al. 2018). Two Masters theses were also produced from this research project (Jones, 2017, Chisnall, 2017). Doggy bags are often touted as one of the solutions to reducing consumer food waste in this sector, but research conducted with New Zealand consumers revealed that this practice is still not commonplace: 1 in 5 people who had asked for a doggy bag were refused by staff (Mirosa et al. 2018). This study identified barriers and benefits of consumers' current doggy bag behaviours and provided the information required to run an effective community-based social marketing campaign encouraging consumers to take their uneaten restaurant and café food home.

In addition to the above data sources, data is also available from other organisations such as food banks. Of New Zealand's 15 food rescue groups operating in 2017, 14 kept records of the tonnages of food donated, revealing that in 2017, 2,777 tonnes of food was rescued (WasteMINZ TAO Forum). In addition to the food rescue organisation's own data, there is also independent evidence available on the benefits of food rescue. For example, in 2016 and then again in 2018, the University of Otago partnered with food rescue organisation KiwiHarvest to evaluate the social value of rescuing food by nourishing communities. These analyses used a Social Return on Investment (SROI) evaluation tool to demonstrate the efficiency and effectiveness of their operation. Outcomes of food rescue for various stakeholders were detailed (Mirosa *et al.* 2016), and prioritised social, economic and environmental outcomes were valued and impacts calculated, resulting in a SROI ratio (social value) of NZ$5.16 for every $1 invested (Hartshorn, 2018).

As previously mentioned (Pearson et al., 2017) published work examining how to further improve and reframe communications that encourage individuals to reduce food waste, this took into account previous major consumer-focused communication campaigns from Australia and New Zealand.

More recently there has been research into *Retail Food Waste in New Zealand* (Skeaff et al., 2019) (Goodman-Smith, 2018). The estimates for retail food waste in New Zealand amounted to 13 kg/capita/year for all food waste and diverted product (i.e. all food not sold or utilised at a retail level), which included 5 kg/capita/year designated as food waste (i.e. food directed to landfill, protein reprocessing and compost) and 3 kg/capita/year sent to landfill. Fresh vegetables (27%), bakery (23%), meat and fish (19%) and fresh fruit (17%) contributed the most to discarded product. Interviews with 16 retail staff identified the following motivators for encouraging food waste reduction: concern for the environment; making profit; caring for the community; and doing the 'right' thing. The key barriers identified to food waste reduction included: training and educating staff; food safety concerns; quality standards; availability of waste diversion avenues and capacity; and lack of available resources.

Like many retailers elsewhere in the world, New Zealand supermarkets have started selling misshapen or "ugly" fruit and vegetables. In response to this, researchers have started to explore New Zealanders' perceptions of this suboptimal produce. For example, using two qualitative research methods, researchers investigated children's edibility perceptions of suboptimal produce with varied appearance defects. The results show that unlike adult samples previously studied, children are more accepting of suboptimal produce reflecting retailers' opportunities in marketing suboptimal produce to children, who by their familial influence may also be able to get families to buy and consume suboptimal produce (Makhal et al, 2019).

Most recently, the government has invested significant funding into research into improved packaging with a three year research project underway investigating consumer understanding of the importance of smart packaging for consumer confidence, food safety and reduced food loss and waste (Mirosa et al, New Zealand-China Strategic Research Alliance Joint Research (2018-21). Another area where significant public and private investment has been made is in converting unmarketable crops that would have been wasted into value-added products for export. The Bioresource Processing Alliance (BPA, https://bioresourceprocessing.co.nz/) is a programme funded by the Ministry for Business, Innovation and Employment (MBIE) which is a collaborative R&D programme involving research institutes and universities. To date (2018), they have conducted 147 research projects, have had ten products enter the market, which have generated over NZ$2.7m in revenue for companies and have diverted over 2,500T of material into higher value uses.

Recent policy developments

Food waste policy has been primarily developed through general waste policy, with the key legislation being the Waste Minimisation Act 2008 (VVMA) which enables the government's resource efficiency and waste portfolio. The WMA provides funding opportunities for waste minimisation initiatives which the Ministry for the Environment distributes via the Waste Minimisation Fund, including projects focused on reducing food waste such as the Good Neighbour Food Rescue project (https://goodneighbour.co.nz/food-rescue/), the aforementioned Love Food, Hate Waste campaign, and several composting projects that recycle food waste into compost products. In addition to central government, New Zealand territorial authorities (TAs) play a key role in waste minimisation and

management at the local level. However despite engagement from both central and local government, there has not yet been a single national strategy document on food waste.

In 2018-2019, the New Zealand Parliament's Environment Select Committee carried out a briefing to look into ways to prevent the waste of food in New Zealand. Though not a formal inquiry, the briefing focused on learning and understanding what the challenges are and what solutions might exist to prevent and reduce food loss and waste in New Zealand. Over this briefing, the committee received written evidence from over 30 organisations and individuals that are involved in some way with the food sector, or with food waste (New Zealand Parliament, 2019). The Environment Select Committee then invited oral evidence from multiple groups. Videos of the oral evidence submissions are archived on the Environment Select Committee's Facebook website (Environment Committee, 2019a, 2019b, 2019c, 2019d).

General optimism around the potential to reduce food waste in New Zealand is high, with significant interest in the issue in both the public and private sectors. Moving forward, a collaborative whole supply chain approach to food waste prevention is going to be a key determinant of success.

Possible Actions and Interventions for Australia and New Zealand

Although a high level of policy attention is now being given to food waste in Australia and New Zealand, there are gaps between translating this into action and interventions to reduce and prevent food waste. The remainder of this section will highlight these possible actions.

There are different actions that can be deployed in different parts of the food system. Reynolds et al. (2019) reviewed existing academic literature on the effectiveness of different consumer food waste interventions, finding that changing the size or type of plates was effective (up to 57% food waste reduction) in hospitality environments (see chapter 24 for further information); information campaigns were also shown to be effective, with up to 28% food waste reduction (in a small sample size intervention). Other actions for reduction have limited evidence of effectiveness at reducing food waste (e.g. though there is anecdotal/self reported evidence that cooking classes, fridge cameras, food sharing apps, advertising and information sharing all work to reduce food waste. All of these methods have no measured evidence of food waste reductions). Many of these interventions could be tested in Australia and New Zealand.

Australia and New Zealand are currently running information campaigns (Love Food Hate Waste), beginning to actively measure food waste, and also have some industry support for food waste reduction. One logical step would be to expand upon these existing actions through the establishment of a voluntary agreement in each country. In the context of environmental sustainability, Voluntary agreements are schemes in which public and private sector organisations make commitments to improve their environmental performance, without the need for legislation or sanctions. They cover arrangements such as public voluntary programmes, negotiated agreements or unilateral commitments (Boulding, and Devine 2019). One example of an existing food waste voluntary agreement is the Courtauld Commitment in the UK (see chapter 12). With strong governmental leadership and industry support, a food waste voluntary agreement has the potential to create the

right environment to reduce food waste in Australia and New Zealand. These voluntary agreements could also include the creation of food waste reduction targets for the government and industry .

One further action for food waste reduction in Australia and New Zealand would be to increase the amount of valorisation and investment in the bio economy (see chapter 25). In both countries valorisation is still in its infant stage. The growth of the bio economy will lead to greater amounts of unavoidable food waste being transformed into higher value products.

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