

Food waste

A global and local problem

The first report in the food waste series from the Prime Minister's Chief Science Advisor, Kaitohutohu Mātanga Pūtaiao Matua ki te Pirimia.



July 2022

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July 2022

ISBN 978-0-473-64311-9 (PDF)



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Front cover (top to bottom):

1. A commercial garden nourished with local compost.
2. Rescued food picked up from a supermarket.
3. Dumplings being made from rescued food for a community meal.
4. By-product from olive oil production ready to be turned into compost.
5. Otago University's Prof Phil Bremer upcycling bruised apples to cider.

Mā tōu rou, mā taku rourou
ka ora te iwi

Food waste: A global and local problem

Report one in the OPMCSA food waste series

Published 8 July 2022

This report, the first in a series on food waste in Aotearoa New Zealand, explains why food waste is a problem, across environmental, social, and economic dimensions. It explores the definition of food waste, outlines what is known about the scale of problem globally and in Aotearoa and defines the scope of the OPMCSA food waste project. It finishes by highlighting the diversity of stakeholders involved in combatting food waste and summarising existing governmental and intergovernmental efforts already underway.

This report is part of a series of food waste reports to be produced by OPMCSA throughout 2022/23. Subsequent reports in the series will focus on solutions to combat food waste in Aotearoa across the food system and will contain policy recommendations. The series will conclude with a summary report that will collate key messages and recommendations from throughout the project and will add bridging recommendations that capture opportunities at the interface between workstreams.

To learn more about the report series, visit our topic webpage where you can find the food waste project framework <https://www.pmcsa.ac.nz/topics/food-rescue-food-waste/>

This report was produced by the OPMCSA, with support from a wide reference group of stakeholders and experts, who are acknowledged by name on pages 37 to 41 of this report.

If you'd like to be involved in this project in 2022/23 and we aren't already in touch, please reach out info@pmcsa.ac.nz

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Abbreviations

AFRA	Aotearoa Food Rescue Alliance
APEC	Asian-Pacific Economic Cooperation
BPA	Bioresource Processing Alliance
CERF	Climate Emergency Response Fund
CO ₂	Carbon dioxide
CO ₂ e	CO ₂ equivalent
COP	Conference of the Parties, e.g. COP21, COP26
DOC	Department of Conservation
ETS	Emissions Trading Scheme
F&B	Food and Beverage
FAO	Food and Agricultural Organisation of the United Nations
IPCC	Intergovernmental Panel on Climate Change
MBIE	Ministry of Business, Innovation and Employment
MfE	Ministry for the Environment
MoE	Ministry of Education
MoH	Ministry of Health
MPI	Ministry for Primary Industries
MPP	Ministry for Pacific Peoples
MSD	Ministry of Social Development
NSC	National Science Challenge
NZFN	New Zealand Food Network
NZTE	New Zealand Trade and Enterprise
OPMCSA	Office of the Prime Minister's Chief Science Advisor
QMS	Quota Management System
ROI	Return on Investment
SDG	Sustainable Development Goal
TPK	Te Puni Kōkiri
UN	United Nations
UNEP	United Nations Environment Programme
WWF	World Wildlife Fund

Glossary

By-product	In the context of food, a by-product is something that is generated during production, processing, manufacturing, or preparing that isn't the targeted food product. For example, a by-product of processing grapes to wine is grape marc, the skins, seeds and stems left over after pressing grapes. While by-products aren't the desired product themselves, they are not inherently waste – i.e. they can be utilised, in the food system or elsewhere.
Bioeconomy	Aspects of the economy that use biological resources, including food systems.
Circular economy	A shift away from the linear take-make-use-waste approach to resource use, towards an approach to resource use that designs waste and pollution out, keeps products and materials in use, and regenerates natural systems.
Class 1 landfill	Municipal solid waste landfills.
Embodied emissions	The greenhouse gas emissions associated with a material or product throughout its lifecycle.
Food	In this project, food is intended to capture both food and beverages. Unless specified, we are referring to food intended for human consumption.
Food rescue	The process by which surplus food is captured for human consumption, typically as part of a charity model – but this isn't inherent in the term.
Food safety	A condition in which food, when used as intended, is unlikely to cause or lead to illness or injury to human life or public health, as defined in the <i>Food Act 2014</i> . Food safety concepts also apply to animal feed. Food safety should not be compromised in the pursuit of food waste reduction, so will be a key concept throughout this project.
Food supply chain	<p>The whole food value chain, from farm to fork. The main stages of the supply chain are:</p> <ul style="list-style-type: none">• Production (i.e. farming, growing, aquaculture, hunting, fishing, gathering, etc), including pre-harvest, harvest, and post-harvest activities.• Processing (involving one main food commodity) and manufacturing (where multiple commodities are combined to produce a composite food product).• Retail.• Consumption, including through the food service industry and in households. <p>Handling, storage, transport, and distribution occurs throughout the food supply chain. In addition, transactions, collaborations, and information flows – not just biophysical flows – are all part of the food supply chain and can contribute to food waste.</p>

Food system	Food system and food supply chain are used interchangeably throughout this project. Food system is intended to capture the reality that the food supply chain isn't inherently linear but rather is made up of a network of interconnected organisations, entities, and individuals.
Food waste	For the purposes of this project, food waste is defined broadly and inclusively, without attempting to establish a precise definition. We consider any food or drink that isn't utilised according to its original purpose, as well as by-products. We include edible and non-edible components of food and give regard to the variable understandings of food and food waste. The entire food supply chain is in scope.
Food recovery hierarchy	The food recovery hierarchy is a modified version of the waste management hierarchy, specific to food. There are many different versions of the food recovery hierarchy. In this project, the tiers we include are: (1) prevention, (2) rescue for human consumption, (3) upcycling to new food products, (4) animal feed, (5) material recycling, (6) nutrient recovery, (7) energy recovery, (8) disposal. Also known as the food waste hierarchy.
Rendering	A process that converts waste animal tissue to value-added, more stable materials (e.g. processing raw fat to lard).
Surplus food	Quality, safe, edible food that is at risk of being wasted if it isn't used, distinct from food that is spoiled, damaged, contaminated, expired, or otherwise no longer fit for human consumption.
Waste management hierarchy	The waste management hierarchy provides a framework for reducing waste by promoting avoidance of material usage in the first instance and keeping materials in circulation as long as possible in their highest value form, with disposal as a last resort. Also known as the waste hierarchy.

Key messages

- Combatting food waste in Aotearoa has scope to deliver environmental, social, and economic benefits.
 - Wasting food means accruing all the environmental harms and expending the often limited resources associated with food systems without realising the benefits of nourishing the growing global population. Land and water use, soil and water contamination, energy use, and greenhouse gas emissions throughout the food lifecycle and during decomposition are among the environmental costs.
 - From a social perspective, wasting quality surplus food represents a missed opportunity to nourish people, which is particularly problematic given the number of people experiencing food insecurity globally and in Aotearoa.
 - It takes financial resources to produce, process, manufacture, distribute, store, market, and buy food, so when food is wasted, people throughout the food system stand to lose economically. The financial costs of food waste may be buried, transferred, or unidentified by players in the food system, but are nonetheless real.
- While Aotearoa doesn't have a robust food waste baseline, we know that households produce around 157,000 tonnes of avoidable food waste per year, and it is likely that hundreds of thousands of tonnes of food are wasted at other stages of the food supply chain. More data is needed to fully understand the scale of the problem and to design targeted interventions. To support an understanding of the problem and enable reduction targets to be set and monitored, the Ministry for the Environment is establishing a national definition of food waste and intends to calculate a national food waste baseline.
- The food recovery hierarchy will guide the OPMCSA food waste project, with prevention of food waste prioritised, as this is generally where the most environment, social, and economic benefit can be delivered. Failing prevention, any quality, safe, edible food or food components should be rescued or upcycled for human consumption. Only when food isn't fit for human consumption should diversion interventions lower in the food recovery hierarchy be pursued – such as use as animal feed, material recycling, nutrient recovery, and energy recovery, typically in that order. Disposal should be the last resort, but ideally avoided.
- Circular economy thinking, which is beginning to be embraced by the private sector and the New Zealand government, will also guide our project. Underpinning a circular economy approach is a shift away from the take-make-use-waste approach to resource use, towards a system where waste is designed out, products and materials are kept in use for as long as possible, and natural systems are regenerated.
- Long before the development of the food recovery hierarchy and circular economy frameworks, sustainable and regenerative relationships with te taiao have been central to te ao Māori, providing insights that are pertinent to combatting food waste in Aotearoa. A relational, holistic, and intergenerational view of environmental stewardship and insights from mātauranga Māori will be embraced throughout project.
- The context into which the OPMCSA food waste project and recommendations will be delivered is populated by a diverse range of stakeholders, who all have a role to play in combatting food waste. In addition, a number of governmental and intergovernmental food waste initiatives are underway. Examples of best practice will be highlighted as case studies to inspire systemic change.

1. Why food waste matters

An estimated 40% of food produced for human consumption is wasted globally, amounting to 2.5 billion tonnes per year.¹ Food waste has adverse environmental, social, and economic impacts, which are explored below.

1.1 Food waste contributes to environmental harms throughout its lifecycle

When food is wasted, it creates environmental harms at the point of disposal – for example, it contributes to global warming by releasing methane when it breaks down, it takes up space in landfills, and it generates landfill leachate.

But to fully account for the environmental impacts of food waste, a whole-of-lifecycle approach is needed. When food is produced, processed, manufactured, packaged, transported, stored, and cooked, limited resources are used, emissions occur, and environmental harms are produced. If that food is wasted, the environmental toll of every step in the food supply chain is still felt, without delivering the benefits of nourishing the growing global population.¹⁻³




Figure 1: A simple schematic of the food supply chain. The term ‘harvest’ is used as a generalisation in this context, intended to capture a wide range of production and collection activities including slaughter, hunting or fishing, collecting milk and eggs, etc. Transactions, collaborations, and information flows – not just biophysical flows – are all part of the food supply chain and can contribute to food waste.

Wasting food contributes to climate change

Food waste contributes to climate change at the end of its life. When wasted food is landfilled, it breaks down in the absence of oxygen to produce methane, a greenhouse gas with a 100-year global warming potential 25 times that of carbon dioxide (CO₂). For every tonne of food sent to a landfill with gas capture in Aotearoa, based on 2020 calculations, around 0.6 tonnes of CO₂ equivalent (CO₂e) are released.⁴ For the less than 10% of levied waste that goes into landfills in Aotearoa without gas capture, around 1.9 tonnes CO₂e will be emitted per tonne of food waste landfilled.^{4,5}

However, to fully account for the emissions contribution of wasted food, emissions throughout its whole lifecycle, from production through to disposal, need to be considered.² Given that food systems emissions are concentrated at the production end of the food supply chain, with end-of-life emissions representing a tiny fraction of food systems emissions,⁶ taking a whole-of-life approach more fully reveals the climate change mitigation potential of combatting food waste.



For every tonne of food sent to a landfill with gas capture in Aotearoa ... around 0.6 tonnes of CO₂e are released.

Estimating embodied emissions for a unit of food waste is not straightforward, particularly given the massive variability in emissions depending on food type. From a whole-of-lifecycle perspective, WasteMINZ estimates that 2.7 tonnes of CO₂e greenhouse gases are released for every tonne of

food waste, although this estimate is likely conservative.⁷ Whole-of-lifecycle emissions from food waste will continue to be explored throughout this project.

At the global level, food waste reduction has been recognised as having considerable climate change mitigation potential. Using 2011 estimates of global food waste across the food system (see section 3), the Food and Agricultural Organisation of the United Nations (FAO) estimated that the whole-of-lifecycle emissions footprint of food waste is 4.4 gigatonnes of CO₂e per year, or 8% of total anthropogenic greenhouse gas emissions.⁸ This means that, if global food waste was a country, it would have been the third biggest emitter in 2011, after China and the United States and before India.

The Intergovernmental Panel on Climate Change (IPCC) produced a report in 2019 that named food waste reduction as an intervention with substantial climate change mitigation potential.⁹ Project Drawdown, a non-profit organisation that explores evidence-based solutions to climate change, calculated that a progressive reduction towards halving 2014 food waste levels by 2050 could lead to cumulative global CO₂e emissions savings of over 90 gigatonnes, predominantly through averted land conversion.¹⁰ And a 2014 paper published in *Nature Climate Change* found that halving food waste throughout the food system by 2050 would reduce total food-sourced greenhouse gas emissions by 22-28% per year, compared to baseline scenarios.¹¹



... if global food waste was a country, it would have been the third biggest emitter in 2011 ...

Combating food waste in Aotearoa will support progress towards domestic climate change mitigation targets,¹² with food waste reduction being recognised in the waste chapter of the 2022 Emissions Reduction Plan (see annex 2).¹³

Different food waste types have different carbon footprints. Meat and animal products have high greenhouse gas emissions, with the World Wildlife Fund (WWF) estimating that these products make up 13% of global on-farm food waste by weight but account for 40% of on-farm greenhouse gas emissions from food waste.¹ The climate impact of meat waste has also been highlighted by FAO⁸ and in academic publications – e.g. see Amicarelli et al. (2021)² – and is attributable to the fact that meat production is an emissions-intensive process relative to other food types.¹⁴ Hotspot analysis, where sustainability challenges are explored by identifying areas where outsized negative environmental impacts are occurring (e.g. by food system stage and commodity type), can be used to inform targeted action to maximise the impact of interventions.^{15,16}

Wasting food means wasting limited resources and harming the environment

When food is wasted, all of the resources used to produce it are wasted as well – including land, water, and nutrients, which are under increasing pressure as the global population grows. In addition, food waste contributes to environmental harms without realising the benefits of nourishing people, with harms including eutrophication of waterways, biodiversity loss (including from fisheries by-catch, agricultural expansion and intensification, and water use), and degradation and contamination of soils.¹

As with assessing the climate impacts of food waste, hotspot analysis can help to identify where the environmental harms of wasted food are greatest. For example, the water footprint associated with on-farm food waste is greatest for cereals and pulses, particularly in places where the success of these crops depends heavily on irrigation, and for water-intensive crops like rice.¹

A recent Australian study found that if food waste was eliminated, Australians would save over 280 L of water per person per day. The same study found that the amount of land used to grow Australia's wasted food was found to be considerable: a landmass bigger than the state of Victoria.¹⁶

Globally, drawing on 2011 estimates of food waste from production through to consumption,¹⁷ Kummu et al. (2012) estimated that the production of food crops that are ultimately wasted accounts for 24% of total freshwater resources used in food crop production, 23% of total cropland area, and 23% of fertiliser use.¹⁸



... if food waste was eliminated, Australians would save over 280 L of water per person per day.

1.2 Food waste represents a missed opportunity to nourish people

According to the results of the 2020/21 New Zealand Health Survey run by the Ministry of Health (MoH), 12% of children live in households where food runs out sometimes and 3% live in households where food runs out often.¹⁹ The burden of food insecurity, with income inadequacy amongst its core drivers, falls unevenly: Māori and Pacific households and socioeconomically deprived people are disproportionately likely to experience food insecurity,¹⁹ a major equity issue for a food producing nation that earned \$31.2 billion from food and beverage exports in 2020/21.²⁰

Wasting quality surplus food represents a missed opportunity to contribute to alleviating hunger. In 2021, Diprose and Lee noted that, while structural changes addressing the root causes of food insecurity are crucial to making sustained gains in alleviating food insecurity in Aotearoa, the food rescue sector can enable people to collectively manage surplus food, address hunger, and reduce waste.²¹ While food rescue isn't the solution to food insecurity or food waste, it can be thought of as a way to manage surplus food and contribute to hunger alleviation while essential mahi on food waste prevention and poverty alleviation takes place.

The relationship between food security and surplus food will be explored in the next report in this series, which focuses on food rescue.

1.3 There's an economic case for reducing food waste

In addition to the environmental and social costs of food waste, wasting food has negative economic impacts for people throughout the food system, as described by Champions 12.3^a in 2017:

“It takes financial resources to grow, harvest, store, process, transport, market, and purchase food. Therefore, when food exits the food supply chain before reaching its intended use – consumption by people – some entity is not recouping a return on the investment it made ... In addition, in some circumstances, an entity incurs direct financial costs when disposing of uneaten food, such as payments to a waste management company to collect surplus food or tipping fees to transfer uneaten food to a landfill.”²²

In their 2017 research into the business case for food waste reduction, Champions 12.3 found that 99% of businesses included in the study achieved a positive return on investment (ROI) from their efforts to combat food waste, with a median return of 14:1 over a three year period (and a maximum return of 618:1).²² Returns were most pronounced for businesses operating closest to the

^a Champions 12.3 is an international coalition of executives from governments, businesses, international organisations, research institutions, farmer groups, and civil society committed to food waste reduction. See annex 2 for further details.

consumption end of the food supply chain (e.g. restaurants), but median positive returns were found for every sector studied.^b

The same study looked at the business case for household food waste reduction.²² It found that a UK initiative that drove household food waste down by 21% between 2007 and 2013 had a 250:1 ROI for households over the seven years of the initiative, and a 2012-13 initiative in six West London boroughs delivered a 92:1 ROI over its lifetime for councils and households combined.^c

In Australia, a 2021 feasibility study exploring options to combat food waste calculated a ROI of 7:1 across all players in the food system for a specified food waste reduction pathway, with benefits particularly significant for industry.¹⁶

Based on 2018 estimates of household waste²³ (see section 4.5 and annex 1), the average household in Aotearoa could save over \$600 a year by eliminating food waste.^d A 2022 survey-based study of food waste in Aotearoa estimated that the average household wastes over \$1,500 worth of food per year.²⁴ Potential savings for other sectors of society haven't been quantified in depth at a national level. However, a 2018 study conducted for New Zealand Trade and Enterprise (NZTE) found unrealised potential to combat food waste to the potential economic advantage of producers, processors and manufacturers in the food and beverage sector²⁵ and business, sector, and region-specific work is underway to explore the business case further (see section 4 and annex 1).



... the average household in Aotearoa could save over \$600 a year by eliminating food waste.

Despite the business case for combatting food waste, many public and private sector leaders are yet to act. Based on interviews conducted by Champions 12.3, this is likely at least in part because food waste is often “buried in operational budgets, accepted as the ‘cost of doing business,’ or considered not worth the investment needed to achieve reductions.”²² In addition, the costs associated with food waste for private sector players may be passed on to consumers in the price charged for food. Challenging these assumptions and practices is key to realising the economic case for combatting food waste.

^b The study included almost 1,200 business across 17 (mostly developed) countries, representing food producers, processors and manufacturers, retailers, and the food service sector – although most businesses for whom data was available sat closer to the fork end of the food supply chain and, by necessity, only included businesses that have taken action to combat food waste and reported on their outcomes.

^c With programme benefits likely persisting beyond the funded period of the initiatives for which the ROI was calculated, the ROI over a longer time period would be larger. However, it's worth noting that the true costs associated with each programme may have been underestimated, with the unsound assumption that implementation of changed practices at the household level came with no associated costs (accounting only for costs incurred at the government, food manufacturer, and retailer levels).

^d Unless specified, we use \$ to denote nominal New Zealand dollars.

2. Defining food waste

2.1 There's no internationally agreed definition of food waste

Food waste is surprisingly difficult to define, lacking an internationally consistent definition. The chief complexities arise from deciding which stages of the food supply chain to include, whether to include both edible and inedible components of food, and which end destinations to count as 'waste.'^{2,7,26-31} This lack of definitional uniformity extends to related concepts, including food loss, surplus food, agricultural waste, and even food itself.²⁶

2.2 A national definition is on the way

Aotearoa lacks a national definition of food waste.⁷ The Ministry for the Environment (MfE), in collaboration with New Zealand Food Waste Champions 12.3,^e is working to fill this gap, as agreed by the Cabinet Environment, Energy and Climate Committee in 2020^{32,33} Establishing a clear, internationally consistent, national definition of food waste is crucial to calculating a national baseline, setting reduction targets and tracking progress, designing and prioritising solutions,^{7,34} and enabling international comparisons.^f

2.3 OPMCSA will use a broad definition for this project

For the purposes of this project, we won't create or adhere to a rigid technical definition of food waste, instead taking a broad and inclusive approach that works to inspire source prevention as the primary objective and ensure food and its by-products are used to maximum benefit and minimal harm – which means embracing the food recovery hierarchy and circular economy concepts, where food is viewed as a resource and only thought of as waste when there are genuinely no feasible avenues for its utilisation (see section 5).

While some technical definitions distinguish between food loss (which focuses on the pre-retail stages of the food system) and food waste (which focuses on waste at the retail and consumption stages), food waste in many instances is used as a catch-all term for waste throughout the food system,²⁶ which is how we will use the term in this project.

Another term, surplus food, is sometimes used to describe quality food that is at risk of being wasted if it isn't utilised, distinguishing it from food that is spoiled, damaged, contaminated, expired, or otherwise no longer fit for human consumption.²⁶ This term is particularly useful in the context of food rescue for human consumption, as it helps to dispel misconceptions about the quality of food being distributed to food insecure communities.³⁵ We will therefore use the term surplus food during this project.

In keeping with most international definitions, we will focus on food waste from the point at which a crop is ready for harvest, an animal is ready for slaughter, milk or eggs have been collected, or a fish

^e A domestic multistakeholder group affiliated with international Champions 12.3 and committed to the kaupapa of food waste reduction. See annex 2 for further details.

^f In the summary report at the end of the OPMCSA food waste series, we intend to explore how Aotearoa's food waste volumes and action compares to other countries. That said, there are many difficulties associated with international comparisons, even if food waste definitions are standardised. This challenge is described in the 2019 Arcadis report on Australia's food waste: "National food waste figures, however, are not particularly useful for international comparison. There are two reasons for this. Firstly, food waste generation is a function of multiple factors unique to each country, including business and consumer practices, economic mix and scale, systems of government, food culture, social demographics, infrastructure, geography and climate ... Secondly, country figures cannot be directly compared due to differences in the way food waste is defined, even where similar overall food waste accounting frameworks have been applied, and in the scope of data and the collection methodologies."

or wild animal is caught.^{26,30,36} However, opportunities to reduce pre-harvest food waste, sometimes referred to as agricultural waste, remain in scope, particularly given there are rarely hard lines that separate pre-harvest agricultural materials and harvest-ready foods.^{37,38}

In this project, we won't wade into the debate around whether rescued food, food diverted to animal feed, or food utilised for biomaterials and bioprocessing should be counted as waste. We will simply explore solutions that look to prevent food waste as the primary priority, and promote high value utilisation of waste, by-products and surplus that isn't prevented.^{26,39}

Both edible and inedible components of food are in scope. This is because inedible parts of food (e.g. bones, corn husks, grape marc) contribute to the environmental harms associated with food waste (e.g. methane release upon decomposition) and opportunities exist for better utilisation of this waste stream. In addition, there is considerable cultural, demographic, and individual variation around what is considered inedible (e.g. different practices relating to potato skins, apple cores, kiwifruit skins, fish heads, etc).^{26,29}

We will explore food produced and consumed in Aotearoa, including imported foods. As a major exporting nation,²⁰ some of the food that Aotearoa produces is inevitably wasted overseas as the result of circumstances that are largely out of our hands. While we won't focus on the waste of New Zealand food overseas, some of the solutions we explore, such as ways to make fruit produced in Aotearoa stay fresher for longer through post-harvest innovations, may help to tackle food waste abroad as well by enabling our products to arrive at offshore destinations in fresher condition. In addition, solutions to food waste that can be pursued through international collaborations, standards bodies, and other global initiatives are in scope, and have potential to combat food waste both in Aotearoa and abroad. Further, we will pay regard to how innovations intended to combat food waste – particularly in the packaging space – intersect not just with recycling capabilities in Aotearoa, but also recycling capabilities in the main importers of New Zealand food and beverages.

Food means different things to different people, with variation in definitions of food, food preferences and practices, and relationships with food particularly pronounced along cultural and religious lines. While progressing this project, we will work to ensure that solutions proposed accommodate this diversity. Cultural and religious understandings of food inform the context of our project, with examples provided below.

- Using a kaupapa Māori research methodology in Whakatāne, Moeke-Pickering et al. (2015) found that many Māori interviewees linked kai and provisioning practices such as growing vegetables and gathering pipis to aroha, hauora wellbeing, whānau, spirituality, intergenerational knowledge transfer, and kaitiakitanga.⁴⁰
- For many Pacific peoples, food practices are central to expressions of culture. Feasting, ceremonies, and the gifting of food are part of many customary practices and important for maintaining relationships and showing respect.⁴¹
- In her 2009 Masters thesis, Markwick identified food as a link between immigrants and their homes and a bridge to other New Zealanders, as well as identifying the ways in which food practices and perceptions change with time, place, and exposure.⁴²



Food means different things to different people, with variation in definitions of food, food preferences and practices, and relationships with food particularly pronounced along cultural and religious lines.

- For many people, intergenerational sharing of recipes or food practices provides a link to the past. For example, the roots of Polynesian pudding recipes and techniques can be traced back more than 3,000 years.⁴³
- Fasting and feasting are common to many religions, and many religions have specific rules relating to foods that should or should not be eaten, and how food should be prepared. Food can also carry symbolic or metaphoric meaning, such as bread and wine in Christian communion.⁴⁴
- For many Chinese people, preparing or ordering large meals when treating others is a common way to demonstrate status and to show gratitude and sincerity.⁴⁵

In addition, cultural considerations are also relevant when considering end uses for food waste. For example, according to te ao Māori perspectives, some end uses for food waste may be considered tapu, others noa. As with culturally varying understandings of food, a diversity of perspectives on acceptable applications of food waste will be respected throughout the project.

3. Measuring global food waste

When global food waste was first estimated in 2011, it was found that roughly one-third of food produced for human consumption was wasted, amounting to 1.3 billion tonnes per year.¹⁷ This estimate encompasses waste from harvest through to consumption. The one-third estimate continues to be widely used, despite being over a decade out of date.

The 2011 estimate drew attention to food waste as a global problem, and in 2015 Sustainable Development Goal (SDG) 12.3 called for food waste reduction to be a priority area for global action. Other SDGs relate indirectly so food waste too, explored further in annex 2. SDG 12.3 reads as follows:

“By 2030, 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.”^{46,47}

Partly motivated by a need to track progress towards SDG 12.3, efforts to measure global food waste have ramped up. Using commissioned research on harvest loss and the most recent United Nations (UN) estimates of waste at other stages of the food supply chain, in 2021 WWF estimated that global food waste is around 40% of food produced for human consumption, amounting to 2.5 billion tonnes per year.¹ The core studies underpinning this estimate follow:

- Research commissioned by the WWF found that around 8.3% of the total volume of food produced is wasted at or around harvest. Only 3% of the data points used in the research came from direct measurement of on-farm waste.^{1,38}
- In 2019, FAO estimated that around 14% of the volume of food harvested globally is wasted from post-harvest, up to but excluding retail. This estimate relies heavily on modelling, given the paucity of data.⁴⁸
- The United Nations Environment Programme (UNEP) estimated that, in 2019, a combined total of 931 million tonnes of food was wasted by retailers, the food service sector, and households. As a percentage of harvested food, 2% was wasted in retail, 5% in food service, and 11% in households. This estimate is based on 152 data points of varying quality, mostly from high income countries and relating to household waste, with gaps filled by extrapolation.³¹

The most recent global estimates described above are substantially higher than in 2011, likely primarily due to improved quantitation. Even still, global food waste figures are estimates and rely on extrapolation from a small number of data points of variable reliability, with only a minority of data points derived from direct measurement (see section 4.1). In addition, pre-harvest wastes and manufacturing wastes are excluded from the global food waste estimate, as is any rescued food and food diverted to animal feed or used in biomaterials or bioprocessing.

The UN is gathering more robust data, including by developing the *FAO Food Loss Index*³⁶ and the *UNEP Food Waste Index*,³¹ and through a retail and consumption food waste questionnaire to be sent to member states in September 2022.³¹ Despite this, there will always be data limitations. Nonetheless, current estimates can be used to approximate the scale of the problem and provide a strong case for action to combat food waste.



... global food waste figures are estimates and rely on extrapolation from a small number of data points of variable reliability ...

4. Measuring food waste in Aotearoa

While understanding global food waste helps to inform the context of efforts to combat food waste in Aotearoa, globally variable production and consumption patterns mean we need domestic data to truly understand the situation at home.

Aotearoa has never calculated a food waste baseline that spans the entire food system. We have some understanding of the extent of food waste at the consumer and retail levels, but less is publicly known about how much food is lost during production, processing, manufacturing, and distribution.⁷ The available data is explored in the sections below, with more detail in annex 1.



Aotearoa has never calculated a food waste baseline that spans the entire food system.

Champions 12.3 advocate for a “target, measure, act” approach to combatting food waste, calling on governments and companies to set food waste reduction targets in line with SDG 12.3, measure their waste baseline so that they can track progress towards their target, and act to reduce food waste. We endorse this approach, but stress that action shouldn’t be delayed while data gaps are filled – Aotearoa is behind the curve on waste management,⁴⁹ and we shouldn’t let lack of data be an excuse for lack of action.

While in the below sections we focus on what can be said about overall volumes of food waste at the national level, we acknowledge that granular data – including breaking food waste down by food type, exploring data for specific regions or sectors, and exploring food waste by demographic profile – is key to finding solutions. This solution-focused granular data exploration will be unpacked in future reports in this series.

In addition, as we progress through this project we will explore drivers of food waste in different parts of the food system – noting that waste at one stage of the food system may be driven by factors playing out in other stages of the food supply system.²⁹ With this in mind, as we progress through this project we will ensure that food waste at one stage of the food supply chain isn’t viewed in isolation or as something to be solved by the actors at that stage of the supply chain alone.

As the OPMCSA food waste project progresses, we will continue to seek data on the current state of the problem in Aotearoa, and in our final summary report will produce a map detailing our best estimates of food waste volumes at different stages of the food system. If you have data that may support this kaupapa in 2022/23, please reach out info@pmcsa.ac.nz

4.1 There are three main ways to calculate food waste

Food waste volumes can be measured directly, calculated based on self-reported data (either elicited through surveys or volunteered), or inferred using modelling and extrapolation. Of these approaches, direct measurement – often through waste audits that provide insights into food waste at a moment in time – yields the most reliable data, but is also generally the most labour-intensive and time consuming.³¹

While self-reported data can help build a picture of food waste, it suffers from limitations including reporting bias (which in some cases may be motivated by a desire to downplay wastefulness) and challenges with recall and estimation.⁵⁰ As an example of the limitations of self-reported food waste

data, when comparing the estimated value of wasted food reported by households with the calculated value of wasted food from bin audits, different studies have demonstrated instances where the self-reported value of food waste has been considerably over- or underestimated by study participants.^{23,51-53}

Approaches to inferring food waste data include:

- using food waste data from one country to make estimates for a similar country;^{17,31,51}
- deriving estimates from macro-economic data and aggregated waste data;⁵⁴ or
- using general data on food waste as a percentage of production volume by sector to estimate food waste volumes during production, processing, and manufacturing, where production volumes are known but waste volumes are unknown.

Inferred food waste estimates should be taken as indicative only as they are often reliant on a number of assumptions and little actual food waste data. For example, two inferred estimates of household food waste in Aotearoa were made in 2011 using different methodologies, with one being over twice as large as the other.^{17,51,54}

4.2 We don't have clear data on food waste early in the supply chain

We have low visibility of food waste volumes at the national level during production, processing, manufacturing, and distribution.^{7,55} Commercial sensitivities, definitional challenges (e.g. which by-products to include, whether to count pre-harvest waste), and the regional variability in food industry activities make it challenging to derive a national estimate from available data.

In addition, most available studies on food waste early in the food supply chain is based on self-reported data, often from a self-selected group of respondents. To our knowledge, the only publicly available study where direct measurement is used focuses on a single tomato grower.⁵⁶

That said, several informative studies exist that provide insights, within prescribed limits. These are described in annex 1.

Australia's 2021 food waste baseline study found that households generated the most unrecovered food waste, followed closely by primary producers and then manufacturers.¹⁶ Short of having our own data on food waste from production through to retail, Australia's food waste data may provide a rough indication of the possible relative contribution of each stage of the food supply chain to food waste in Aotearoa, given the several similarities between our countries – including our food systems.^g



Australia's 2021 food waste baseline study found that households generated the most unrecovered food waste, followed closely by primary producers and then manufacturers.

4.3 We have some visibility of retail waste, but there are coverage gaps

A mixed-methods study in 2020 explored nationwide food waste volumes produced by the three main supermarkets in Aotearoa (Countdown, New World, and Pak'n'Save), estimating that a total of 60,500 tonnes of food is unsold per year.⁵⁷ Of this, 23% is landfilled, with the remaining 77% being diverted, predominantly for use as animal feed. 15% of unsold food was donated to food rescue

^g E.g. high market consolidation in retail sector, high production and export levels per capita.

organisations. For all unsold food, fresh vegetables were found to dominate (27%), followed by bakery items (23%), meat and fish (19%), and fresh fruit (17%).

While this data provides a good estimate of food waste from the country's main supermarkets, it doesn't cover the full suite of food retailers in Aotearoa. For example, available data doesn't cover convenience stores, green grocers, speciality stores, bulk food stores, or wholesalers.

4.4 Food service waste is partially characterised

Food waste in the food service industry is only partially characterised. It has been estimated that more than 24,300 tonnes of food are wasted by restaurants and cafés nationwide, based on direct measurement through audits in 2017 and 2018, with findings extended to provide a national estimate.^{51,58-60}

The destination of restaurant and café food waste was not recorded. However, the available studies did report that spoilage accounted for 7% of food waste, preparation accounted for 60% of food waste (including unsold cabinet food), and plate waste accounted for the remaining 33%.^{51,58-60}

However, restaurants and cafés represent only part of the food service industry, with food also served in schools, day-cares, preschools, kindergartens, halls of residence, aged care facilities, hospitals, prisons, hotels, defence force settings, at events, and in the transport sector (e.g. on planes, ferries, ships, trains), among other settings.³¹

In addition, the impact of the rising online food delivery sector on food waste hasn't been studied in detail in Aotearoa or abroad.⁶¹ Available food service data is now more than four years out of date, and trends and events described in section 4.5 below, including the COVID-19 pandemic, have likely impacted food waste volumes.

4.5 Household food waste was studied in detail in 2018, but hasn't been revisited

In 2018, a bin audit study was conducted to determine how much food is sent to landfill by New Zealand households.²³ Directly measuring food waste in the kerbside bins of nearly 600 households throughout the country and using the findings to provide a national estimate, it was found that New Zealand households produced almost 300,000 tonnes of food waste for kerbside collection in 2018, equating to a median average of 164 kg per household per year.

The study included an analysis of the composition of household food waste, finding that 52.8% (around 157,000 tonnes) was avoidable (i.e. food waste that could have been eaten at some point), 13.5% was potentially avoidable (i.e. parts of food that some people eat – e.g. potato peels), and 33.7% was non-avoidable (i.e. parts of food that are unlikely to be eaten by the majority of the population – e.g. banana skins, eggs shells, teabags). Of the avoidable food waste, bread was the most wasted product by volume (9.6% of avoidable food waste), followed by leftovers (8.2%), with all other food categories each making up less than 5% of the avoidable waste volume. The value of avoidable household food waste was found to be \$644 per year on average.



... New Zealand households produced almost 300,000 tonnes of food waste for kerbside collection in 2018, equating to a median average of 164 kg per household per year.

A limitation of this study is that it only captured food waste disposed to landfill, excluding waste disposed of using in-sink disposal units, compost bins, worm farms, fed to pets, or via other

pathways. Therefore, the total food waste volume of almost 300,000 tonnes likely underestimates the true extent of household food waste.

In addition, the study is now four years out of date. While there was little difference between household food waste results between 2015 (when a similar study was conducted) and 2018, except for what could be attributed to a growing population,^{23,53} it can't be assumed that this steady state has been maintained from 2018 to present, particularly given the growing global and domestic profile of food waste and its impacts, the advent of the COVID-19 pandemic,⁶² the rising cost of living,⁶³ and possible changes in shopping, provisioning, and consumption patterns (e.g. meal boxes, online food delivery,⁶¹ alternative proteins and cellular agriculture, etc).

An additional source of information about household food waste in Aotearoa is a survey series that has been run by Rabobank since at least 2017^{24,52,64} (and a WasteMINZ survey in 2014).⁶⁵ These surveys involve a nationally representative sample of New Zealanders, who are asked to respond to questions relating to their attitudes and behaviours around food waste. Among the survey questions, respondents were asked to report how much food they think they waste, as a percentage of food that they purchase. The most recent survey results, from 2022, revealed that New Zealanders on average report that they waste 13.4% of the food they purchase, the highest percentage reported through the multi-year survey series. Given the limitations of self-reported food waste data (see section 4.1), the findings from these surveys, which are expanded on in annex 1, should be taken to indicate household's perceptions of how much they waste, rather than as a reflection of actual household waste. With food waste receiving increasing global and national attention, the increase in the percentage of waste reported over time is likely at least in part a reflection of increasing food waste awareness.

4.6 There's more data out there

Because food waste is ultimately a cost to businesses in the food supply chain, (see section 1.3) we anticipate that more data is out there – it's just a matter of accessing it. While food waste data can be deemed commercially sensitive, voluntary data sharing by businesses in the food system can be encouraged through a high trust model where businesses buy in to the food waste reduction kaupapa and agree to share data in an anonymised or aggregated format to enable change. The UK Courtauld Commitment⁶⁶ and the Australian Food Pact⁶⁷ are national-level initiatives that model this approach overseas.

Drawing inspiration from these initiatives, New Zealand Food Waste Champions 12.3 will soon launch the Kai Commitment, a voluntary agreement through which businesses can commit to setting targets, measuring food waste, and acting to reduce food waste. Through the Kai Commitment, businesses will be required to share anonymised waste data within the collective, which will be a collaborative space for best practice sharing and will also provide members with access to technical support.⁶⁸

Regional voluntary data sharing agreements are already underway. A collective of food and beverage processing businesses in Timaru, under the umbrella 'Sustainable is Attainable', have been working together and in collaboration with the research community to find uses for their processing by-products. Part of this involves data collection and sharing. The Sustainable is Attainable initiative, which began in Timaru around three years ago,



... New Zealand Food Waste Champions 12.3 will soon launch the Kai Commitment, a voluntary agreement through which businesses can commit to setting targets, measuring food waste, and acting to reduce food waste.

is now being rolled out in Hawke's Bay, with support of the region's councils. Funding has been provided by Callaghan Innovation, the Bioresource Processing Alliance (BPA) and the Hastings District Council to support students to assist in data collection and collation.⁶⁹⁻⁷²

There are various other efforts underway to gather more food waste data. For example:

- The Ministry for the Environment has acknowledged the weaknesses in our national waste data,^{49,73} and is working to address this issue, including through requiring additional mandatory reporting of waste data as agreed by Cabinet in 2021⁷³ and working to calculate a national food waste baseline at the Environment Committee's recommendation and as endorsed by Cabinet in 2020.^{32,33}
- The food rescue sector gathers data on food that they receive and redistribute to food insecure communities. With the Aotearoa Food Rescue Alliance (AFRA) having recently developed a new data standardisation platform that is being rolled out to its members, data on rescued food is set to improve.⁷⁴ This will be explored in the next report in this series, which focuses on food rescue.
- At the territorial authority level, a small pilot study is being conducted with three to four councils in collaboration with WasteMINZ to gather data on household waste in a pre- and post-intervention study to assess the impacts of education and empowerment interventions on food waste practices.⁷⁵
- Foodprint, an app through which the food service industry can connect with consumers to sell discounted food in order to reduce waste, gathers data from their partners, which could supplement existing data about waste in the food service sector.⁷⁶ In May 2022, data collected from the platform found that 26 kg worth of food was sold at a discounted price via Foodprint to combat food waste.⁷⁷
- Work is underway by Fisheries New Zealand to tighten the framework outlining which quota management system (QMS) fish by-catch must be landed and to increase monitoring via on-board cameras. This will improve the accuracy of by-catch data.⁷⁸

While all data streams have scope to build the national food waste picture, care should be taken to avoid double counting. The risk of double counting is particularly significant where data is sourced both from actors in the food supply chain (as outgoing streams) and actors in the food rescue, upcycling and waste management sectors (as incoming streams).



While all data streams have scope to build the national food waste picture, care should be taken to avoid double counting.

4.7 There are examples of good practice internationally

Galvanised by SDG 12.3, several countries have calculated national food waste baselines to characterise the scale of the problem domestically and monitor progress towards reduction targets. In particular, quantification efforts by Australia^{16,79} and the UK⁸⁰ offer details of food waste across the food supply chain and by destination (e.g. animal feed, compost, landfill), providing meaningful insights into national patterns of waste to inform prioritised food waste reduction activities.

Other countries have high quality food waste data specific to isolated stages of the food supply chain – for example, UNEP found that 17 countries had high quality food waste data for at least one stage of the food supply chain from retail to consumption, including Aotearoa's household and retail food waste data, as described above.³¹ Examples of good practice food waste measurement can be used

to inspire strengthened food waste data collection and reporting in Aotearoa and inform the approach to baseline calculation efforts.

As the OPMCSA food waste project progresses, we will be exploring food waste initiatives in other countries, including looking at whether they have food waste baselines and the approach used for baseline calculation. If you know of any countries that we could draw insights from to support our project in 2022/23, please reach out info@pmcsa.ac.nz

5. Guiding frameworks for combatting food waste

5.1 Te ao Māori perspectives and mātauranga Māori bring crucial knowledge

Long before the development of the food recovery hierarchy and circular economy frameworks discussed in sections 5.2 and 5.3 below, sustainable and regenerative relationships with te taiao have been central to te ao Māori,^{81,82} providing insights that are pertinent to combatting food waste in Aotearoa.

Harmsworth and Awatere (2013) outline several key concepts from te ao Māori as they relate to the environment and sustainability, including whakapapa (through which humans are connected to ecosystems and all flora and fauna), kaitiakitanga (active guardianship of the environment for present and future generations), ki uta ki tai (a whole-of-landscape approach to understanding and managing resources and ecosystems), and mauri (the internal life force of all living things, including the environment, which can be damaged or lost through environmental harm).⁸¹

According to Harmsworth and Awatere (2013):

“The Māori world view acknowledges a natural order to the universe, a balance or equilibrium, and that when part of this system shifts, the entire system is put out of balance. The diversity of life is embellished in this world view through the interrelationship of all living things as dependent on each other, and Māori seek to understand the total system and not just parts of it.”⁸¹

With a te ao Māori framing in mind, it’s clear that action taken today to combat food waste in Aotearoa is not just to the benefit of people and the environment today; it is an act of guardianship that will bring benefits for future generations. This relational, holistic, and intergenerational view and insights from mātauranga Māori will be embraced as we progress the OPMCSA food waste project.

5.2 The food recovery hierarchy will guide our project

The waste management hierarchy provides a framework for reducing waste by promoting avoidance of material usage in the first instance and keeping materials in circulation as long as possible in their highest value form, with disposal as a last resort. The waste management hierarchy was explored extensively in OPMCSA’s 2019 project, *Rethinking Plastics in Aotearoa*.⁸³

Efforts to combat food waste are typically framed in relation to the food recovery hierarchy,²⁶ a modified version of the standard waste management hierarchy.³⁹ There are many variations on the food recovery hierarchy used or advocated for by various governments, groups, and academics^{16,26,39,49,83,84} but they are united in their core approach to food waste management.

According to the food recovery hierarchy framing underpinning this project, actions to prevent food waste – e.g. by designing waste out of our food production processes and empowering consumers to engage in shopping, cooking, and eating practices that are free from food waste – should be prioritised, as this is generally where the most environment, social, and economic benefit can be delivered.^{2,26}

Failing prevention, any quality, safe, edible food – i.e. surplus food – should be rescued for human consumption, and edible by-products or components of food should be repurposed (‘upcycled’) into new food products for human consumption if possible. Only when food isn’t suitable for human consumption should diversion interventions lower in the food recovery hierarchy be pursued, such as use as animal feed, material recycling, recovery of nutrients, or recovery of energy, typically in

that order. Disposal should be the last resort, but ideally avoided.^{26,85} With surplus food and food waste having multiple possible destinations, the food recovery hierarchy helps to clarify and prioritise options for food waste reduction and management.

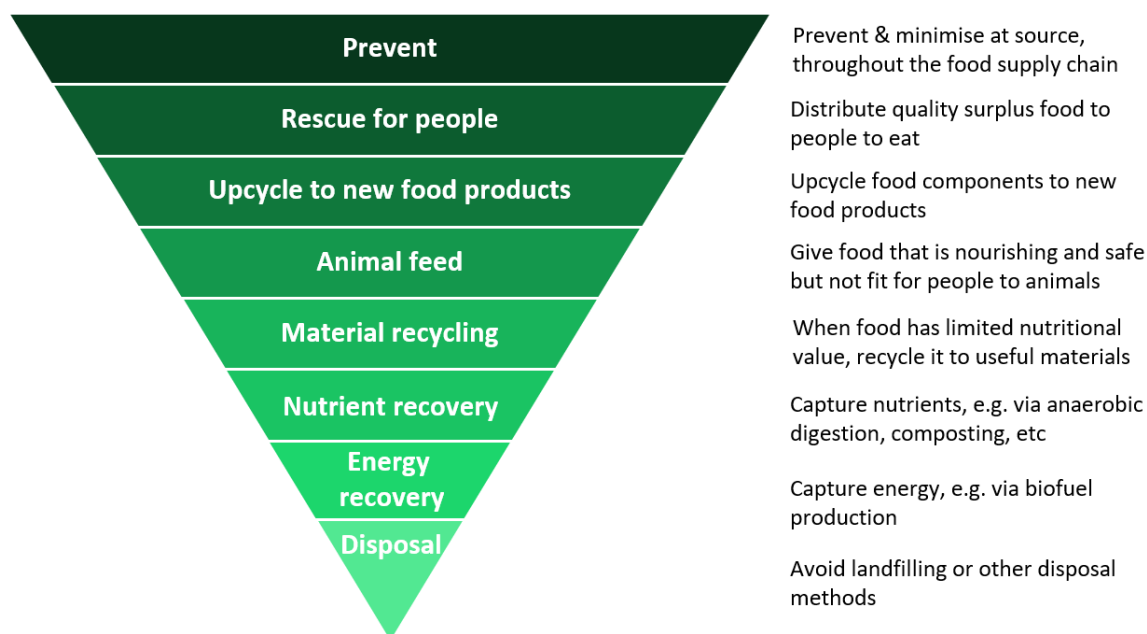


Figure 2: The food recovery hierarchy, modified from Teigiserova et al. and Moshtaghia et al.^{26,85} The food recovery hierarchy is a modified version of the waste management hierarchy, which provides a framework for reducing waste by promoting avoidance of material usage in the first instance and keeping materials in circulation as long as possible in their highest value form, with disposal as a last resort.

Reflecting the core principles of the food recovery hierarchy, our project vision follows:

Everyone in the food system works collaboratively to reduce the environmental, social, and economic costs of food waste by preventing food waste in the first instance and working to capture the value of surplus and wasted food where prevention doesn't occur.

Trade-offs and tensions will be borne in mind throughout the project

While the food recovery hierarchy is a valuable guide to reducing food waste and its adverse impacts, rigorously adhering to it can have unintended consequences, so it needs to be applied with nuance.²⁶ Illustrative examples are provided below, highlighting the types of tensions that will be borne in mind and further explored in subsequent reports.^h

- Food waste prevention may be facilitated by packaging that extends a product's shelf life, but the packaging itself may not be reusable or recyclable or may be resource or emissions-intensive to produce – therefore, it is important to consider whether the food waste prevention benefit is worth the environmental costs associated with the packaging.^{86,87}


 ... it is important to consider whether the food waste prevention benefit is worth the environmental costs associated with the packaging.

^h The examples provided are illustrative rather than exhaustive. In addition, the present report doesn't attempt to solve these tensions; they will be addressed, among others, in subsequent reports in this series.

- Surplus food could be reduced by decreasing overall production and import volumes, operating with leaner margins between food supply and demand. However, taken to the extreme, this could lead to food scarcity and increased food prices, which would have widespread detrimental impacts on wellbeing.
- It is necessary to balance the need to invest in food waste management systems and infrastructure against the imperative to prioritise food waste prevention. Current food waste volumes shouldn't be taken to reflect enduring need for food waste management systems and infrastructure, and the risk that waste management investments end up incentivising the production of surplus food or food waste as a feedstock should be mitigated.^{29,88}
- Adverse public health outcomes can result from taking food waste prevention to the extreme, such as risking undermining food safety, driving an increase in food processing to extend shelf life, or avoiding serving healthy new foods that children might reject in school lunches.⁸⁹



It is necessary to balance the need to invest in food waste management systems and infrastructure against the imperative to prioritise food waste prevention.

Trade-offs and tensions of this nature will be considered throughout this project. All recommendations for action will need to be made in the context of the broader societal objectives rather than with a narrow lens on combatting food waste at any cost.

5.3 The circular economy is another valuable guiding framework

The circular economy, a concept closely related to the waste management hierarchy, calls for a shift away from the linear take-make-use-waste approach to resource use, towards an approach to resource use that designs waste and pollution out of the economy where possible, and keeps products and materials in use, slowing, narrowing, and closing material resource loops and regenerating the taiao.^{13,83,88,90} Definitions vary,⁹¹ but MfE describes the core principles of a circular economy as follows:

“Design out waste and pollution – View waste as a design flaw. Loss of materials and energy through the production process is minimised.

“Keep products and materials in use – Think in systems. Products are designed to be reused, repaired and recycled, and waste materials for one process become an input for another.

“Regenerate natural systems – Shift perspectives from minimising environmental harm to doing good. Valuable nutrients are returned to the soil and ecosystems are enhanced.”⁴⁹

The circular bioeconomy, while not defined by consensus among academics, industry, or government, sits at the intersection between the circular economy and the bioeconomy (i.e. aspects of the economy that use biological resources, including food systems), and is a useful concept to bear in mind in the context of food waste.^{90,92}

Teigiserova et al. (2020) imagine a circular economy approach applied to combatting food waste, which fuses elements of the food recovery hierarchy, food supply chain, and circular bioeconomy.²⁶ Their conceptualisation usefully separates edible and inedible food and food components,

highlighting different pathways suitable for each category. A modified version of their fusion diagram is depicted in figure 3 below.

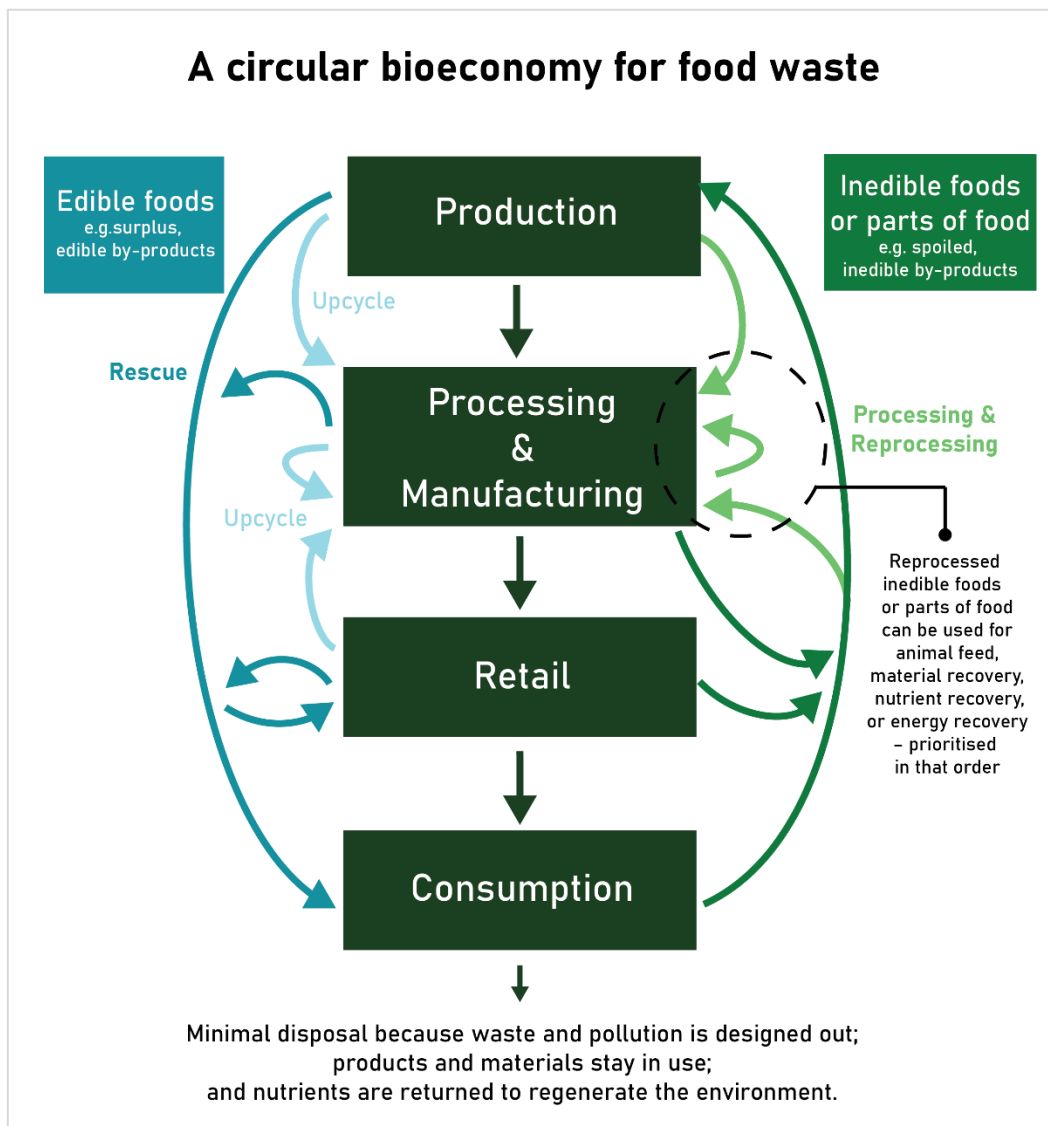


Figure 3: Food waste circular economy diagram, inspired by Teigiserova et al., that combines elements of the food recovery hierarchy, circular economy, and food supply chain, and distinguishes between pathways suitable for edible food (e.g. surplus, edible by-products) and inedible food or parts of food.²⁶

Aotearoa is embracing elements of a circular economy in the public and private sector. For example, at the central government level:

- MfE has articulated its vision to progress towards a more sustainable, regenerative, and less extractive relationship with the environment by 2050,^{13,49} in line with the Climate Change Commission’s advice to the government on the country’s emissions budgets and Emissions Reduction Plan.⁹³
- The Ministry for Business, Innovation and Employment (MBIE) is developing a circular economy strategy, analysing investment in innovation and infrastructure needed to support the transition to a circular economy,⁹⁴ and is funding a transdisciplinary circular economy research project, Āmiomio Aotearoa.⁹⁵
- The Infrastructure Commission’s 2022-2052 strategy document highlights movement to a circular economy among its five objectives.⁹⁶

Having made rhetorical commitments to transition to a circular economy, Blumhardt and Prince (2022) state that “the task government agencies now face is to elevate and sustain ambition while ensuring cross-sector coordination to avoid diluted goals or divergent policy approaches.”⁸⁸

OPMCSA’s project will provide an evidence base to support the circular economy kaupapa in the context of food waste, while noting that the nature, scale and scope of transformation required to achieve a truly circular economy in Aotearoa goes beyond the scope of this project.

6. Mapping the system

A diverse range of crucial stakeholders have a role to play in combatting food waste. In addition, a number of governmental and intergovernmental initiatives are underway which relate to food waste, which will be borne in mind as we work through our series of reports.

6.1 Combatting food waste requires collaboration between many stakeholders

A wide range of experts and stakeholders with crucial knowledge and experience will be engaged throughout the OPMCSA food waste project.

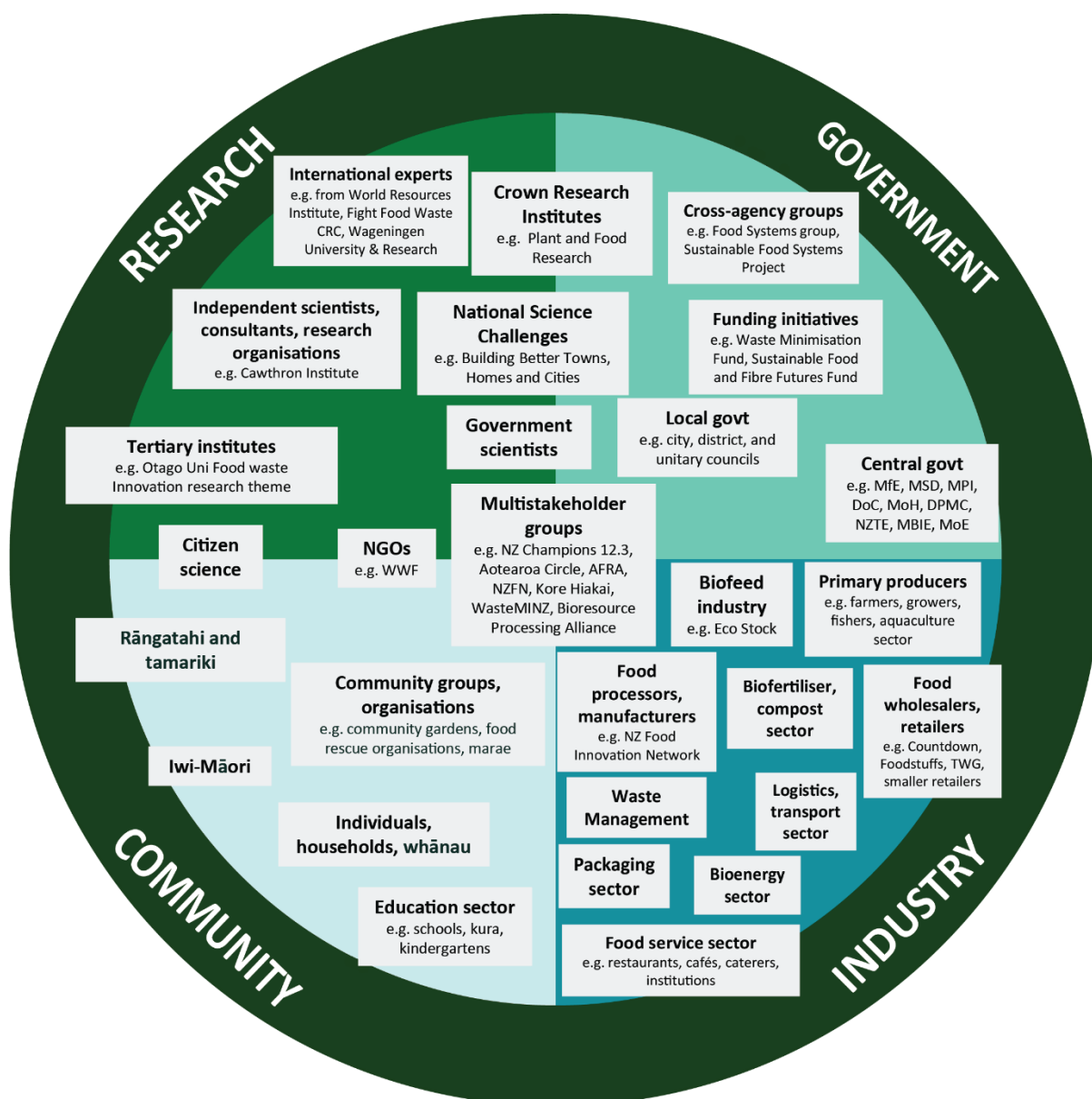


Figure 4: A map of some of the many stakeholders with a role to play in combatting food waste in Aotearoa. The named organisations are provided as illustrative examples rather than being exhaustive. Many stakeholders – beyond those that are physically depicted as sitting on the margins between community, industry, research, and government – cross those boundaries in their memberships, relationships, funding sources, and context.

Närvänen et al. (2020) describe food waste as a wicked problem – i.e. a problem that is unstructured, cross-cutting, and relentless – and view food waste management as a “multilevel, multi-actor effort to prevent and reduce food waste through various solutions.” With this in mind, “food waste management requires shared responsibility of all actors at multiple levels from everyday life to the policy level.”²⁹

6.2 A range of government initiatives are already underway

Many government initiatives to combat food waste are already underway. MfE is the main central government agency involved in this work, with food waste falling under its mandate from a waste minimisation and management perspective and an emissions reduction perspective. Territorial authorities – i.e. city, district, and unitary councils – also play a crucial role.

The Ministry of Social Development (MSD) has recently become involved in combatting food waste through the food rescue work occurring under its Food Secure Communities programme, which began with the advent of the COVID-19 pandemic. While MSD’s work supports efforts to combat food waste through food rescue, the Ministry’s main priority is supporting food insecure communities, with food waste reduction as a positive spinoff from their core focus.

The Ministry for Primary Industries (MPI) is another key government player, with a role in food waste prevention during the production stage of the food supply chain and work already underway such as efforts to reduce fisheries by-catch. In addition, MPI is a key player in cross-agency work on regenerative agriculture, for example with the primary industries sector representing some of the key end users of diverted food waste in the form of biofeed and biofertiliser. MPI’s responsibility for food safety, a theme which cuts across the entire food waste landscape, is also crucial.

Other agencies are involved to varying degrees in combatting food waste, including, MBIE, the Ministry of Education (MoE), and MoH. See annex 2 for the details of current government initiatives relating to food waste.

The constellation of government actors and initiatives targeting food waste presents a coordination challenge, particularly given that agencies come into food waste with differing mandates and motives, such as the environmental perspective of MfE and the food security perspective of MSD. In addition, the disseminated nature of government efforts to combat food waste presents challenges relating to funding, responsibility, and accountability.

Several cross-agency coordination mechanisms have recently been stood up in attempt to promote greater collaboration between agencies with a stake in food waste reduction, and we hope that our food waste project will provide an evidence base to underpin systems thinking and collaboration.

Action at the domestic level sits in the context of growing international awareness and efforts to combat food waste. Key intergovernmental initiatives are covered in annex 2, and we will highlight the actions of individual countries throughout the project, in an effort to draw international insights.



... the disseminated nature of government efforts to combat food waste presents challenges relating to funding, responsibility, and accountability ... we hope that our food waste project will provide an evidence base to underpin systems thinking and collaboration.

Annex 1: What do we know about food waste in Aotearoa?

As the OPMCSA food waste project progresses, we will continue to seek data on the current state of the problem in Aotearoa, and in our final summary report will produce a map detailing our best estimates of food waste volumes at different stages of the food system. If you have data that may support this kaupapa in 2022/23, please reach out info@pmcsa.ac.nz

Table 1: The below table summarises key data sources that provide information about the volume of food waste in Aotearoa across the food supply chain. The table is sorted by stage in food supply chain, starting with production, and numbers are provided using the same significant figures as in the source material. NB: The 'waste volume' column contains data about 'true' waste (i.e. sent to landfill or otherwise disposed of, with no value captured) as well as surplus, by-products, by-catch, food waste, etc that is diverted from landfill to other tiers of the food recovery hierarchy, including those that, according to many definitions, aren't considered to be food waste. We provide this information to probe the extent to which the food recovery hierarchy is being honoured through diversion practices used in Aotearoa. Abbreviations: approx. = approximately; BPA = Bioresource Processing Alliance; esp. = especially; est. = estimated; F&B = food and beverage; incl. = including.

Stage in food system	Waste volume	Year	Methodology	Data completeness	Additional comments
Production – fruit, Central Otago ⁵⁶	An estimated 8.6% (4,151 tonnes) of the total Central Otago fruit crop (covering apples, apricots, cherries, peaches, nectarines) is not harvested, and 4.2% (2,014 tonnes) is harvested but not sold on from the packhouse – most is mulched, fed to animals, or (rarely) disposed of in pits on the orchard.	2021	Self-reported (survey), region-wide extrapolation.	Survey reached growers and packhouse operators in Central Otago (covering approx. 65% planted fruit growing hectares in the region). Not all fruit types represented (e.g. blueberries and pears excluded).	Harvest waste drivers incl. labour shortages (esp. for apples in 2020 due to COVID-19), maturity, quality, and demand. Non-harvested fruit could be better utilised if fruit was acceptable, of economic value, and labour was available. Cosmetic standards are rising.
Production – glasshouse tomatoes, single grower ⁹⁷	In a study looking at one of NZ's largest tomato growers, 16.9% of marketed yield was wasted (incl. 13.9% unharvested, 2.8% rejected at the glasshouse, and 0.3% rejected at the packhouse).	2021	Direct measurement.	1 grower only.	Qualitative interviews found that waste was mostly driven by commercial factors, so collaboration across the supply chain is needed to address waste.

Stage in food system	Waste volume	Year	Methodology	Data completeness	Additional comments
Production – kiwifruit, Zespri ⁵¹	A reported 2.5 million trays of export grade Zespri kiwifruit (est. 9,000 tonnes) were not sold for human consumption in a single year. Destination unknown.	2016	Self-reported (volunteered).	Refers to waste of 1 product type only, and only in packhouse (excludes pre-harvest and harvest waste).	WasteMINZ has suggested that this waste was driven by commercial considerations.
Production – fisheries, nationwide ⁹⁸	In the 2021 calendar year, a total of 19,030 tonnes of by-catch (by greenweight) was reported from commercial fisheries. Of this, 198 tonnes of by-catch were eaten onboard, 116 tonnes were used as bait, and 1,999 tonnes of fish were returned to the sea under schedule 6 of the Fisheries Act 1996, which requires most to be returned alive. The condition (alive or dead) of the remaining 16,717 tonnes of by-catch returned to the sea is not specified in reporting.	2021	Self-reported, some observer reported (compliance activity).	By-catch data relates only to what happens to fish on a vessel and is likely an underestimate. This data does not include any information on fish that are landed but not consumed.	Fisheries NZ is proposing to introduce a new landings and discards framework, which will establish evidence-based criteria to guide which QMS fish can be returned to the sea and which QMS fish must be landed. In addition, the government has announced the further roll out of onboard cameras, which will increase the level of monitoring of commercial fishing activity and improve accuracy of by-catch data in the future.
Production – farms, Otago ⁹⁹	An estimated 10,658 tonnes of food and other putrescible waste is disposed of on farms in Otago.	2020	Inferred from 2013 survey data.	Data is very high level.	

Stage in food system	Waste volume	Year	Methodology	Data completeness	Additional comments
Production, processing, manufacturing – horticulture and agriculture, companies working with the BPA nationwide ⁵¹	From the businesses who have approached the BPA, 350,000 tonnes/yr of food by-products are going to landfill, being spread on land or are going to no value, or low value applications (such as fertiliser or animal feed).	2017	Self-reported (volunteered).	Only captures companies working with the BPA.	308,000 tonnes of this waste would reportedly require commercial processing to be converted into food products or nutraceuticals.
Production, processing, manufacturing – F&B (and forestry), top of the South Island (Marlborough, Nelson, Tasman) ¹⁰⁰	Total organic waste for the top of the South Island was estimated from a survey of stakeholders. Excluding forestry waste of 249,800 tonnes/yr (which is out of scope for the OPMCSA project), an estimated 472,875 tonnes of organic waste is produced in the region per year. The main end points of organic waste sit low in the food recovery hierarchy – aside from organic waste that is abandoned (mostly forestry waste), landfill dominated, followed by land spread, composting, and finally diversion to animal feed.	2021/22	Self-reported (survey), region-wide extrapolation.	48 stakeholders from a wide range of industries were contacted, with an 85% response rate. No indication of the proportion of the region's food system actors captured in the study.	This study was led by Food Security Solutions, a company that is selling a bioconversion product.
Processing – horticulture and agriculture, nationwide ¹⁰¹	2.2 million tonnes/yr in food processing waste, unknown destination.	2022	Mixed methods (self-reported and extrapolation from reported production volumes in NZ and published data on proportions of biowaste by sector).	Covers wide variety of horticultural and agricultural products, at national level.	

Stage in food system	Waste volume	Year	Methodology	Data completeness	Additional comments
Processing, manufacturing – F&B excl. dairy, 39 companies nationwide ²⁵	A reported 153,470 tonnes of food processing and manufacturing by-products were diverted from landfill via a range of diversion routes (e.g. composting, animal feed, rendering) while 9,046 tonnes were unutilised (i.e. landfilled or otherwise disposed of).	2018	Self-reported (survey).	Only captures data from 39 F&B companies. The survey was sent to 160 of the top food and beverage companies by revenue in NZ, with a 24% response rate (i.e. 39 companies). The dairy industry is not included in this data.	The study found that different companies and industries utilised by-products to differing degrees. Common barriers to greater utilisation included access to capital, infrastructure, scale, variability in volumes and content of by-products, market demand, internal resource constraints, and resource consent constraints.
Processing, manufacturing – 10 F&B companies, Otago ⁹⁹	Narrative accounts of the waste management practices of food processors and manufacturers in Otago were provided in a 2022 report. For one company, Harraway Oats, an organic waste estimate was provided – 3,800 tonnes/yr, 90% of which is used as animal feed, compost, or by regenerative farmers and 7.5% of which is used as a biofuel by Harraways (with ash used as fertiliser by local vineyards).	2022	Self-reported.	Only covers 10 F&B companies, and organic waste estimate only provided for 1 company.	

Stage in food system	Waste volume	Year	Methodology	Data completeness	Additional comments
Processing, manufacturing – F&B, 65 companies in Auckland ¹⁰²	The 65 businesses included in the survey reported food waste volumes of roughly 48,000 tonnes/yr. Approx. 75% of food waste was reportedly used for animal feed, 6% regularly landfilled, and the rest rendered, composted, used as a soil amendment, or (to a lesser extent) used to produce biofuel or petfood, or sent to charities.	2008/09	Self-reported (survey).	Only captures data from 65 Auckland F&B processors and manufacturers, comprising 6% of such businesses in the Auckland region – although the businesses included make up 69% of the industry's revenue in the region.	
Manufacturing – F&B, 28 companies in Auckland ¹⁰³	40,800 tonnes/yr of food waste was reported. 63% of this was used for stock feed. The second most common destination was landfill.	2017	Self-reported (survey).	Only captures data from 28 F&B companies.	
Retail – major supermarkets, nationwide ⁵⁷	Using data from 16 supermarkets and extrapolating to give a national estimate of food waste from Countdown, New World, and Pak'n'Save, it was found that 60,500 tonnes/yr is unsold. For those supermarkets audited, 46% of unsold food was diverted to animal feed, 23% went to landfill, 15% was donated for human consumption, 14% went to protein reprocessing, and 1% was composted.	2020	Mixed methods (direct measurement and self-reported), nationwide extrapolation.	Provides an estimate for food waste from all major supermarkets in NZ but doesn't include a range of other food retail actors.	Fresh vegetables (27%), bakery (23%), meat and fish (19%), and fresh fruit (17%) contributed the most to unsold food (all end destinations combined).

Stage in food system	Waste volume	Year	Methodology	Data completeness	Additional comments
Food service – cafés and restaurants, nationwide ^{51,59,60}	Data from a sample of cafés and restaurants was used to provide a national estimate of 24,366 tonnes/yr, to unspecified destinations.	2017/18	Direct measurement, nationwide extrapolation.	The destination of wasted food was not recorded.	Spoilage accounted for 7% of waste, preparation waste accounted for 60% of waste (incl. unsold cabinet food), and plate waste accounted for 33% of waste.
Households – nationwide ⁶⁵	In 2014, a nationally representative survey of NZ households estimated that they wasted an average of 5% of the food they purchased.	2014	Self-reported (survey).	Given the limitations of self-reporting (see section 4.1), this data provides insights into how wasteful people perceive themselves to be, rather than providing evidence to understand how much food is actually wasted in NZ.	These studies also collected insights into food waste behaviours and attitudes, which will inform future reports in the OPMCSA series.
Households – nationwide ^{24,52,64}	In 2022, a nationally representative sample of New Zealanders estimated that they wasted an average of 13.4% of the food they purchased. This compared to 8.6% in 2021, 10.2% in 2019, and 12% in 2017. Based on 2022 survey results, it was estimated that the average NZ household wastes \$1,520 worth of food per year.	Most recent data from 2022, with studies dating back to 2017	Self-reported (survey).		

Stage in food system	Waste volume	Year	Methodology	Data completeness	Additional comments
Households – nationwide ²³	Based on a sample and extrapolating to provide a national estimate, approx. one-third of kerbside waste is food waste, with NZ households producing 298,246 tonnes of food waste for kerbside collection each year. Of food wasted, 52.8% was avoidable, 13.5% was potentially avoidable, and 33.7% was non-avoidable.	2018 (updating on a 2015 study ⁵³)	Direct measurement, nationwide extrapolation.	This doesn't include household waste disposed of in other ways (e.g. in-sink disposal, home composting).	\$644/household/yr worth of avoidable wasted food, on average.
Whole of food system – nationwide ^{17,51}	Using inference, it was estimated that NZ produces 1,315,200 tonnes total food waste and 504,160 tonnes household food waste/yr.	2011	Inferred by extrapolation from North American data.		These estimates are now 11 yr out of date and the methodologies used mean we have low confidence in the estimates.
Whole of food system – nationwide ⁵⁴	Using inference, it was estimated that NZ households generated over 224,000 tonnes of food waste, and NZ industry generated over 103,000 tonnes of food waste.	2011	Inferred from macro-economic data and aggregated waste data.		
Food waste in Class 1 landfills – nationwide ⁷³	333,881 tonnes food waste sent to Class 1 municipal landfills in 2020.	2020	Unspecified.	Waste in other classes of landfills and food that is disposed of in other ways or diverted from landfill is not captured.	This data can't be used to identify the source of food waste. It combines both household and commercial waste.

Annex 2: Governmental and intergovernmental food waste initiatives

The below tables outline existing governmental and intergovernmental initiatives relating to food waste. The below symbols indicate the initiative type.



Report, roadmap, strategy, plan



Coordination mechanism



Funding mechanism



Activity, action, programme











Legislation, regulations, standards







As the OPMCSA food waste project progresses, we will continue to develop our overview of governmental and intergovernmental initiatives, with updated versions to be included in our final summary report. If you know of an initiative that we should reflect in our 2022/23 project, please reach out info@pmcsa.ac.nz








Governmental initiatives






Table 2: The below table summarises key governmental initiatives focussed on or closely related to food waste in Aotearoa. The table is sorted alphabetically by who it involves (firstly) and initiative name (secondly). Abbreviations: BPA = Bioresource Processing Alliance; CERF = Climate Emergency Response Fund; DOC = Department of Conservation; ETS = Emissions Trading Scheme; m = million; MfE = Ministry for the Environment; MoE = Ministry of Education; MoH = Ministry of Health; MPI = Ministry for Primary Industries; MPP = Ministry for Pacific Peoples; MSD = Ministry of Social Development; NSC = National Science Challenge; TPK = Te Puni Kōkiri; QMS = Quota Management System.



Initiative	Who	Description
 Venison donations ¹⁰⁴	DOC	In 2020, DOC partnered with the Fiordland Wapiti Foundation to donate 18,000 kg of venison to food banks, from deer management operations on conservation land.
 Bioresource Processing Alliance (BPA) ^{7,105-107}	MBIE	The BPA, which is funded by MBIE, develops innovative solutions to convert primary sector by-products into high value export products. The BPA co-funds and undertakes research and development projects with companies by using the expertise of its partner organisations (AgResearch, Scion, Plant and Food Research and Callaghan Innovation) and universities. By 2022, the BPA had conducted around 210 research projects and had 16 products enter the market, generating \$20 m in revenue for companies and diverting over 300,000 tonnes of waste to higher value uses. The programme has been running since 2012 and has received approx. \$23 m of MBIE funding.
 NSCs ¹⁰⁸	MBIE	The NSCs are interdisciplinary mission-led research challenges intended to address the biggest science based challenges and opportunities facing Aotearoa. They were established in 2014 and are funded by MBIE, with a total of \$680 m being allocated to the 11 Challenges over 10 yr. Several of the challenges have connections to combatting food waste, including Building Better Homes, Towns and Cities; Healthier Lives; Our Land and Water; and Sustainable Seas.

Initiative	Who	Description
Climate Change Response Act 2002 and Zero Carbon Amendment Act 2019 ^{12,109} 	MfE	The <i>Climate Change Response Act 2002</i> and <i>Zero Carbon Amendment Act 2019</i> form NZ's core legislative response to the climate emergency. This legislation provides a framework through which NZ can contribute to global climate change mitigation efforts in keeping with the <i>Paris Agreement</i> , including by setting greenhouse gas emissions reduction targets, establishing the Climate Change Commission, and requiring the government to develop and implement climate change mitigation budgets, as well as plans and policies for emissions reductions and adaptation. Efforts to comply with the requirements of this legislation can be supported by food waste minimisation and management measures. In addition, the Act requires landfills to report their methane emissions, with methane produced when food waste decomposes in the absence of oxygen, and surrender NZ Units under the ETS.
Emissions Reduction Plan ¹³ 	MfE	The country's first Emissions Reduction Plan, published in May 2022 and serving as a roadmap for reducing emissions for the next 15 yr, includes several aspects related to combatting food waste as part of nationwide efforts to reach net-zero long-lived emissions and achieve a 24-47% reduction in biogenic methane emissions by 2050. Relevant aspects include the circular economy and bioeconomy chapter and the waste chapter. The waste chapter lays out several actions intended to prevent food waste and increase diversion of food waste from landfills, as well as improving methane capture from landfills. The circular economy and bioeconomy chapter foreshadows planned strategic work and investment in these areas, including establishment of a baseline for the supply and demand of bioenergy feedstocks (which includes food waste) and bioenergy demand.
Environment Committee food waste briefing ⁷ and government response ³³ 	MfE	After receiving a briefing on food waste in 2020, which was accompanied by an expert report produced by Assoc Prof Miranda Miroso, Parliament's Environment Committee recommended that the government adopt a national definition of and measure of food waste and include reducing food waste with a reduction target as part of a national waste strategy and implementation plan. The Environment Committee recommendations (but not all the recommendations in the Miroso report) were endorsed by the Cabinet Environment, Energy and Climate Committee in 2020, and MfE is progressing work on implementation. Other recommendations made in the Miroso report were noted but not agreed to, particularly those relating to action to combat food waste (the accepted recommendations reflect the 'target' and 'measure' stages of the 'target, measure, act' approach to combatting food waste).
National Waste Strategy ^{49,110} 	MfE	MfE is developing a waste strategy, laying out its vision and aspirations for a low-waste NZ and a roadmap for getting there – due for completion in mid-2022. The strategy will be accompanied by a long-term waste infrastructure plan. This work will include the development of new waste legislation. In the strategy consultation document, MfE acknowledges that NZ is behind the curve on waste minimisation and management, and that efforts to strengthen the country's strategic approach to waste are crucial.
Waste Disposal Levy ^{111,112} 	MfE	MfE is progressively increasing the landfilling levy from \$10/tonne as set in 2009 to \$60/tonne by 2024, and additional disposal sites will be included beyond the municipal landfills currently levied. Half of the funds raised through the landfill levy are allocated to territorial authorities for waste minimisation activities and the other half go into the Waste Minimisation Fund, a contestable fund that supports waste minimisation initiatives. Increasing the levy has scope to act as a deterrent to landfilling waste and raise more revenue for territorial authorities and the Waste Minimisation Fund.

Initiative	Who	Description
Waste management legislation ^{49,110,113,114} 	MfE	Waste minimisation and management in NZ is predominantly governed by the <i>Waste Minimisation Act 2008</i> and the <i>Litter Act 1979</i> . The <i>Litter Act 1979</i> prohibits littering and dumping while the <i>Waste Minimisation Act 2008</i> aims to encourage waste minimisation and management, with responsibilities mostly lying with territorial authorities. MfE is reviewing both acts and intends to replace them with legislation that is clearer, stronger, takes a more strategic and long-term approach to waste, and includes a more significant role for central government in leading on waste minimisation and management. A bill is being developed to be introduced into Parliament in 2022.
Waste Minimisation Fund ¹¹⁵⁻¹¹⁷ 	MfE	The Waste Minimisation Fund is a contestable fund managed by MfE, with funds raised through the Waste Disposal Levy. Applicants can apply for funding to support step-change projects that promote waste reduction or waste management, typically at the regional or national level, with funding normally provided for up to 3 yr. The fund doesn't cover operational costs and is oversubscribed – in the 2021 funding round, 32 out of 224 applicants were funded, including 5 projects relating to food waste. The fund is currently undergoing a transformation, including a shift to an “always open” model and efforts to enhance the alignment between the fund's investment signals and the MfE's strategic objectives, as well as work to improve impact evaluation.
Ka Ora, Ka Ako ^{118,119} 	MoE, with support from other agencies incl. MoH, MPI, MfE, TPK	Ka Ora, Ka Ako, MoE's school lunches programme, is targeted at the top 25% of students in schools and kura facing the greatest socioeconomic barriers that could affect access to education, achievement, and wellbeing. Growing rapidly from a pilot in 2019 with 40 schools and kura, the programme now serves approx. 220,000 lunches a day across 947 schools and kura. Lunches are produced by the schools themselves, provided by external suppliers, or by iwi and hapū, which generates jobs and wider community benefits. Following the establishment and bedding in phase, the programme is now maturing, with MoE recruiting new staff into education, sustainability, and assurance roles within the programme and prioritising efforts to reduce surplus lunches through supplier relationships and demand forecasting.
Nutrition Survey ^{120,121} 	MoH	MoH runs a survey to collect information on the food and nutrient intake of New Zealanders, with a view to informing and monitoring health policies. From a food waste perspective, survey findings relating to eating habits and consumption patterns could be used to support NZ households to reduce food waste and may provide useful insights relating to food insecurity. The survey hasn't been run since 2008/09 for adults and 2002 for children; MoH is currently working with the University of Auckland to scope a nation-wide survey.
Australia New Zealand Food Standards Code ^{122,123} 	MPI	NZ standards relating to food labelling, composition and contaminants are set by the <i>Australia New Zealand Food Standards Code</i> . Most standards in the code have been adopted in NZ under the <i>Food Act 2014</i> . This includes rules relating to date labels (e.g. use by, best before, baked on), covered by standard 1.2.5. Date labels have an impact of food waste behaviours and the food rescue sector.
COVID-19 food redistribution funding ¹²⁴ 	MPI	MPI received around \$15 m from the COVID-19 Response and Recovery Fund to redistribute surplus food resulting from reduced demand through COVID-19 restrictions. The initiative involved the establishment of a contingency fund allowing MPI to purchase products where significant food waste, animal welfare, biosecurity concerns or environmental concerns would otherwise result, redistributing the food to struggling communities.



Initiative	Who	Description
Fisheries Act 1996 ^{78,125,126} 	MPI	The <i>Fisheries Act 1996</i> is one of multiple pieces of legislation governing fishing activity in NZ. Fisheries NZ, a business unit of MPI, is proposing to introduce a new landings and discards framework, which will establish evidence-based criteria to guide what fish can be returned to the sea and what fish must be landed. In addition, the government has announced the further roll out of onboard cameras, which will increase the level of monitoring of commercial fishing activity and improve accuracy of by-catch data in the future.
Food Act 2014 ^{127,128} 	MPI	The <i>Food Act 2014</i> works to ensure food sold in NZ is safe and suitable. Of relevance to food rescue, section 352 (colloquially known as ‘the Good Samaritan Clause’) protects food donors from liability resulting from the consumption of donated food, provided that the food was safe and suitable at time of donation and the donor provided the recipient with the information needed to maintain the safety and suitability of the food.
Legislation relating to animal food ¹²⁹⁻¹³³ 	MPI	To ensure that food waste used in animal food doesn’t create any animal or human health risks, the <i>Agricultural Compounds and Veterinary Medicines Act 1997</i> applies. Where the animal food contains any animal ingredients, the <i>Animal Products Act 1999</i> and <i>Biosecurity Act 1993</i> and relevant regulations also apply.
Sustainable Food and Fibre Futures Fund ¹³⁴ 	MPI	MPI administers the Sustainable Food and Fibre Futures Fund, through which approx. \$40 m is available each year. Businesses, organisations, researchers, community groups, land-owners and institutions can apply for funding on a co-investment basis, with a wide range of project types being eligible, including innovations to transform by-products to high-value products.
Fit for a Better World ^{135,136} 	MPI and wider NZ government	In July 2020, the government released a roadmap for the food and fibre sector to 2030, <i>Fit for a Better World</i> . Its purpose is to support the primary industries to become more productive, sustainable, and inclusive. Aspects relating to food waste include reducing fisheries by-catch and exploring regenerative farming practices, as well as the overall ambition to reduce primary sector emissions and promote sustainability. Implementation of the roadmap’s vision is supported by three partnership groups: Te Puna Whakaaronui, the Food and Fibres Partnership Group, and Ngā Pouwhiro Taimatua.
Mana Kai Initiative ¹³⁷ 	MPI, MfE, plus non-government stakeholders	The Aotearoa Circle is a public-private partnership that works to investigate and promote sustainability. The Mana Kai Initiative is a collaborative kōrero intended to enhance the performance and sustainability of NZ’s food system. The initiative will culminate in the production of a national food roadmap in mid-to-late 2022, which will include aspects relating to food waste.
NZ Food Safety Strategy ¹³⁸ and Action Plan ¹³⁹ 	MPI, via business unit NZ Food Safety	The 2019-2024 food safety strategy and action plan lay out NZ Food Safety’s approach to promoting food safety in NZ and ensuring the safety of foods exported from NZ. Aspects of this work intersect with food waste, for example, with efforts to enhance understanding of and adherence to safe food practices having scope to impact levels food waste throughout the food system.







Initiative	Who	Description
Food Secure Communities ¹⁴⁰⁻¹⁴³ 	MSD	Representing the first time government has provided direct funding to community food providers alleviating food insecurity while building food secure communities, MSD received \$32 m in funding in June 2020 to support food insecure communities over 2 yr. Funding has since been extended, with an extra \$18.5 m until June 2023, and has been used to fund NZFN, Kore Hiakai, and AFRA, as well as providing grants to smaller community organisations. NZFN and AFRA contribute to food waste reduction through food rescue. The funding and work in this space was galvanised by the evident food security needs throughout the COVID-19 pandemic. With the Food Secure Communities programme only funded until mid-2023, MSD is currently exploring options for its future food security work.
Territorial authority initiatives ^{13,144,145} 	Territorial authorities	Territorial authorities, which are required to promote effective and efficient waste management and minimisation in the areas under their jurisdiction, are engaged in a wide range of food waste initiatives that vary across the motu. All territorial authorities have waste management and minimisation plans, as required under the <i>Waste Minimisation Act 2008</i> . In addition, some councils have linked combatting food waste to other aspects of their work, beyond, such as Auckland Council's incorporation of food waste reduction targets and actions in its climate plan. ¹⁴⁶ The landfill levy provides earmarked funds for territorial authorities to conduct waste minimisation activities, which take on a variety of forms such as establishment of a local-level fund for community waste initiatives and waste reduction at events.
Love Food Hate Waste ^{75,144} 	Territorial authorities (i.e. city, district, and unitary councils)	Love Food Hate Waste is a consumer empowerment and education programme designed to combat food waste, primarily at the household level. It was first rolled out by WasteMINZ in NZ in 2016, funded by central government (via the Waste Minimisation Fund) and territorial authorities until 2018. Still managed by WasteMINZ but now solely funded by territorial authorities through population-adjusted annual fees, Love Food Hate Waste is supported by 47 out of 67 territorial authorities.
Climate Emergency Response Fund (CERF) ¹⁴⁷ 	Treasury, to fund initiatives across government	<p>The CERF was established in 2022 with funding equivalent to the available cash proceeds from the ETS over the period from 2022/23 to 2025/26, to be dedicated multi-year funding source for public investment on climate-related initiatives.</p> <p>Of particular relevance to food waste, MfE's bid for CERF funding for their 'Reducing emissions from waste' initiative was successful in Budget 2022. The initiative seeks to implement a suite of proposals to reduce biogenic methane emission from waste in line with the target reduction pathway in the ERP. This initiative will reduce and divert organic waste from landfill and enable emissions to be reduced through delivering resource recovery feasibility studies, business cases, infrastructure and other assets; behaviour change programmes to reduce emissions from waste; and a national waste data programme including landfill gas capture research.</p>
Sustainable Food Systems Project ¹⁴⁸ 	Multiple agencies, incl. MPI, MfE (principal leads), MSD, MoH	The Sustainable Food Systems Project is building foundations for work across agencies, and with Treaty partners, on food systems challenges facing NZ, particularly food affordability and the cost of living, and intersecting with food waste. In the short term the project will deliver advice to Ministers on food systems issues and identify opportunities to do further work.

Initiative	Who	Description
Cross-agency food systems group ¹⁴⁹ 	Officials in central government agencies with a role and interest in the food system (e.g. MPI, MfE, MSD, MoH, MBIE, MoE, TPK, MPP, DOC, Kainga Ora)	The cross-agency food systems group brings together officials from across agencies with a role and interest in key aspects of the food system (encompassing areas such as primary production, food safety, nutrition, food security, environmental impacts and sustainability, food waste, supply chain, consumer interests). The purpose of the group is to share information, build connections, strengthen coordination and cohesion in policy advice and initiatives across the food system, and identify and take forward opportunities for cross-agency collaboration.
Petition on food waste and food insecurity ¹⁵⁰ 	Sunday Blessings	Grassroots Community Group Sunday Blessings presented a petition to parliament on 17 May 2022, calling for the House of Representatives to: “implement legislative and policy reforms to: recognise that adequate food is a fundamental human right; increase accessibility to nourishment and food security by food waste minimisation; enable and protect growth of safe food; and promote self-determination in food-insecure communities.”

Intergovernmental initiatives

Table 3: The below table summarises key intergovernmental initiatives focussed on or closely related to food waste. The table is sorted alphabetically by who it involves (firstly) and initiative name (secondly). Abbreviations: APEC = Asian-Pacific Economic Cooperation; COP = Conference of the Parties; FAO = Food and Agricultural Organisation of the United Nations; SDG = Sustainable Development Goal; UN = United Nations; UNEP = United Nations Environment Programme.

Initiative	Who	Description
Global Methane Pledge ¹⁵¹ 	112 countries and the EU <i>This includes NZ</i>	The <i>Global Methane Pledge</i> was launched at COP26 in 2021 with the intention of contributing to efforts to keep the <i>Paris Agreement</i> alive. Parties to the pledge agree to take voluntary actions to contribute to a collective effort to reduce global methane emissions at least 30% from 2020 levels by 2030.
Paris Agreement ¹⁵² 	192 countries and the EU <i>This includes NZ</i>	The <i>Paris Agreement</i> , agreed at COP21 in 2015, is a global agreement to keep global temperatures well below 2°C above pre-industrial levels, but ideally aiming for 1.5°C.
Codex Alimentarius ^{153,154} 	88 countries, plus the EU <i>This includes NZ</i>	<i>Codex Alimentarius</i> sets international food standards, including in relation to food quality, labelling, and processes at international borders.
Food Security Roadmap Towards 2030 ¹⁵⁵ 	APEC member states <i>This includes NZ</i>	At the APEC forum chaired by NZ in 2021, APEC Ministers responsible for food security endorsed the <i>Food Security Roadmap Towards 2030</i> , which focuses on achieving sufficient, safe, nutritious, accessible and affordable food for all. Through the roadmap, APEC forum member states have committed to working together to combat food waste, for example by exploring options to allow perishable goods to clear customs in a timely manner and holding capacity building and best practice sharing workshops to work towards SDG 12.3.

Initiative	Who	Description
Champions 12.3 ¹⁵⁶⁻¹⁵⁸ 	International public-private coalition <i>NZ is currently not part of this group, but has an active domestic chapter with links to the international group</i>	<p>Champions 12.3 members are executives from governments, businesses, international organisations, research institutions, farmer groups, and civil society who are committed to achieving SDG 12.3. Members lead by example on food waste reduction advocate for and raise the profile of SDG 12.3. SDG 12.3 publishes reports tracking global progress towards SDG 12.3 and explores solutions to assist with progress.</p> <p>While NZ does not currently have a member in the international Champions 12.3 group, NZ Food Waste Champions 12.3 is a multistakeholder domestic committed to the SDG 12.3 kaupapa and affiliated with the international group. Activities of NZ Food Waste Champions 12.3 include: advocating for a national food waste reduction target aligned with SDG 12,3; leading work on a food waste definition with MfE; launching NZ's first voluntary agreement on food waste reduction, the Kai Commitment; and co-production of a food waste reduction roadmap.</p>
C40 ¹⁵⁹ 	Network of mayors from nearly 100 cities around the world <i>This includes Auckland</i>	<p>Founded in 2005 by the mayor of London, C40 is a collaborative network of cities committed to climate action. Auckland has been part of C40 since 2014 and has signed several C40 declarations including the <i>Advancing Towards Zero Waste Declaration</i>, which includes commitments relating to food waste. The <i>Good Food Cities Declaration</i>, which Auckland hasn't yet signed, commits signatories to working to halve food loss and waste by 2030.</p>
FAO Food Loss Index ³⁶ 	UN member states <i>This includes NZ</i>	<p>FAO is responsible for tracking progress towards reducing food waste along production and supply chains, in accordance with SDG 12.3. To this end, it has developed a methodology for measuring pre-retail food waste and has applied the methodology to provide a food waste estimate.</p>
SDG 12.3 ^{46,47} 	UN member states <i>This includes NZ</i>	<p>In 2015, UN members set 17 global goals to be achieved by 2030, designed to secure a more sustainable future. SDG 12.3 relates directly to combatting food waste, and multiple others relate closely, such as SDG 2 (zero hunger) and SDG 13 (climate action), among others.</p>
UN Food Systems Summit 2021 ^{160,161} 	UN member states <i>This includes NZ</i>	<p>The UN Food Systems Summit was held during the UN General Assembly in September 2021. The summit was an opportunity for dialogue on moving towards sustainable food systems, including through reducing food waste, and was supported by a research paper on science and innovations for food systems transformations. An international public-private coalition called 'Food is Never Waste' was formed from the summit and is in the early stages of determining its purpose and function.</p>
UNEP Food Waste Index ³¹ 	UN member states <i>This includes NZ</i>	<p>UNEP is responsible for tracking progress towards halving food waste at the retail and consumption phase of the food supply chain, in accordance with SDG 12.3. To this end, it has developed a methodology for measuring food waste at the retail and consumption phases of the food supply chain and has applied the methodology to provide a food waste estimate. It will continue monitoring global progress, including with a food waste questionnaire for member states in September 2022.</p>

Acknowledgements

We thank the many researchers, stakeholders, and officials in our project reference group. Our work wouldn't be possible without the academic and on-the-ground insights shared by this diverse group, who have helped to guide our approach to this project, commented on drafts, hosted us for visits, engaged in thought-provoking discussions, and shared resources and whakaaro.

We also acknowledge the Chief Science Advisor Forum members for their contributions to this project.

Our acknowledgement of the people who have helped us in this mahi in no way indicates their endorsement of the project outputs, and responsibility for any errors and omissions sits with OPMCSA. We have done our utmost to keep track of everyone who has contributed to this project and extend our sincere apologies if we have inadvertently omitted anyone.

As this project is unfolding in a series of reports, we continue to welcome new members to the reference group. If you'd like to be involved in our 2022/23 project, please contact info@pmcsa.ac.nz

We also extend our thanks to everyone who has paved the way for the combatting food waste kaupapa, both here in Aotearoa and abroad. We have discovered a rich legacy and growing momentum around food waste minimisation and management, forming an excellent context in which to conduct our work.

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