# Victoria Unboxed

## Reducing Packaging Waste in Short Fresh Produce Supply Chains


Report prepared by
**Sustain: The Australian Food Network**

By Beth Ciesielski
Angus Howlett
Helen Addison-Smith


SUSTAIN
the Australian food network

# Executive summary

Food packaging waste in Australia contributes significantly to waste generation and environmental pollution.[1] Despite a high percentage of packaging being reusable, recyclable, or compostable, actual recycling and composting rates are low.[2] The solution to this is not as simple as removing packaging from food supply chains, as it plays an important role in keeping food fresh and undamaged, thus reducing food waste, a significant contributor to greenhouse gas emissions.[3] As such, a balance must be sought between food and packaging waste to improve environmental outcomes.

Under the National Waste Action Plan, the Australian government has set ambitious targets for 2025 to reduce packaging waste. These targets include:

**100%**
reusable, recyclable or compostable packaging.

**70%**
of plastic packaging being recycled or composted.

**50%**
average recycled content included in packaging (revised from 30% in 2020).

**The phase-out**
of problematic and unnecessary single-use plastic packaging.

The Victoria Unboxed project aligned with these targets, specifically focusing on reducing pre-consumer packaging waste in short fresh produce supply chains. It was inspired by the existing crate usage by small-scale farmers in Victoria and produce distributor Natoora's commitment to using crates for their deliveries to hospitality venues. Victoria's local produce is the hero of our greatest cafes and restaurants, and this project worked to document and enhance the unsung, behind the scenes sustainability work that the farmers, hospitality workers and distributors do to move towards a circular economy.

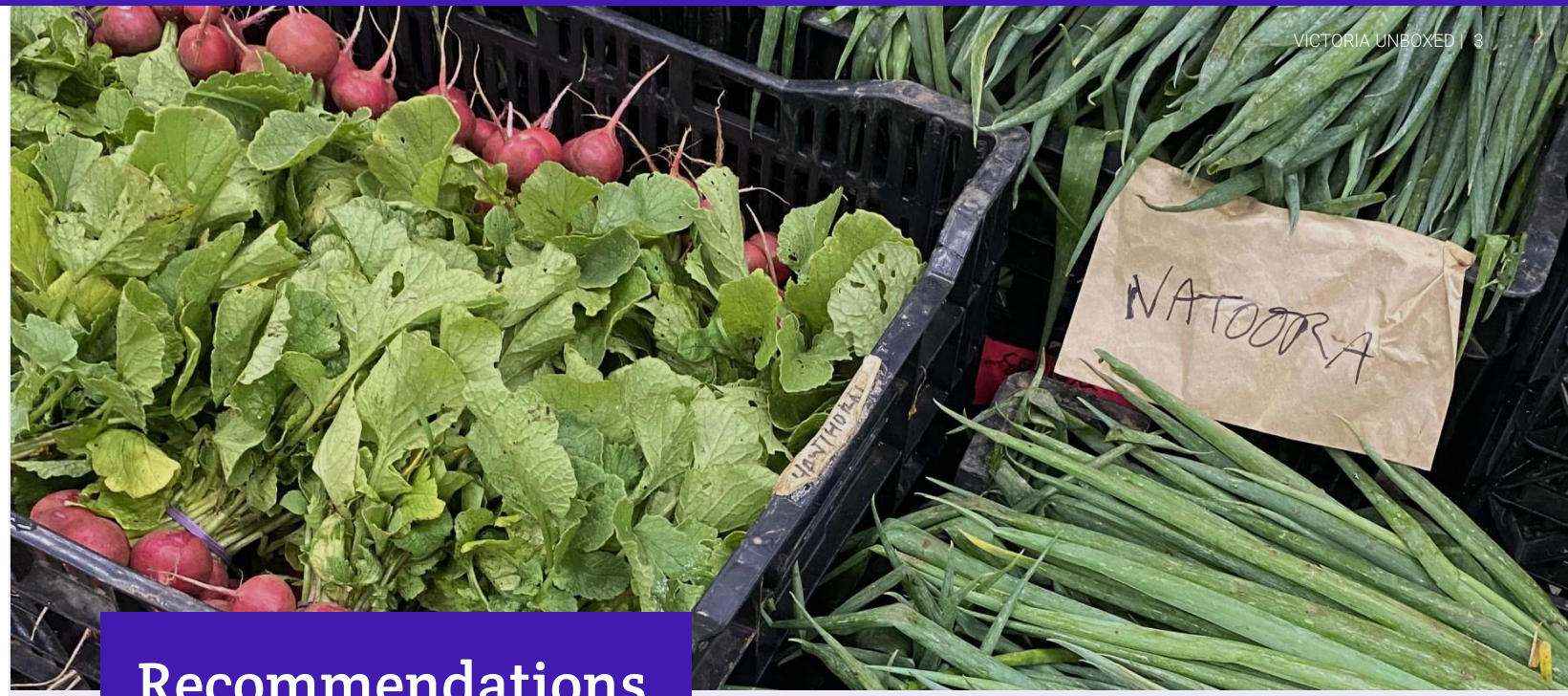
Research has found that packaging reuse programs, particularly those involving reusable plastic crates, can enhance the sustainability of fresh produce supply chains.[4] There are reusable crate programs currently in use in Australia, with both Coles and Woolworths utilising reusable plastic crates in their supply chains.[5] And of course, the use, reuse and adaptive use of the milk crate is ubiquitous and every day. Many small-scale farms in Victoria have independently adopted plastic crates for storage and transport of produce.[6] However, despite the inherent waste savings related to reusable plastic crates, their use remains relatively low because of the startup costs and logistical complexity of such schemes.

The Victoria Unboxed Project worked to reduce these startup costs and document and streamline the logistics of crate use to boost growth in circular crate systems and reduce packaging waste in fresh produce supply chains. We achieved this by researching current industry practices and running a crate-use pilot program with Natoora, a Melbourne-based direct-to-hospitality produce distributor. The pilot program was designed based on desktop research, stakeholder consultation and field visits. The desktop research component of the project sought examples of existing reusable packaging programs and conducted a lifecycle assessment of packaging materials. Stakeholder feedback was gathered during all stages of the project. Our fieldwork also uncovered other circular packaging solutions currently used in small-scale farms - particularly egg cartons and sealed tubs for salad mix. We adapted our project to showcase these initiatives, as they have great potential to drive circular food packaging solutions.

1. Arunan & Crawford, 2021
2. Australian Packaging Covenant Organisation, 2021
3. Department of Climate Change, Environment, Energy and Water, 2023; NSW Environment Protection Agency, 2022
4. Del Borghi et al., 2021; López-Gálvez et al., 2021
5. Coles Group, 2023; D'Souza, 2023
6. CHEP, 2024

Overall, this project demonstrated reusable crates' effectiveness in reducing waste and operational stress. The continued use of crates from this project saves an estimated 7.18 tonnes of packaging waste per annum, **the equivalent of 6.2t of CO2e (production emissions).** Many of Natoora's stakeholders involved in the project were already fully engaged with creating circular packaging solutions, so the extra resources this pilot program afforded created a more sustainable system with sufficient 'slack' to ensure more consistent and efficient use of crates. We received overwhelmingly positive feedback from farms and hospitality venues alike.

The logistics involved in circular economy schemes requires thoughtful consideration. Our research found that **using distinctive branded crates and a regular exchange of crates** led to a highly efficient return of crates in the distributor to hospitality supply chains. On the other hand, using crates within a more porous system - that of the farm - proved more of a challenge. It was not that crates were lost or destroyed, but they became increasingly used for long-term storage.




# Recommendations

Based on the findings, the report recommends **expanding reusable packaging solutions across more segments of the hospitality supply chain.** Crates are handy and adaptable, but **product-specific solutions** (such as egg cartons and sealed containers for salad mixes) are essential for circular packaging in the future. Our research has shown that such systems work best when attached to existing systems. **Circular packaging systems do not necessarily need to be high-tech, as they mostly rely on the goodwill and commitment of the people within them.** Government investment would be well targeted at **subsiding the crate infrastructure available to farmers, distributors and businesses and supporting the education and engagement of the hospitality, farm and distributor sectors.**

Government policies and regulations also play a pivotal role in shaping industry practices regarding packaging waste. **Legislative measures, such as bans on single-use plastics, mandates for recyclable materials, and incentives for circular packaging use,** are vital to shifting to sustainable food production and distribution models. It is important for government interventions to strike a balance, ensuring compliance with less willing actors while encouraging engaged industries to adopt proactive measures.

# Table of contents




## Acknowledgements

The Board and staff of Sustain acknowledge that we work on the traditional lands of the Wurundjeri, Woi Wurrung and Bunurong peoples of the Kulin nation.

We respectfully acknowledge the custodianship of the Wurundjeri, Woi Wurrung and Bunurong elders, recognising that they and their ancestors stewarded these lands and their diverse creatures sustainably for tens of thousands of years.

Thank you to all the organisations who participated in this project and generously shared their insights. Special thanks to Natoora Melbourne and our case study farms Sunnybank Farm Ballarat, Farm Raiser, Common Ground Project and Torello Farms.

# The Victoria Unboxed Project

Replacing single use boxes with crates in the wholesale produce supply chain can benefit the financial and environmental bottom line. However, the logistics of crate use are tricky as, unlike single-use packaging, reusable crates need to be cleaned, tracked and returned. There are certainly functional precedents in the use of reusable crates for distribution - milk and bread crates in particular permeate our everyday life. However, there has been no significant research to date into what is the best practice for such systems, and how smaller players can overcome the financial burden of beginning such a program. This is precisely what Sustain set out to achieve through the Victoria Unboxed project. Here, we designed and piloted a reusable crate program based on stakeholder consultation and then gathered the findings of its effectiveness in reducing packaging waste. We worked with farmers, a distributor and the hospitality industry, all players chosen because they include a significant cohort of workers and operators who are interested in improving both the financial and environmental bottom lines of the local food system.

The Victoria Unboxed Project had two key components:

**A Pilot Program**
Partnering with a fresh produce wholesale, Natoora Melbourne, to pilot a crate reuse program to reduce waste in their supply chain.

**Case Studies**
Conducting case study research with four farms already employing successful packaging waste reduction measures.

For our pilot program, Sustain partnered with Natoora Melbourne, a fresh produce distributor that sources 50% of its produce directly from local farms. This partnership worked to design and pilot a reusable crate program, document the learnings, and reduce the cardboard, waxed cardboard, and polystyrene packaging waste in Natoora's supply chain. At the commencement of this project, Natoora delivered around 31% of their orders in crates. The remaining 69% of produce delivered was packed in cardboard, waxed cardboard or polystyrene boxes. They also received some orders from suppliers in reusable crates.

The following sections summarise the methodological approaches, key findings, and learnings from the pilot program and the case studies. This is followed by an exploration of the project's limitations and the overarching challenges for reducing packaging waste. Finally, we outline recommendations for government intervention to foster widespread, systematic action in reducing Australia's packaging waste footprint. .

The project was delivered by Sustain: The Australian Food Network, with funding provided by Sustainability Victoria under Round 2 of the Circular Economy Communities Fund. The funding enabled the purchase of crates for the project and created 1.3 FTE of short-term employment and a contribution of 163 volunteer hours.

# Methodology

The project ran from February 2023 until March 2024 and included following components:

## Background Research

A review of relevant peer-reviewed and industry research and actions from state and federal government, industry bodies, and dominant stakeholders was conducted to develop a thorough understanding of the packaging waste problem.

## Lifecycle Assessment

A lifecycle assessment was performed to determine the comparative emissions of cardboard, waxed cardboard, polystyrene boxes and plastic crates. This assessment was limited to production emissions, as there was a lack of data concerning the recycling rates of the packaging materials.

## Stakeholder consultation

The Sustain team consulted with stakeholders across Natoora's supply chains to understand the experiences and perspectives of farmers, hospitality venues, and staff regarding reusable crates and waste minimization practices. Fifteen stakeholders participated in interviews or online surveys. A Sustain staff member also shadowed a driver to gain first-hand knowledge of Natoora's supply chain operations.

## Baseline waste audit

The Sustain team conducted a baseline audit that quantified the volume of packaging waste disposed of both at Natoora's warehouse and by Natoora's customers. The audit included:

- A manual audit of the volume of packaging boxes disposed of at Natoora's warehouse in a week.
- A review of delivery data to determine the ratio and quantity of orders delivered in single-use box crates compared to reusable crates.

## Pilot program design

Our team designed the pilot program using the findings from the desktop research, lifecycle assessment and consultation.

## Pilot program implementation and stakeholder feedback

The pilot program was initially rolled out to four farms and six hospitality venues in July and August 2023. This allowed time to receive feedback, review the initial design and make changes if necessary before rolling the pilot program out to all customers and local farm suppliers. Ultimately, no material changes were required following the initial rollout of crates. However, the pilot program wasn't rolled out across Natoora's operations until March 2024 due to shipping delays on the foldable crates. Farmers, hospitality venues and Natoora staff provided feedback throughout the pilot. Feedback was via phone interviews and online surveys.

## Final waste audit

Waste was audited using the same methodology as the baseline waste audit. The results of this audit were used to estimate the total waste savings resulting from this project.

## Case studies

Field research identified farms successfully reducing packaging waste. A Sustain staff member visited the selected farms to interview relevant stakeholders and observe operations.

## Identification of limiting factors

After analysing the project's results, the Sustain team identified the challenges and limitations of the pilot program.


# Background Research

Food packaging waste significantly contributes to Australia's waste generation profile and is a major contributor to environmental pollution,[7] and as such is of critical environmental concern. Data from 2019/20 shows that of the 86% of Australia's packaging that is reusable, recyclable, or compostable **only 16% of packaging is, in fact, recycled or composted.**[8] Information about the **reuse** of packaging is not available. According to the 2012 Australian Recycling Sector report, such low rates of recycling or composting can be largely attributed to consumer behaviours and lack of end markets for recycled products.[9] However, this data considers only the consumer side of packaging waste. There is limited research on pre-consumer food packaging waste such as the cardboard, waxed cardboard, polystyrene boxes and the single use plastic coverings that are used for transporting food but disposed of before reaching the consumer.

While food packaging presents an environmental challenge, it can increase the longevity of produce and so reduce food waste, which is a considerable source of carbon emissions in Australia.[10] The weighing up the use of packaging in extending the shelf life of food versus the environmental impact of the packaging itself is complex.[11] Food packaging serves several key functions, including keeping food safe from contamination, facilitating transport, and extending food shelf life. However, packaging materials are, most often, single use and consigned to landfills. The challenge lies in balancing sustainability in packaging materials with their effectiveness in preventing food waste.

Australians discard four times more food than food packaging, a fact that could be fuelled by consumers' perceptions of packaging[12] as being an 'unnecessary' single-use waste product, while food waste is 'natural' and 'inevitable'.[13] According to several studies, misconceptions lead many to view packaging only as a single-use waste product, overlooking its critical function in preserving food and extending shelf life.[14] However, these studies only compare the impact of food packaging against food waste in terms of greenhouse gas emissions and fail to consider the broader environmental impacts. For example, the prevalence of plastics in single use packaging products contribute to the growing issue of ocean plastics, which pose a threat to marine life and the balance of marine ecosystems.[15] With somewhere between 93 and 236 million tonnes of plastic waste currently estimated to be in the world's oceans, this is a significant issue.[16] Further concerns exist with packaging waste that includes 'forever chemicals', including perfluorinated and polyfluorinated substances (PFAS and PFOS). While the extent of impact caused by

7. Bambridge-Sutton, 2023
8. Australian Packaging Covenant Organisation, 2021
9. Brulliard et al., 2012
10. Anderson et al., 2023; Department of Climate Change, Environment, Energy and Water, 2023
11. Bambridge-Su
12. Zheng, 2023
13. Brennan et al., 2023; Zheng, 2023
14. Brennan et al., 2023; Zheng, 2023
15. Watt et al., 2021
16. Van Sebille et al., 2015

these chemicals in the concentrations that exist in packaging remains a matter of debate, potential risks to reproductive and children's health have been identified,[17] and research demonstrates concentrations of PFAS and PFOS are present in soil, water, wildlife, and the human body.[18]

Previous government interventions and policy aimed at reducing the volume of packaging waste in Australia exist at both federal and state level. In 2019, The Australian Federal Government adopted the 'National Waste Policy Action Plan' (NWPAP). The NWPAP defined a set of 'National Packaging Targets' to be met by 2025, including:

**100%**
reusable, recyclable or compostable packaging.

**70%**
of plastic packaging being recycled or composted.

**50%**
average recycled content included in packaging (revised from 30% in 2020).

**The phase-out**
of problematic and unnecessary single-use plastic packaging.

The Australian Packaging Covenant Organisation (APCO) was then charged by the government to lead the National Packaging Targets.[19] However, in their 2023 *Review of the 2025 National Packaging Targets* report, APCO stated that these targets would not be met.[20]

Strategies to limit waste vary significantly from state to state. In 2020, South Australia pioneered action on packaging waste by restricting the use of certain plastic products and promoting waste reduction and better waste management practices.[21] Following South Australia's landmark policy, all other Australian states, excluding Tasmania, have implemented similar initiatives.[22]


17. Anderko & Pennea, 2020
18. Abunada et al., 2020
19. Australian Packaging Covenant Organisation, n.d.
20. Australian Packaging Covenant Organisation, 2023
21. Replace the Waste, n.d.
22. Australian Marine Conservation Society, 2023

# Industry action

Australia's fruit and vegetable supply chains are heavily dominated by supermarkets, accounting for 60% of the total market.[23] Australia's three major supermarkets (Coles, Woolworths and Aldi) have adopted publicly available strategies to reduce waste going to landfill. These policies all included objectives to reduce food packaging waste in some form.[24]

Large supermarket chains have the ability to implement waste reduction strategies at scale. When it comes to **food waste**, these companies' relationships with food relief organisations such as OzHarvest and SecondBite are well known. However, what is less obvious is the supermarkets' direct relationships with farmers and the fact that their produce is delivered directly to their distribution outlets,[25] enabling considerable control over pre-consumer packaging waste. Indeed, Coles and Woolworths use reusable crates to transport much of their fresh produce between farms and stores and engage third-party organisations to supply, store and wash the crates.[26]

On the other hand, the vast majority of produce sold via wholesale markets is transported in single-use packaging. As 50% of fresh produce distributed in Australia is sold via such markets,[27] considerable waste is being produced in this supply chain. Such markets deal with a large range of suppliers, most often farmers and distributors who are selling their produce business to business. For example, the Melbourne Market is utilised by over 2700 individual businesses.[28] To introduce a standardised, reusable packaging program into this setting would be difficult - although of course the history of produce distribution is far longer than the history of either cardboard boxes (which gained popularity around the turn of the twentieth century) or polystyrene boxes (which were only invented in 1944).[29] The Melbourne Market does not have the capacity to run the infrastructure for reusable crate program, as this would require **a state, if not nationwide approach.** Instead, it focuses on recycling systems, with an onsite transfer station collecting and processing a wide range of recyclable waste streams including polystyrene, cardboard, hard plastics and soft plastics.

Within the Melbourne Market environs, there are reusable crate progams such as that run by CHEP, which supplies, collects, and washes reusable plastic crates to paying customers.[30] The use of such programs are at the discretion of the individual business, and in the course of our research, Melbourne Market staff indicated that they only occasionally see reusable crate use, with single use packaging being the norm.

However, there is a growing sector within the food supply chain that offers a more direct distribution from farm to table, with small scale farmers selling direct to hospitality venues or the public in forums such as farmers' markets. Natoora - the company who was engaged with for this project - is a rare example of a distributor that deals with such small local farmers, and then distributes directly to the hospitality industry. The small scale of these farms means that they have been able to implement reusable crate schemes without it becoming too logistically overwhelming. Our background research found that many small farmers have already independently adopted reusable plastic crates to store and transport produce, for both financial and environmental reasons. Natoora also used crates for some, but not all, of their deliveries to restaurants and received some, but not all, of their produce in crates as well.

23. Zheng, 2023
24. Aldi, n.d.; Coles Group, 2023; Woolworths, n.d.
25. Wakiyama, 2020
26. Coles Group, n.d.; D'Souza, 2023
27. Fresh Markets Australia, n.d.
28. Melbourne Market Authority, n.d.
29. Smith, 2017; Twede & Selke, 2005, pp. 41-42, 55-56
30. CHEP, n.d.

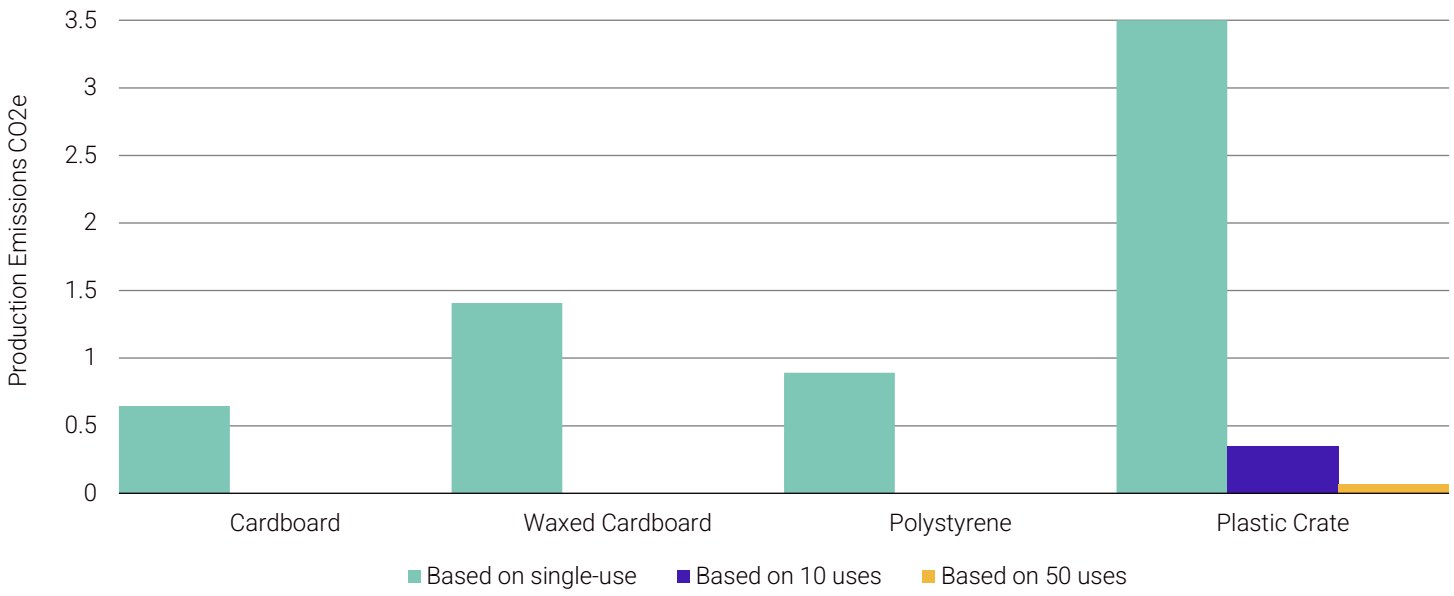
# Lifecycle Assessment

Plastic crates are the most readily available and utilised circular system for distributing produce within Australia. However, there is limited research on the environmental impacts of reusable crate programs, and the research that has been undertaken has had mixed results. One study, which used a comparative life cycle assessment to quantify and compare the environmental impacts of plastic, corrugated board and wood crates used for food delivery, showed that plastic crates are best if a recovery system is planned; otherwise, the best choice is wooden crates.[31] Another study on reusable plastic crates in the cauliflower industry found that reusable schemes had a lower environmental impact than single-use cardboard and wooden boxes.[32] However, a study of a bread delivery system in Finland comparing transport in a reusable plastic crate program versus recyclable cardboard boxes found that the recyclable cardboard boxes system was more environmentally friendly in the studied impact categories.[33] This study was thorough and covered emissions from manufacturing of the crates/boxes, their use, transport at various stages of life, washing (in the case of crates) and waste management/recycling of the crates/boxes.

The Sustain team conducted a basic comparative lifecycle assessment to determine the environmental impacts of different packaging alternatives for this project. This assessment was limited to production emissions as the recycling rates for boxes, polystyrene, and waxed cardboard are highly variable, and a detailed lifecycle assessment was outside this project's scope. The per-use production emissions of each packaging type are represented in the graph below. The full lifecycle assessment is provided in Appendix 3.

The plastic crates used in this project are made of high-density polyethylene (HDPE), which is among the most recycled plastic types.[34] This is an advantage as it contributes to the environmental sustainability of crate use. Sustain reached out to several domestic plastic recyclers (namely Precious Plastic and GT Recycling, Geelong) and found that end-of-life plastic crates could be recycled and, in many cases, would be accepted free of charge. However, the bread crate study mentioned above shows that life cycle assessment is complex and more fulsome research is warranted in order to make assumptions before scaling up.

## Production Emissions of packaging per use




31. Del Borghi et al. 2021
32. López-Gálvez et al., 2021
33. Koskela, 2014
34. Louzeiro, 2021

# Stakeholder Consultation

## Overarching concerns

**Overpackaging**
This was particularly evident in concerns about specific packaging types of notably soft plastics, polystyrene, and excessive cardboard.

**Silos**
Greater collaboration between all industries in the supply chain was a commonly held goal.

**Awareness**
As this kind of packaging is often invisible to the public, there was a general perception that greater awareness about this issue is needed.

## Hospitality concerns

**Lack of space**
At many venues, space to store crates is limited. Some venues must unpack their deliveries immediately and return the crates to the delivery driver. This situation is not ideal for delivery drivers or kitchen staff as it creates time-sensitive, stressful work.

**Mixing up crates from multiple suppliers**
Multiple suppliers deliver produce in solid, unmarked black crates sourced second-hand from the bulb import industry. Therefore, crate exchange sometimes results in delivery drivers taking crates intended for a different supplier.

**Use of crates for long term storage**
During interviews, the team observed hospitality venues using crates to store items such as onions, potatoes, napkins, and miscellaneous hospitality supplies at multiple venues. As second-hand crates are not typically marked as the property of any particular supplier, their ownership in supply chains becomes fluid.

**Staff awareness**
Staff awareness about reusable crates impacts the rate of crate return. The more staff are aware of the crates' utility across the supply chain, the more attentive they tend to be in returning crates correctly to suppliers after delivery.

## Farm concerns

**Crate cost**
Farmers identified the cost of crates as a key barrier to their use. Although second-hand crates are cheap to purchase, considerable effort is involved in sourcing, cleaning, and ensuring that customers return them.

**Produce quality**
Although crate use was high amongst farmers consulted for this project, some specific packaging products were still preferred to crates for certain produce. For example:

- Polystyrene boxes, usually second-hand, were used by some farmers to package fragile, high-value items, such as zucchini flowers.
- Plastic liners were used to protect produce, such as salad mix, from drying out in the cool room.
- Polystyrene pads were used to stop fragile produce, such as tomatoes, from bruising.

**Tracking of crates**
Because of their limited supply and replacement costs, farmers were wary of leaving crates with restaurants and suppliers. Crate loss was of great concern. Farmers who run direct-to-consumer box schemes also identified this as a point of crate loss. Farmers felt that crate loss was inevitable, with one farmer purchasing 400 crates and was left only 50 within a year.

## Distributor concerns

**Loss of crates to other suppliers**
Natoora loses a significant number of crates to other suppliers. As each crate has both financial and use values, losing a crate to a competitor is a challenge.

**Continued supply of single use packaging**
Although some of their suppliers already use crates, some bigger suppliers still use single-use packaging for their products. Consequently, various types of single-use packaging, including cardboard, waxed cardboard, and polystyrene boxes, continue to enter Natoora's supply chain.

**Non-return of crates by hospitality venues**
Although generally on good terms with their customers, some venues repeatedly do not return crates.

**Reluctance to pay for crate rental**
Natoora has found that when customers or suppliers have the choice between a paid crate rental program or free single-use packaging, they will choose the latter. It should also be noted that any sort of pay-per-use program will hit farmers the hardest, as they have the largest quantity of boxes/crates in use.

**Insufficient crates**
Before the initiation of the pilot program, orders often went out single use boxes, simply because Natoora did have enough crates to consistently run the scheme.

# Baseline Audit

The waste audit conducted before implementing the crate use pilot calculated that Natoora wasted an average of 416kg of cardboard, waxed cardboard and polystyrene boxes per week. This volume equates to over 21t of waste per annum or 18.9t of CO2e (production emissions) based on an approximate ratio of 10% polystyrene, 10% waxed cardboard, and 80% cardboard. The audit also found that, on average, Natoora delivered 31% of orders in crates, with the remainder being sent out in single use packaging.

# Pilot Program Design

The initial pilot program design was informed by stakeholder consultation, desktop research, and the comparative life cycle assessment. Two types of reusable crate systems were developed to satisfy the different needs of hospitality venues compared with farms. The figure below shows the logistics of the two systems:

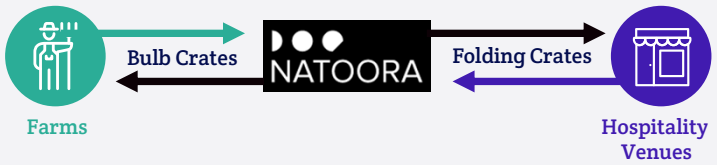



*Figure 1: Demonstration of crate flow per pilot design*

## Farms to Natoora – bulb crate scheme

The crates chosen for transport between farms and Natoora were second-hand solid plastic crates. Having previously been used to import bulbs from the Netherlands, these crates are considered end-of-life by that industry and are available for purchase second-hand. At $5 each, these crates were relatively low-cost and consistent with those already used by both Natoora and farmers. When compared to the average cost of a virgin cardboard box at over $2, only three crate uses are required before financial savings are made.

Farmers prefer these types of crates as they are tough, can be used as a sieve for washing produce, slide and stack, and fit neatly onto a pallet. The low cost of these crates enabled the purchase of a significant volume for the pilot program and ensured that they are more accessible for farmers who may wish to purchase additional crates in the future. Eight hundred crates were purchased to' flood' the Natoora farm supply chain.

*Figure 2: Example of Farm Crates*

One key consideration was whether these crates should be branded to indicate Natoora's ownership. The crates do not have a surface suitable for attaching a label, but testing with stencils and spray paint proved this was an option. However, given the large volume of low-cost crates, the labour required to brand them was not economical compared with their replacement cost. In addition, these crates were already used by Natoora and their suppliers, and labelling crates would create complexity for farmers to ensure certain crates were only used for Natoora orders.

Natoora adopted a "One In, One Out" system to minimise crate loss. The process required farmers to advise how many crates they used for an order before delivery or collection. Natoora would then ensure an equal number of empty crates were available and exchanged. This process intended to ensure that both Natoora and the farmers maintained consistent volume crates on hand for future orders.

## Natoora to hospitality – green foldable scheme

Space was a primary concern for hospitality venues. Therefore, the pilot adopted a **different foldable crate** for this stage of the supply chain. The foldability of these crates also meant that they fit easily into delivery vans, even when said vans are full of orders. This was a change for Natoora, who previously delivered produce in second-hand bulb crates to some hospitality customers.

Second-hand foldable crates are not easily attainable, so these crates had to be purchased new. The cost of this crate is over five times the price of the second-hand bulb crate. One advantage of these crates was that their dark green colour matched Natoora's branding and made them identifiable by customers and Natoora's drivers. All crates were labelled with Natoora branding and the name of the project to clearly designate their ownership. One thousand crates were purchased to serve all of Natoora's customers.

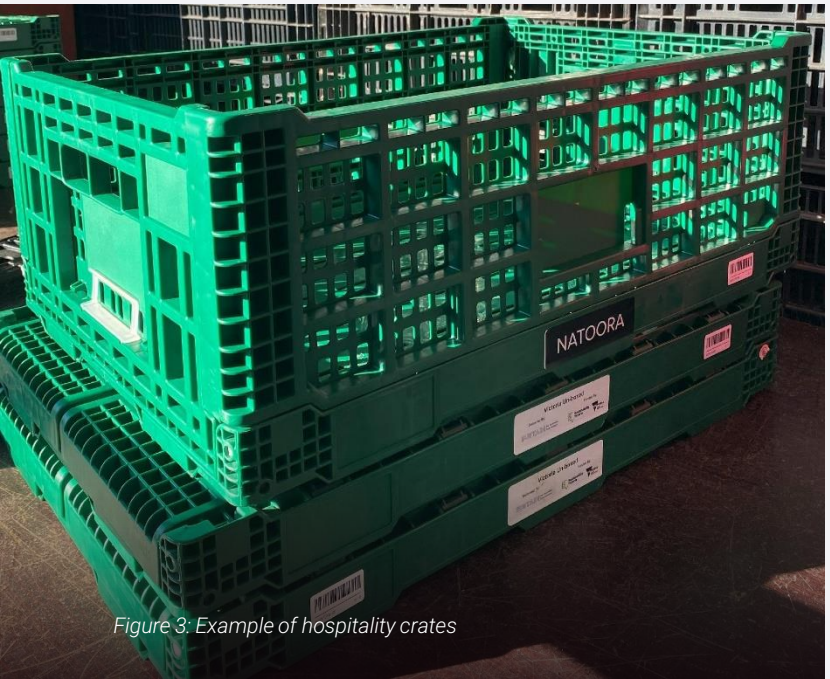



*Figure 3: Example of hospitality crates*

Because of the expense of the crates ($27 each), effective tracking became a priority. A digital system for tracking the crates through barcodes was trialled but found to be inefficient due to the additional time it added to deliveries. However, **a simple crate tracking system**, relying on the daily delivery run sheets already in use, **was effective and cost-efficient as it did not significantly increase labour.** This final process noted the number of crates given to and returned by a hospitality venue with each order. Natoora staff then entered the run sheet information into a spreadsheet, which provided the number of outstanding crates at each venue so that they could be collected during the next delivery or followed up if they went missing.

The hospitality hospitality green foldable scheme was implemented in two stages. Six venues trialled the pilot program between June and October 2023. This was followed by a bulk rollout of 900 crates in March 2024.

| CRATE TRACKING | | | | | OUT | IN | | OUT | IN |
|---|---|---|---|---|---|---|---|---|---|
| VENUES | TOTAL DIFF | DELIVERED - THIS WEEK | PICKED UP - THIS WEEK | | MONDAY | | DIFF | TUESDAY | |
| Venue 1 | -1 | 1 | 0 | | | | 0 | 1 | |
| Venue 2 | -2 | 4 | 2 | | | | 0 | | |
| Venue 3 | 0 | 1 | 1 | | | | 0 | | |

*Figure 4: Example of crate tracking spreadsheet*

## Health and safety

Both types of crates require washing between uses to ensure they are contamination-free. Natoora already had a system in place to wash crates with a high-pressure water spray in a dedicated area of their warehouse, and this was simply extended to the crates from the pilot program, with no significant issues.

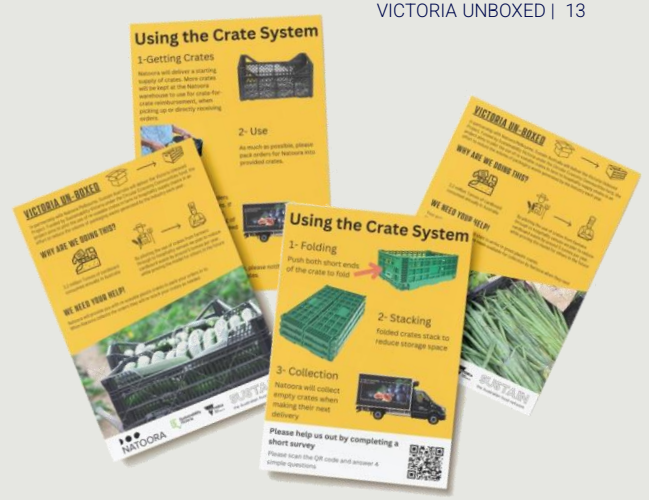



*Figure 5: Flyers provided to Hospitality venues and farms*

**Education** was identified during stakeholder consultation as important for customer and supplier staff to understand and participate correctly in the pilot program. To this end, Natoora's general manager personally onboarded key contacts at farms and hospitality venues to the pilot program, discussing the system changes and the environmental outcomes Natoora was aiming to achieve. Because staff members at both the farms and hospitality venues often changed, flyers were developed explaining the pilot program in simple steps and delivered with produce orders (see the figure above).

# Pilot implementation and stakeholder feedback

## Farms to Natoora – *bulb crate scheme*

Overall, this part of the pilot program performed well, with some minor challenges incurred in the later stages. All eight hundred crates purchased for this part of the pilot were rolled out to five farms at once, providing each farm with a stockpile of crates for use in upcoming orders. Five more farms involved in the scheme were already delivering all of their produce in crates or bulk bins. However, maintaining this system had previously been a consistent struggle. A positive outcome of this scheme for farmers was a considerable reduction in stress, particularly during peak seasons, because of the availability of additional crates.

Natoora attempted to use the crate system with a supplier who delivered produce via the Melbourne Market. Natoora provided the supplier with crates to deliver their orders. However, Natoora has no permanent presence at the market and limited space to store crates, so the system proved unfeasible. Natoora feared that leaving crates for exchange in the open space Natoora did have available to them would lead to crate theft. It is our suggestion that **businesses with a permanent presence in the market would be better positioned to implement a crate reuse system.**

Before this scheme, crate shortages often resulted in disposable packaging being used in the farm to Natoora supply chain, and this scheme counteracted that. One participant in the study indicated that 100% of their produce is now consistently shipped in reusable crates. This shift not only contributes to overall environmental sustainability but also streamlines the operational processes for both farms and distributors.

Another producer reported that after the implementation of this scheme, 95% of their produce was packed in crates, with only specific delicate produce still packed in disposables. It was a general finding that some crops required either additional packaging inside the crates, or different, disposable packaging. Discussions with relevant farmers suggested that compostable liners or paper padding both worked to effectively preserve produce quality inside the crates. The use of different types of reusable packaging for specific produce is discussed further in the following case studies.

> The crates have been highly effective in reducing waste.
>
> **- TIMBARRA FARM**

> I've now got loads of crates. I've never had enough. They've got a million uses.
>
> **- DAYS WALK FARM**

However, during the busy summer period, farm stockpiles of crates slowly diminished. This was due to the following factors:

**Increasing order size**
As hospitality venue orders increased during the busy summer season, and in turn, Natoora's orders from farms, so did the volume of crates in use. Due to delays in the deliveries of the foldable crates, Natoora continued supplying some hospitality venues in the farm crates during this time. The stockpile held by Natoora became insufficient to return an equal number of crates to farms while still having enough to deliver hospitality orders.

**Use of crates for customers outside the Natoora/farm supply chain**
In some cases, the crates provided to farms by Natoora, were used to service orders to the farms' other customers, thus temporarily removing them from Natoora's supply chain. This still results in waste savings by reducing the volume of boxes used and supports the objectives of this project. However, any individually implemented and self-funded crate scheme that is run **by distributors** is unlikely to support this if it leads to crate loss.

**Storage of produce in crates**
Using crates for long-term storage on farms contributed to the reduced availability of crates for order delivery. Farmers used some crates to store produce such as garlic, potatoes, and pumpkin. This effectively removes the crates from the supply chain during the storage period.

The decision to 'flood' the supply chain with farm crates was based on their low cost and their existing use on most farms. While this approach provided sufficient crates for the scheme to operate, it also likely contributed to the challenges encountered, with the significant supply creating less urgency for return. Coming out of summer, Natoora has noted that the crate stockpiles are building up again, which would seem to indicate that the crates have remained in the system.

In further schemes, it may be worth considering a small volume of crates to be delivered to each farm with the majority of the stockpile managed by the distributor. This way, as long as the stockpile on farms is sufficient to account for increases in order size, the distributor would always have enough crates to return an equal number. However, farm crates are bulky, and storage space at distributor warehouses is often limited. It might also be a possibility for **farmers** or **local food hubs** to own crates, as they have plenty of space to store them, and many different uses for them. With cost identified as a barrier in initial stakeholder consultation, the cost of crate purchase will likely prove a challenge to many businesses looking to implement a system of reusable crates. A tracking system could also be considered for future projects; however, as previously identified, the added labour cost of administering a digital tracking system would likely outweigh the low price of these crates.

It is a straightforwardly positive outcome of this project that Victoria Unboxed was able to purchase a significant volume of crates, which will remain active in the supply chain and so reduce packaging waste for many years to come.

*Figure 6: Examples of additional packaging used in crates (newspaper-left, damp paper towel-right)*

*Figure 7: Example of crates being used for produce storage on farm*

> I prefer using crates for deliveries as they are the same size and stack easily in my van, they are easy to carry and stack on my trolley, the bottom is guaranteed to never fall out, unlike cardboard boxes where this happens too often
>
> **- KASH, NATOORA DELIVERY DRIVER**

# Natoora to Hospitality venues *– green foldable scheme*

The crates used for the Natoora to hospitality part of the supply chain were far more costly than the used bulb crates. This meant that keeping track of them became a priority, and so our team tested a barcode based inventory management system. This was effective, but ultimately expensive because of the time required to scan each crate when it moved to a new location. The cost of this and similar app-based tracking systems, at over $500 per annum, is also a barrier to its implementation.

Our research showed that the **manual tracking of crates** using run sheets, along with the unique colour of the crates, ownership labels and information flyer, is, in fact, **a highly effective system**. **No crates were lost in the course of the pilot program.** Natoora delivery drivers reported that having the **colour and labelling of the crates being distinct to Natoora was a clear advantage** as they could **quickly identify the crates** when they were being used for storage in hospitality venues. The clear ownership of the crates enabled Natoora to follow up and ensure the crates were available for collection, and Natoora has noticed an improvement in the speed of crate return compared to bulb crates. Hospitality venues interviewed after the initial rollout preferred these crates over single use boxes and particularly noted the practicality of the folding crates for space savings.

However, Natoora's packing team experienced challenges with a staggered rollout. The team found it hard to manage a small number of specific customers using the folding crates while others received produce in Natoora's existing bulb crates and boxes. As the feedback from the initial stage of the pilot scheme was overwhelmingly positive, and the crates had a high rate of return, the decision was made to roll out the system to the vast majority of Natoora's customers at the same time. As previously noted, the procurement of 900 crates required them to be imported from overseas, which delayed the roll of crates to early March 2024.

After the roll out of the expanded pilot program, we received more positive feedback from participating hospitality venues including, once again, the space savings made by the folding crates. Further to this, several venues have identified a noticeable reduction in packaging waste due to the pilot and also noted the time saved in breaking down boxes for disposal. An unexpected outcome was that several venues also said that they have received less damaged produce in crates than in cardboard boxes.

A further advantage of the green crates, as identified by Natoora's drivers, is the **ability to fit them into a full van**. Previously, bulb crates that were available for collection at the start of a delivery run could not fit into the van. The drivers had to return to these venues later in their delivery run, and the crates were often missing when they returned. In contrast, **the folding crates have no issue fitting into the van at the start of the run**. Furthermore, up to twenty folded crates can be placed on a hand trolley, compared to only five bulb crates, reducing the time to collect empty crates from venues where direct access is not possible.

# Final audit

The waste disposal and load auditing process was repeated following the large-scale rollout of crates to farms and hospitality venues to determine the project's overall impact on waste generation. This audit found that the continued use of crates from this project would save Natoora an additional 7.18 tonnes of waste per annum, the equivalent of 6.2t of CO2e (production emissions).

| | Percentage of orders delivered in Crates | Projected Annual Waste Generation in Natoora's supply chain |
|---|---|---|
| If Crates were not used | 0% | 31.22t |
| Pre-Victoria Unboxed | 31% | 21.54t |
| Post Victoria Unboxed | 54% | 14.36t |

# Limiting factors

Various factors limited the possible waste savings from this project. Natoora reported that several customers (less than 5%) do not receive produce in crates, either by the venue's own request or due to regular non-return of crates. Those who request cardboard boxes are generally catering businesses who operate at a variety of sites. Natoora received feedback that the logistics of crate management generates additional stress when catering offsite as compared to single use boxes, which can be disposed of at any venue.

However, the major factor limiting the waste reduction from this project was the continued supply of produce in cardboard, waxed cardboard, and polystyrene boxes from the Melbourne Market. This supply chain accounts for approximately 50% of Natoora's total produce and most of its remaining cardboard, waxed cardboard, and polystyrene footprint. Consequently, there are still some orders delivered to hospitality venues in boxes. For instance, if a hospitality venue orders a box of cauliflowers and Natoora has received a whole box through the Market supply chain, it will be delivered in the box rather than repacked into a crate.

The **relatively high cost of the foldable crates** is a limitation for small farmers and distributors rolling out similar programs. There are some low-cost new or second-hand crates in the market. However, they are unavailable in unique colours and are either less rigid or branded property of another organisation (such as Chep or Woolworths). Due to their lower cost, these crates may be a viable option for farms or suppliers looking to implement a folding crate system. However, based on the learnings of this project, consideration should be given to **making the ownership of crates as easily identifiable as possible**. To counteract this set up cost, it may be possible that a widespread crate hire program would be a viable alternative. In 2019, Mornington Peninsula farmer Natasha Sheilds conducted a study into the packaging waste issues facing fresh food producers in Australia, and identified packaging as a significant cost to the horticulture industry. The report identified that the cost of plastic crate hire starts at $1.10 per crate[35] and at such a price point, crate hire programs are cheaper than both crates and cardboard box purchase.

35. Sheilds, 2021

# Case Studies

In addition to the crate use pilot program, Sustain interviewed four small scale farms in Victoria which are actively working to reduce packaging waste. These organisations illustrate how packaging waste can be minimised in different ways across short-supply chains. These organisations were identified during the project as having existing processes in place to reduce packaging waste in their operations. The farms examined are:

1. Farm Raiser
2. Sunnybank Farm Ballarat
3. Common Ground Project
4. Torello Farm


*Figure 8: Example of tubs in use by Farm Raiser*

CASE STUDY #1

# Farm Raiser

Farm Raiser is a not-for-profit urban farm located on unused land of the Waratah Special Development School in Melbourne's northeastern suburbs. The organisation aims to create positive outcomes for people and the environment. Its core mission extends beyond growing food, as Farm Raiser enhances community health and well-being by supplying affordable healthy food to residents, providing educational opportunities for students with disabilities, and fostering connections between people and their food sources.

The organisation champions the local food movement by distributing all its produce to local customers. Produce is sold directly to the public from a farm gate shop and is sold wholesale to local hospitality and retail venues. Through its operations, Farm Raiser is committed to minimising environmental impact, and has managed to almost entirely eliminate packaging waste from their supply chain.

Farm Raiser has implemented the following strategies to minimise packaging waste:

1. **Crate exchange program**
   Farm Raiser operates a reusable crate exchange program with wholesale customers. Some of these crates were purchased second-hand from the bulb industry and some were supplied by their biggest customer.

2. **Blue tub exchange program**
   Sealable, lidded tubs are used to store and supply produce sensitive to air exposure, such as lettuce and basil. These tubs overcome the need to use plastic sleeves or bags to maintain freshness, and have extended the shelf life of such produce to approximately two weeks after harvest. Farm Raiser supplied 250 kg of salad to a hospitality business operating at the 2024 Australian Open without any packaging waste.

3. **Second-hand polystyrene boxes**
   The team reclaims second-hand polystyrene boxes to pack produce sensitive to temperature or impact, such as broccolini and zucchini flowers.

4. **Reusable seedling trays and weed matting**
   Although they currently use plastic seedling trays and weed matting, these materials are employed far beyond their intended single-use lifespan. They plan to upgrade to more durable alternatives when financially viable.

5. **A plastic free retail shop**
   Farm Raiser stands out for refusing to use plastic packaging for its produce, relying instead on paper bags and cardboard punnets and encouraging customers to bring their containers.

*Source: Farm Raiser*

Farm Raiser's approach to packaging waste has challenges, particularly when balancing the longevity and quality of produce with environmental objectives. They suspect they have foregone sales, especially of leafy greens, because they are not supplied in the accustomed plastic sleeves. The farm educates customers on optimal storage methods to extend the life of produce brought home in eco-friendly packaging, such as transferring salad mixes to sealed containers. Such an educational aspect is crucial for maintaining product quality without compromising sustainability goals.

Looking forward, Farm Raiser intends to address the remaining elements of its operations that contribute to waste, such as finding alternatives to plastic seedling trays and weed matting. The farm also aims to expand its wholesale channels, improve crop yield efficiency, and invest in renewable energy sources like water harvesting and solar power, all while maintaining its commitment to waste reduction.

Farm Raiser's dedication to reducing packaging waste represents a forward-thinking approach to urban farming. By prioritising sustainability in its supply chain and customer interactions, the farm contributes to a healthier planet. It sets a precedent for how agricultural operations can thrive without compromising environmental integrity. As Farm Raiser continues to evolve, its sustainability and community engagement efforts serve as an example for others in the industry, proving that growing food responsibly and ethically in an urban setting is possible.

> Using the exchangeable blue tubs has allowed us to reduce waste, and ultimately cost within our supply chain. It also demonstrates to our customers our commitment to sustainability not just on the Farm, but throughout our network and community
>
> **- EVE FRASER, CO-MANAGER, FARM RAISER**

Source: Sunnybank Farm Ballarat


Figure 9: Example of crates used by Sunnybank

CASE STUDY #2

# Sunnybank Farm Ballarat

Sunnybank Farm is a multi-generational family farm near Ballarat employing holistic and regenerative practices. The recent addition of chickens to the farm supports healthy soil by spreading manure and eating insects after sheep and cattle have grazed on the pastures.

Sunnybank distributes eggs directly to hospitality venues, retailers, and consumers. They deliver approximately 50% of egg orders to hospitality customers in reusable plastic crates containing plastic trays holding 240 eggs. The size of the plastic crates is a challenge for some customers due to limited storage space in their kitchens, and reusable packaging is not yet suitable for retailers and consumers. Despite this, Sunnybank Farm is committed to reducing waste and improving sustainability in its operations.

Hygiene is a critical consideration in the storage and transport of eggs. As such, Sunnybank maintains separate inventories of crates and trays. One group of crates and trays is used to transport eggs from the farm to their processing plant, while the others transport washed eggs to customers. Sunnybank disinfects all crates using spray disinfectant and wipes after each use. Egg trays are soaked in disinfectant, washed, and air-dried, requiring approximately one hour of labour per week.

Seven cardboard egg trays and a cardboard box to transport them costs $2.55 GST. With approximately 30 boxes of eggs being sold weekly, transitioning to reusable crates and trays represents a significant cost-saving measure for Sunnybank. The reusable crates also significantly reduce the environmental impact of Sunnybank's operations, saving approximately two tonnes of cardboard each year.

The owners of Sunnybank have observed that the egg industry has been slow to adopt reusable packaging due to perceived extra work in handling and cleaning trays. The open-topped crate design that they currently use also increases the risk of damage to the eggs. Despite these obstacles, Sunnybank Farm remains committed to exploring sustainable solutions for its packaging needs.

CASE STUDY #3

# Common Ground Project

The Common Ground Project (CGP) is a social enterprise and regenerative farm based in the South Coast Shire in Victoria. The organisation supports food security by creating fairer access to locally grown, healthy food. They operate a regenerative farm, an on-site café and events space, a 'Future Healthy Food Hub' in collaboration with VicHealth as well as the Staying Grounded Program giving employment opportunities to marginalised immigrant communities.

The CGP Food Hub is a point of sale for local produce and a centre for knowledge sharing and upskilling workshops. The Food Hub has worked with 20 local producers, all but one producer are within 30km radius, ensuring a supply of hyper-local and ethically grown produce. This close-knit operation facilitates a unique narrative for each product, enhancing customer engagement and transparency. The hub operates a weekly veggie box delivery program, a mini market in their on-site café, and a stand at local farmers' markets and community events. It serves as a vital link between local producers and the community.

The CGP Food Hub stands out as a model for other food hubs aiming to reduce their environmental footprint. The primary waste generated in the Food Hub's supply chain includes BioGone biodegradable salad bags, Biopack compostable punnets, paper carry bags, cardboard boxes, and the occasional polystyrene box. To address food waste, the Food Hub has implemented a circular system where leftover produce is either repurposed in its café or fed to chickens and worms.

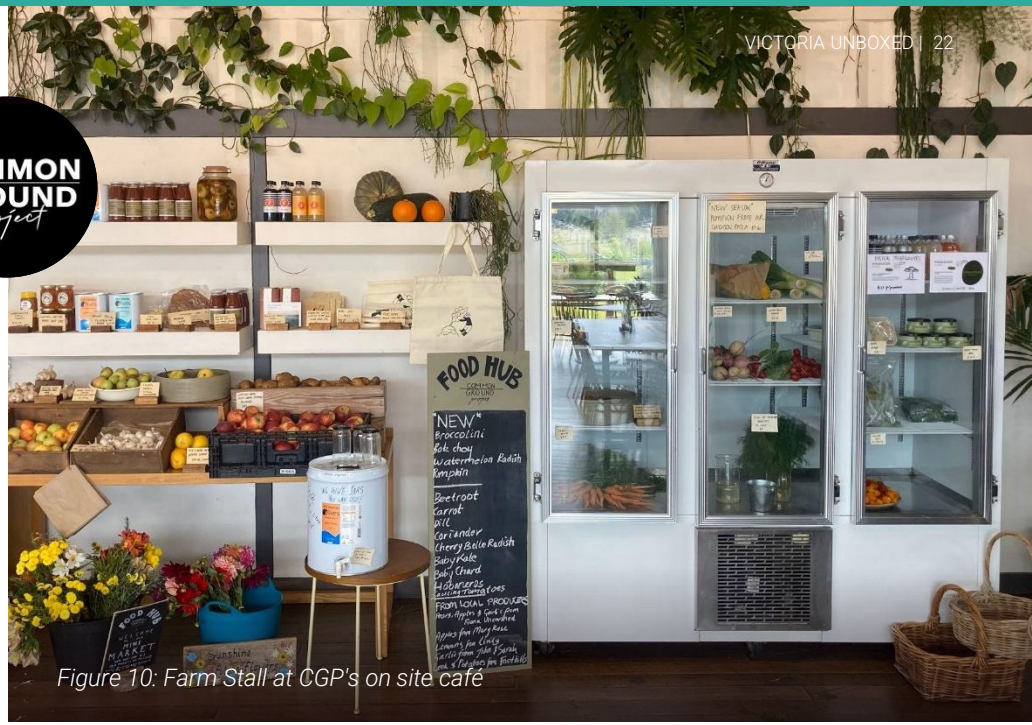


*Figure 10: Farm Stall at CGP's on site café*

The Food Hub has adopted several specific practices to reduce packaging waste. Key strategies include:

1. **Reusable crates**
   Produce is delivered in foldable crates.
2. **Reusable egg transport systems**
   Sturdy, washable plastic egg crates are used for delivery of eggs to the onsite café which reduces cardboard waste. Note that eggs sold externally are still packed in to cardboard cartons.
3. **Paper bag library**
   Paper carry bags received with produce are offered to and reused by market customers.
4. **Cardboard box reuse**
   Cardboard boxes find new life in school programs or as carriers for large customer purchases. The remaining boxes are recycled.

Despite these efforts, certain packaging items like polystyrene boxes are still necessary to transport some produce.

Looking ahead, the CGP Food Hub aims to minimise packaging waste further, particularly focusing on cardboard and polystyrene boxes. The Food Hub is considering using crates for veggie box deliveries, which would necessitate a system to return the crates to the hub. Reusing items like salad bags and punnets is an ongoing process. While these products are currently required for storage and logistical purposes, the hub continuously seeks ways to reduce their environmental impact.

The CGP Food Hub exemplifies a proactive approach to minimising packaging waste within the local food system. Its efforts in reusing and repurposing materials, alongside a circular approach to organic waste, demonstrate a commitment to sustainability beyond conventional practices.


Source: Torello Farm


*Figure 11: Shelves of plastic packaging free produce at Torello's farm gate*

CASE STUDY #4

# Torello Farm

Torello Farm produces meat and fresh produce across two farms on the Mornington Peninsula. The produce is primarily distributed through their farm gate shop, along with other locally sourced produce and food items, including take-home meals. The farm provides a range of produce, partnering with other small-scale and larger growers. This diversified approach allows Torello Farm to cater to many customers while also supporting local agriculture.

The type and quantity of waste generated by Torello Farm varies depending on the source of the produce. Smaller local farmers that supply their shop often use reusable plastic crates for their deliveries. However, larger growers, who also supply supermarkets, may use single-use packaging, such as plastic sleeves, for herbs and other delicate produce. This forms the major waste stream in Torello Farm's supply chain. The plastic sleeves challenge their commitment to being plastic-free but also demonstrates how packaging can reduce food waste. Sophie from Torello Farms acknowledges that the plastic sleeves prevent spoilage of delicate herbs and, therefore, there is a need to strike a balance between sustainability and practicality.

Torello's commitment to sustainability is not just about their own practices, but about inspiring change in their suppliers. They actively engage with their suppliers, particularly smaller growers, to reduce packaging waste. For instance, they encourage growers to switch to compostable packaging materials, providing them with compostable products such as berry trays to facilitate this transition.

Looking ahead, Torello has plans to continue their efforts in reducing packaging waste. They are exploring the use of compostable vacuum packaging materials for meats. Additionally, they are working closely with their packaging supplier to source environmentally friendly alternatives.

Torello identifies supermarkets as a primary barrier to large-scale reduction in packaging waste. They emphasise that supermarkets, which account for a significant portion of produce sales, need to take a leadership role in sustainability. Encouraging supermarkets to adopt more sustainable packaging practices and educating consumers about responsible packaging use are crucial steps toward achieving substantial waste reduction in the industry. This highlights the need for broader industry cooperation and leadership, whether voluntarily or through Government intervention, to drive large-scale reduction in packaging waste.

# Project challenges and conclusions

The pilot program component of the Victoria Unboxed Project successfully reduced waste generation in Natoora's supply chain. However, a waste profile remains which this project could not impact, with the vast majority of this being a result of Natoora's purchase of produce through the Melbourne Wholesale Market. It is clear that these **larger supply chains require more robust interventions in order to reduce packaging**

> The biggest barrier to eliminating or significantly reducing cardboard, polystyrene, and waxed cardboard waste in the industry lies at the systematic level. Single-use boxes and polystyrene containers have become industry norms, primarily because they effectively transport goods and are easily disposable. Natoora believes that the key to overcoming this barrier is to shift the industry's mindset towards valuing reusable packaging.
>
> **- MARK LEAHY, NATOORA GENERAL MANAGER**

This project also clearly shows that **local food networks produce less packaging waste as intense packaging of produce is most necessary to support long food supply chains.**

It is also clear that many small farms are already doing their best to reduce their packaging waste generation. Their decision to minimise waste also makes business sense as most packaging, such as cardboard boxes, must be purchased by the farm and is single-use only. The farms involved in the project **had already started using crates or other reusable vessels to deliver their produce,** and Victoria Unboxed simply **increased their capacity to reduce waste and enter into the circular economy.** However, it is evident that the larger farmers, often selling through the wholesale market or directly to large buyers such as supermarkets, are **influenced by the demands of these big customers who have long shelf life and long supply chains built into their models.** For example, when one farmer we interviewed requested their suppliers switch to compostable packaging, a supplier stated that they could not alter their processes as **their major buyer, a supermarket group, would not accept such packaging.**

This project has identified that the path to reducing packaging waste in the produce supply chain **doesn't require the complete elimination of packaging, but rather transitioning packaging to a circular system.** It recognises the crucial role that **robust, reusable materials play in striking a balance between maintaining food quality and minimising the environmental impact of food distribution.** This project has shown that **relatively low tech systems that boost current sustainable practices can be highly effective in reducing packaging waste and that local food systems require less packaging and so produce less packaging waste.** What follows is a series of recommendations for government, then two appendices with practical tips for farmers and hospitality venues addressing packaging waste in their supply chains.

# Recommendations for government interventions

Government intervention is crucial in shaping industry practices related to packaging waste. Government, across all levels, may leverage any of the below strategies as relevant to their remit:

1. **Enhanced regulatory frameworks**
Governments can develop stricter regulations regarding packaging materials, focusing on **phasing out single-use plastics and supporting circular packaging solutions** as the first port of call. Food systems are complex, however, and some points in the supply chain may require biodegradable or recyclable alternatives.

2. **Incentives for sustainable practices**
Offering tax breaks, grants, or subsidies to companies that invest in circular packaging technologies can encourage a shift towards eco-friendly solutions. Grant programs can support organisations with the up-front costs of purchasing reusable packaging infrastructure. Similarly, Environmental Upgrade Agreements could be expanded to allow for the purchase of such assets. Consideration must be given to the fact that circular economies require **storage space and access to low cost, logistical expertise.** We recommend **local food hubs,** which can provide a central point for the storage and distribution of reusable bulk food packaging if government investment allows them to do so.

3. **Extended producer responsibility**
Implementing extended producer responsibility or product stewardship policies, where producers are responsible for the entire lifecycle of their packaging, including disposal and recycling, can motivate companies to design packaging with reduced environmental impact.

4. **Public Awareness Campaigns**
Governments can invest in educational campaigns to raise public awareness about the environmental impacts of packaging waste in **all parts of the food supply chain.** This can increase consumer demand for sustainable packaging and support compliance with new regulations.

Through these measures, governments have significant power to influence industry practices in reducing packaging waste.

# Appendix

APPENDIX #1

# What can you do as a farmer?

The Victoria Unboxed Project has explored pathways to reducing waste in short fresh produce supply chains. This section is a practical guide for farmers adopting more sustainable packaging.

1 **Understanding the waste challenge**

Every farm faces unique challenges regarding waste, including the type of produce sold, customers' requirements, the availability and affordability of alternative packaging options, and the availability of waste management systems.

Begin by assessing the types and volumes of waste generated on your farm including both organic and inorganic waste. Understanding your waste streams is the first step towards implementing effective waste reduction strategies.

2 **Adopting Reusable Packaging**

Transitioning to reusable packaging can significantly reduce waste. Consider using durable containers, crates, or other reusable materials for your products. Evaluate different materials to find those that best suit your needs while ensuring you balance any impacts on product quality and shelf life. Look beyond your farm to local networks who can help bear the cost and the logistics of circular packaging systems.

3 **Use biodegradable solutions when necessary**

Reuse or no-use is always the best-case scenario for waste management, but if that is not possible, look into other innovative packaging solutions that maintain the quality of your produce. Products such as certified home compostable soft plastic substitutes may effectively reduce the volume of waste in landfills from the farm.

4 **Community and customer education**

Educate your customers and community about the importance of sustainable packaging. Share information on how they can contribute to the program, such as returning reusable containers. Share tips on produce storage - these may seem to common sense to you, but are lost knowledge for many. These efforts also foster community engagement and create a robust network of care around your farm.

5 **Learning from success stories**

Look for case studies or examples of successful waste reduction initiatives in the agriculture sector. These stories can provide valuable insights and inspiration for your journey towards sustainability.

APPENDIX #2

# What can you do as a Hospitality Venue?

As the fresh produce buyer, hospitality venues can influence how their produce arrives. Below are some practical tips for hospitality venues wishing to reduce packaging waste.

1. **Demand sustainable packaging**
Hospitality venues can influence the supply chain by explicitly demanding reusable packaging. By doing so, venues can prompt suppliers to innovate and reduce the environmental impact of their packaging. In some cases, alternatives may not be immediately available, but by demonstrating consumer demand, you will support a shift toward more sustainable packaging options.

2. **Supplier selection**
Choose suppliers such as Natoora committed to sustainable practices. Venues can evaluate potential suppliers based on their environmental initiatives, especially regarding packaging. Give preference to those who minimise packaging, use recycled materials, and are committed to reducing their carbon footprint.

3. **Facilitate reusable crate/container programs**
Establishing a program where reusable containers are used for deliveries can drastically reduce waste. Venues and suppliers can work together to create a system for these containers' use, return, and sanitation. This approach reduces waste and can be cost-effective in the long term.

4. **Educate and influence suppliers**
Engaging in an open dialogue with suppliers about the importance of sustainability can lead to mutually beneficial outcomes. Venues can share best practices, suggest alternatives to current packaging, and collaborate on innovative solutions that align with environmental goals.

5. **Waste audit and management**
Conducting regular waste audits helps venues understand the specifics of their waste generation, particularly related to packaging. Audits are at their most valuable when raising staff awareness of waste issues. Identifying the most significant sources of waste can inform strategies for reduction, such as altering ordering practices.

APPENDIX #3

# Lifecycle Assessment

| Packaging Type | Production Emissions (per gram of material x weight of item) | | | Intended Number of Uses | Emissions Per Use |
|---|---|---|---|---|---|
| | Average weight | Emission per Kg | Emission Total per unit | | |
| Cardboard Box | 0.68 kg (40L) | Range from 0.7 to 1.2 kilograms of CO2 per kilogram of product.<br>0.95kgCO2 average | 0.646 KgCO2e | Single Use | 0.646 KgCO2e |
| Waxed Cardboard Box | 1.28 kg (69L) | Range from 1 to 1.2 kilograms of CO2 per kilogram of product.<br>1.1kgCO2 average | 1.408 KgCO2e | Single Use | 1.408 KgCO2e |
| Polystyrene Box | 0.3 kg (50L) | 2.97kgCO2 average | 0.891 KgCO2e | Single Use | 0.891 KgCO2e |
| Plastic Bulb Crate | 1.75 kg (40L) | Range from 1.5 to 2.5 kilograms of CO2 per kilogram of HDPE product.<br>2kgCO2 average | 3.5 KgCO2e | 50+ | 0.07 KgCO2e |
| Folding Plastic Crate | 1.7 Kg (40L) | Range from 1.5 to 2.5 kilograms of CO2 per kilogram of HDPE product.<br>2kgCO2 average | 3.4 KgCO2e | 50+ | 0.068 KgCO2e |

# References


Abunada, Z., Alazaiza, M.Y.D, & Bashir, M.J.K. (2020, December 21). An Overview of Per- and Polyfluoroalkyl Substances (PFAS) in the Environment: Source, Fate, Risk and Regulations. *Water, 12*(12). https://doi.org/10.3390/w12123590

Aldi. (n.d.). *Sustainable Packaging.* https://www.aldi.com.au/sustainability/good-planet/sustainable-packaging/

Anderko, L., & Pennea, E. (2020, February). Exposures to per-and polyfluoroalkyl substances (PFAS): Potential risks to reproductive and children's health. *Current Problems in Pediatric and Adolescent Healthcare, 50(2).* https://doi.org/10.1016/j.cppeds.2020.100760

Anderson, L., Grudnoff, M., Hawking, T., & Campbell, R. (2023, September 18). *Food Waste in Australia.* The Australia Institute. https://australiainstitute.org.au/report/food-waste-in-australia/

Arunan, I. & Crawford, R. (2021, May). Greenhouse gas emissions associated with food packaging for online food delivery services in Australia. *Resources Conservation and Recycling, 168.* https://doi.org/10.1016/j.resconrec.2020.105299

Australian Marine Conservation Society. (2023, July 1). *Which Australian states are banning single-use plastics?.* https://www.marineconservation.org.au/which-australian-states-are-banning-single-use-plastics/

Australian Packaging Covenant Organisation. (2021, November). *APCO Collective Impact Report.* https://documents.packagingcovenant.org.au/public-documents/APCO%20Collective%20Impact%20Report

Australian Packaging Covenant Organisation. (2023, April). *Review of the 2025 National Packaging Targets.* https://documents.packagingcovenant.org.au/public-documents/Review%20of%20the%202025%20National%20Packaging%20Targets

Australian Packaging Covenant Organisation. (n.d.). *100% reusable, recyclable or compostable packaging.* https://apco.org.au/100-reusable-recyclable-or-compostable-packaging

Bambridge-Sutton, A. (2023, August 16). *Extending shelf life through packaging: The complexities and variations.* FoodNavigator. https://www.foodnavigator.com/Article/2023/08/16/Extending-shelf-life-through-packaging-The-complexities-and-variations

Brennan, L., Parker, L., Schivinski, B., Jackson, M., Pochun, T., Florence, E., Langley, S., Hill, A., Ryder, M., Lockrey, S., Verghese, K., Francis, C., Sherman, A., Alessi, N., Phan-Le, N.T., & Chorazy, E. (2023). *Consumer Perception of the Role of Packaging in Reducing Food Waste: Final Project Report.* https://endfoodwaste.com.au/wp-content/uploads/2023/11/Consumer_Perceptions_final_report.pdf

Brulliard, C., Cain, R., Do, D., Dornom, T., Evans, K., Lim, B., Olesson, E., & Young, S. (2012, January). *The Australian Recycling Sector Report.* Department of Sustainability, Environment, Water, Population and Communities. https://www.dcceew.gov.au/sites/default/files/documents/australian-recycling-sector.pdf

CHEP. (n.d.). *Reusable Plastic Containers (RPCs).* https://www.chep.com/au/en/reusable-plastic-containers

Coles Group. (2023). *Working towards a more sustainable future [Sustainability Report].* https://www.colesgroup.com.au/FormBuilder/_Resource/_module/ir5sKeTxxEOndzdh00hWJw/file/Sustainability_Report.pdf

Coles Group. (n.d.). *Together to zero waste.* https://www.colesgroup.com.au/sustainability/?page=environment.

Del Borghi, A., Parodi, S., Moreschi, L., & Gallo, M. (2021, April). Sustainable packaging: an evaluation of crates for food through a life cycle approach. *The International Journal of Life Cycle Assessment, 26(4),* 753-766. https://doi.org/10.1007/s11367-020-01813-w

Diaz-Farina, E., Díaz-Hernández, J.J., & Padrón-Fumero, N. (2023, May). Analysis of hospitality waste generation: Impacts of service and mitigation strategies. *Annals of Tourism Research Empirical Insights, 4*(1). https://doi.org/10.1016/j.annale.2022.100083

D'Souza, M. (2023, July 31). *Pact extends plastic crate pooling contract with Woolworths.* Food Magazine. https://www.foodmag.com.au/pact-extends-plastic-crate-pooling-contract-with-woolworths/

Department of Climate Change, Environment, Energy and Water. (2023). *Reducing Australia's food waste.* https://www.dcceew.gov.au/environment/protection/waste/food-waste

# References


Fresh Markets Australia. (n.d.). *About Fresh Markets Australia.* https://www.freshmarkets.com.au/about-fresh-markets-australia/

Koskela, S., Dahlbo, H., Judl, J., Korhonen, M., & Niininen, M. (2014, April 15). Reusable plastic crate or recyclable cardboard box? A comparison of two delivery systems. *Journal of Cleaner Production, 6.* https://doi.org/10.1016/j.jclepro.2014.01.045

López-Gálvez, F., Rasine, L., Conesa, E., Gómez, P.A., Artés-Hernández, F., & Aguayo, E. (2021, June). Reusable Plastic Crates (RPC) for Fresh Produce (Case Study on Cauliflowers): Sustainable Packaging but Potential Salmonella Survival and Risk of Cross-Contamination. *Foods, 10*(6). https://doi.org/10.3390/foods10061254

Louizero, R. (2021, August 21). *Plastic's – What can be recycled and Australia's plans for the Future.* https://www.integratesustainability.com.au/2021/08/26/plastics-what-can-be-recycled-and-australias-plans-for-the-future/

Melbourne Market Authority. (n.d.). *Overview.* https://melbournemarkets.com.au/about-the-market/overview/

NSW Environment Protection Agency. (2022, November). *Emissions impacts of landfilling food waste.* https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/wasteregulation/fogo/22p4163-emissions-impacts-landfilling-food-waste.pdf

Replace the Waste. (n.d.). *Food and Hospitality.* https://www.replacethewaste.sa.gov.au/food-and-hospitality

Shields, N. (2019). *Alternatives to Plastic Packaging on Fresh Produce Options For Vegetable Growers.* Nuffield International Farming Scholars. https://www.nuffieldscholar.org/reports/au/2019/alternatives-plastic-packaging-fresh-produce-options-vegetable-growers

Smith, E. (2017, March 21). *The Brief, Confusing History of Foam Packaging.* Atlas Obscura. https://www.atlasobscura.com/articles/styrofoam-history#:~:text=Expanded%20polystyrene%20wasn't%20always,using%20the%20expanded%20polystyrene%20process.

Tehrani, M., Fulton, L., & Schmutz, B. (2020, July 24). Green Cities and Waste Management: The Restaurant Industry. *Sustainability, 12*(15). https://doi.org/10.3390/su12155964

Twede, D., & Selke, S.E.M. (2005). *Cartons, Crates and Corrugated Board: Handbook of Paper and Wood Packaging Technology.* DESIGN HOUSE Incorporated. https://books.google.com.au/books?id=kc0MSzFvrH8C&newbks=0&hl=en&source=newbks_fb&redir_esc=y

Van Sebille, E., Wilcox, C., Lebreton, L., Maximenko, N., Hardesty, B.D., Van Franeker, J.A., Eriksen, M., Siegel, D., Galgani, F., & Law, K.L. (2015, December 8). A global inventory of small floating plastic debris. *Environmental Research Letters, 10*(12). https://doi.org/10.1088/1748-9326/10/12/124006

Wakiyama, T. (2020). Agricultural Food Supply Chain: A journey from food production to consumption. *The OAASIS Project.* https://www.sydney.edu.au/content/dam/corporate/documents/faculty-of-science/research/physics/oaasis-food-supplychain-report-2020-03.pdf

Watt, E., Picard, M., Maldonado, B., Abdelwahab, M.A., Mielewski, D.F., Drzal, L.T., Misra, M., & Mohanty, A.K. (2021, June 17). Ocean Plastics: environmental implications and potential routes for mitigation - a perspective. *RSC Advances, 35.* https://doi.org/10.1039/D1RA00353D

Woolworths Group. (n.d.). *Sustainable Packaging.* https://www.woolworthsgroup.com.au/au/en/sustainability/Product/sustainable-packaging.html

Zheng, S.S. (2023, May 9). *Misconceptions of food packaging aggravates food waste problem.* RMIT University. https://www.rmit.edu.au/news/all-news/2023/may/food-waste.

SUSTAIN

the Australian food network