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Phase 3 - Upcycled Food Business Case

2.4.2 Accelerating Food Transformation

ENDFOODWASTE COOPERATIVE RESEARCH CENTRE

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Executive Summary

Across Australia, various businesses and other entities are engaged in upcycling food. Upcycling food is a food loss and waste reduction strategy that involves using food surplus and waste from farms to create value-added products or converting waste created during food manufacturing into value-added products for human consumption. This project investigates upcycled foods in Australia with a focus on identifying the challenges and opportunities to upcycling towards developing a broad set of recommendations regarding how to enable upcycled food.

This is Report 3 (of 4) from the project, and it provides findings from Phase 3 of the project. This phase involved a case study analysis of 5 entities engaged in upcycling to contextualise the findings from the prior phases of the research and deepen understandings of the operations and strategies employed by entities engaged in upcycling. While there are numerous entities in Australia engaged in food upcycling, there is no academic study into how these businesses operate and under what conditions. Furthermore, academic studies providing case study analyses of businesses engaged in food upcycling are very limited.

This report identifies some common features and strategies regarding upcycling as follows:

1. Food processing techniques and equipment that are comparatively low-tech have facilitated upcycling more for the entities examined than high-technology methods requiring highly specialised knowledge and equipment.
2. The engagement with more low-tech approaches for these entities has been a business strategy that has not hindered product development and increases scalability.
3. Entities engaged in upcycling tend to stem from actors with food manufacturing expertise indicating that prior skills and experience in food manufacturing (as opposed to food production and retail) are a key factor enabling upcycling.
4. While each entity faces their own set of challenges based on their context, marketing and communication to consumers was a challenge commonly identified.
5. Engaging in upcycling requires relationships and collaborations across the supply chain. While developing an upcycled product may be driven by a particular actor, it requires information sharing, coordination and ‘buy-in’ from various actors, which is a feature and area for strategy that differs from other kinds of product development.
6. Entities engaged in upcycling are creating products with a view to reducing waste while also providing a range of other environmental and health benefits thus the definitional understanding of upcycling may be broader than conventional interpretations and/or more work is required to conceptualise using food surplus and waste to create value-added products.

The next phase of this research will engage with consumer perceptions and understandings of upcycled foods. This will provide further insights into how to enable upcycled foods and address a key challenge identified in this report.

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1. Introduction

"Upcycled food" is a new food category and industry that focuses on transforming food surplus and waste into value-added products. Generally, upcycled foods use either or both food surplus from farms or by-products created during food and beverage production. Upcycled foods are positioned by media, academia, and institutions as a way to reduce food loss and waste while also enabling food and beverage innovation and rural livelihoods (Lytton, 2024; Namkung, 2024; Thorsen et al., 2024; Upcycled Food Association, 2024).

This is Report 3 from the Accelerating Food Transformation Project. It presents findings from Phase 3 of the research project, which involved a case study analysis of five (5) Australian businesses engaged in food surplus and waste transformation. The purpose of Phase 3 was to capture the natural context and complexities faced by upcycled food businesses, profile examples of upcycled food businesses and gain insights into the quantity of waste that could be redirected towards upcycling. It sought to answer questions regarding how alternative markets for food waste and surplus transformation have emerged, what factors facilitated and enabled their emergence, and how can regulators and other businesses identify and facilitate future opportunities for food surplus and waste transformation. At the time of writing, no academic analyses involving case studies of Australian entities engaged in upcycling have been published, and literature more generally involving case studies of businesses engaged in food upcycling is very limited (Gedi et al., 2020).

Developing case studies of upcycled food businesses also provides further illustrations of the opportunities and barriers to food surplus and waste transformation that were developed in Phase 1 of this project, which centred on semi-structured interviews with upcycled food stakeholders. It further allows for testing of the findings of Phase 2 of this project, which was a regulatory analysis of laws and policies influencing upcycled foods in Australia and internationally.

The following report outlines the methodology before presenting each business case study. It then provides an analysis overall of the upcycled food businesses studied and identifies links with the project's findings from Phase 1 and 2. Following this, the report identifies some conclusions and recommendations.

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2. Methodology

The objective of Phase 3 was to understand the practices, challenges, and impacts of upcycled food businesses and to enrich the findings from Phase 1 and 2 of this research with a more detailed examination of specific organisations. This research adopts a multiple case studies methodology to allow for a detailed examination of organisations and the collection of quantitative and qualitative data (Yin, 2009, p. 18). A case study methodology is a useful and widely accepted research strategy for understanding complex phenomena in real-world contexts (Priya, 2021; Yin, 2009). Primarily, the case study approach used could be described as both descriptive, in the sense that the aim was to detail particular entities involved in upcycled food and how they upcycle food, and explanatory, as the focus was also on why the organisations emerged and what sequence of events and what conditions are shaping the entities and their involvement in upcycling (Yin, 2017).

2.1 Case Study Selection

For this study, the cases, or object being studied, were specific organisations (Vaus, 2001, p. 220). Case studies were selected based on their involvement in upcycling with a specific focus on Queensland-based businesses or businesses upcycling foods produced in Queensland. They were also selected on the basis of ensuring diversity among the sample with respect to: (a) the role taken in regard to upcycling (i.e. directly upcycling or facilitating upcycling); (b) purpose (profit and not-for-profit); and (c) size (small to large enterprises).

2.2 Data Collection Methods

A case study approach involves multiple methods of data collection and triangulation of data to obtain a rich understanding of the phenomena being studied (Yin, 2017). Case study data was assembled from:

(1) Semi-structured interviews with staff in leadership roles within the selected organisations;
(2) Site visits to observe operations firsthand;
(3) Publicly available information about each entity and any further information provided by the organisations.

2.3 Data Analysis

Interview transcripts were coded using a thematic analysis, drawn from the approach developed by Braun and Clarke (2006), to identify common themes and patterns for each case study. These codes were then compared across each case study to identify key patterns. Observations from site visits were written by researchers.

2.4 Ethical Considerations

This research was conducted with approval from QUT as a Human Ethics Low Risk Application (LR 2024-8476-19301). As part of this, participants provided informed consent to be part of the study.

2.5 Limitations

This study has three main limitations. Firstly, as case study approach, this research is only able to present on the specific circumstances of the businesses examined, as opposed to providing generalisable findings about upcycled food businesses. Secondly, there is potential for bias in researcher-participant qualitative research, which was mitigated via the use of recognised strategies for qualitative analysis including appropriate participant sampling and theoretically and reflexively engaging with findings (Morse et al., 2002). Finally, we were generally unsuccessful in obtaining data from companies and other entities about the specific amounts of waste being redirected, and this was due to a number of reasons including participant unwillingness to share data and a lack of such data being systematically collected.

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3. Zest Element

3.1 Background

Zest Element is a small business based in Warana (Sunshine Coast Region) established October 2023. Sam Musson is the CEO and founder. Zest Element creates fruit powders, which it sells in 150g packets to consumers and 5kg pails to food service and manufacturing. Zest also sells dried citrus fruit slices in 40g packets. They make these products using produce from farms that could not otherwise sell the fruits to retailers – as the fruits do not meet specifications – and by using standard food dehydrators. Currently, Zest Element has used/uses lemons, limes, oranges, strawberries, Davidson plums, finger limes, and aniseed myrtle. The fruit powders are marketed as 'natural fruit powder pouches' that last up to 18 months for 'use in everyday food prep' including in salad dressings, smoothies, pasta dishes, teas, curries, and baked foods. The citrus fruit slices also have an 18-month shelf life and can be used for beverages and cooking.

Figure 2 Zest Element Fruit Powder Line

Figure 1 Close up picture of the Lemon Powder from Zest Element

3.2 Drivers

The drivers for Zest Element include internal motivations, identification of a gap in the market, and experience in small-scale food processing.

In relation to internal motivations, Musson is personally motivated to create food products that increase fruit and vegetable consumption and are not ultra-processed (i.e., food products made from ingredients not commonly found in kitchens such as emulsifiers, sweeteners and artificial colours and flavours). As Musson explained, she is particularly motivated to understand the

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nutritional value of her products: “I want to find the nutritional value. If you have a teaspoon of our product every single day, what good is it doing you? So, you can stop taking these artificial products.”

Alongside this motivation, Musson is also inspired to reduce food waste with a particular emphasis on sustainability and resourcefulness in the sense of not letting edible food go to waste. She also values supporting and connecting with local farms. Musson explained: “When I first started doing the fruit, that’s the first thing that I came in with. You’re helping the planet. You’re helping the people. You’re helping farmers”.

Musson identified a gap in the market for dehydrated fruits when running a previous small business specialising in raw and vegan foods. She explained:

> …lots of people [were] asking about how I flavoured my product. I was just like, it’s just fruit. I just dehydrate fruit. I had a whole bank of five small dehydrators. I just kind of realised, maybe there’s something in this. It was like 4:30, 5:00 one morning and I’m chopping, or slicing about 10, 20 kilograms of oranges and I remember thinking, maybe there’s something in this. I did some research and there seems to be people that do citrus in Australia. There’s people that do natives. There’s some people that do tropical. But nobody crosses both lines and we used all fruit in our raw vegan stuff every year. It didn’t matter what it was, if it came from the Sunshine Coast.

Musson’s prior and current experience in small-scale food processing enabled her to identify the opportunity and equipped her with the skills to take the opportunity further. This experience extended to selling dehydrated fruits in the United Kingdom (UK). She explained:

> I lived in the countryside down in Somerset in the UK and I just went to local farms, and I started drying fruit… I learnt along the way that when you dehydrate you have to do certain temperatures and lower, and the lower the temperature the longer shelf life you get out of it. Then we used to, actually in the UK, sell packets of – we used to do raspberries... We used to send our dried fruit slices and raspberry powder to Amazon. We used to sell so much of it - it was crazy.

3.3 Design: supply chain and process

Zest Element sources fruits that do not meet supermarket standard from local farms and so are either going to be left on-farm, diverted to livestock feed, or sent to landfill. In terms of identifying and sourcing these fruits, Zest Element relies on networking with local fruit farms via existing relationships, Facebook marketplace advertisements for B grade produce, or direct engagement. Musson explained:

> I guess the citrus I just trawl through – I just keep my eyes and ears out. I listen. I ask people for connections. Then actually as I was driving out to the strawberries, I saw two pineapple farms, and I’ve been struggling to find pineapples. Even though we don’t do that as a powder at this current time. But now I know where there’s two pineapple farms. I literally drove straight past them and was like, okay, for future reference.

In relation to the quality of the produce, Musson emphasised that the reason the produce was going to waste was cosmetic, which does not matter for the type of products she is creating: “The lemons are normally the size of your hand. I’m not kidding…The limes generally are really small. The Davidson plum; I buy their b-grades. Generally, when I was looking at it when I was processing this week, they’re just really small”.

While this is the primary source of the fruit used, Zest Element grow about 10% of the fruit that are used in their products.

After bringing the fruit back to the rented commercial kitchen, Zest Element performs a certain process that was not disclosed but ultimately they dehydrate the fruit and package it. The main equipment used by Zest Element at the time of conducting the interview was food processors/blenders and dehydrators.

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Zest Element sells their products at markets, through approximately 30 retail stores mostly in Victoria, and online.

3.4 Quantities and scalability

As of mid-2025, Zest Element has significantly expanded its capacity, now dehydrating up to 120 kilograms of fruit in 24 hours, resulting in a weekly output of approximately 600 kilograms. This marks a substantial increase from mid-2024, when the company could process around 60 kilograms over a 20–24 hour period. Musson explained: 'The scalability is huge. With even minimal increases in time and resources, production has already grown significantly'.

Zest Element did not identify access to inputs (i.e., fruit) or the type of machinery required as barriers to scalability. In relation to machinery, this could be because the equipment required is not, at this point in time, highly specialised.

Plans are in place to scale this further in the coming months with the installation of three heat pump-assisted dehydration rooms, which will dramatically increase production capacity to 3.2 tonnes per week. Consistent with its emphasis on sustainability, Zest is maintaining energy efficiency through this expansion by using shared power infrastructure.

3.5 Relationships and support

The importance of building relationships with farms to source inputs, but also with the broader industry and related groups, was emphasised by Zest Element. The business is in the process of forming connections within specific fruit industries, and it has established relationships with two institutions the Food and Beverage Accelerator (FaBA) (a research institute focused on food processing) and End Food Waste Australia. Zest Element has also accessed private business consultants and related experts for advice primarily, and has been involved in various industry conferences. Finally, Zest Element has also accessed some funding from public institutions. While this was discussed broadly during the interview, specifics of those arrangements were not disclosed.

3.6 Marketing approach

While Zest Element initially approached marketing by focusing, in part, on their use of fruits that would have gone to waste, this has largely shifted on their website and packaging to a focus on personal health and wellness benefits. This shift was the result of advice received from a consultation with a business advice organisation. Musson explained:

> The [business advice organisation] said to me, most people don’t care [about social and environmental claims]. You need to go in with what’s with them? What’s in it for them? So that’s now how I target it. Right. They said it needs to be the big – painting that scene that’s all about – the architecture is all about health and wellness.

3.7 Challenges

Zest Elements experiences similar challenges to other new businesses in terms of access to finance, having to build new relationships and put in place legal and administrative systems such as intellectual property protections. However, these are accepted as part of setting up a business. A unique challenge experience by Zest Element is a lack of public knowledge about how to use dried fruit powders, and as such, marketing was positioned as a key solution. Musson explained: “A lot of people are finding it hard to sell the product because people don’t understand how they should use it. Hence why we need to do a big marketing program”. Consumer understanding of upcycled food and food waste was not a key challenge in terms of facilitating the business, as this was not the main focus of the marketing regarding Zest Element. Regardless, Zest Element will continue to engage with broader education regarding the useability of produce that does not meet cosmetic standards or expectations.

3.8 Future Directions

Zest Element are leveraging new and existing relationships to expand their production and sales in Australia. They are also actively developing connections with UK importers, distributers and large-scale manufacturers towards selling their product in the UK market. In the future, Zest Elements is interested in developing personalised supplements using fruit powders.

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3.9 Analysis

Zest Element reflects a number of themes identified through Phase 1 of this study and contained in Report 1. In particular, Zest Element illustrates the importance of institutional funding, business skill support, and third-party enablers for upcycling food start-ups. The business also reflects the important role of personal values and motivations in driving start-up upcycled food businesses. Zest Element has not identified any particular regulatory burdens, which further supports findings from Phase 2 of this project explained in Report 2 that specific food safety and related laws are not commonly an undue burden on upcycling food businesses. The experiences of Zest Element also show how upcycled food companies emphasise other attributes (namely health) over food waste reduction potential. At this stage, Zest Element have not faced cost or other barriers to locating produce that would have gone to waste, and this could partially be because they are based in an area where there is a mix of small fruit farms and the size of their current production.

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4. Second Squeeze

4.1 Background

Waste Transition Focus PTY LTD t/a Second Squeeze is a small business based in Burleigh Heads, Gold Coast, developed and run by cofounders Michael Paull, Brent Beauchamp and Douglas Bario. The business develops upcycled food products, using inputs that are considered waste or not fit-for-purpose. Importantly, their business-to-business partnerships enable manufacturers and producers to replace conventional ingredients with upcycled alternatives, directly contributing to waste reduction efforts.

In particular, the business seeks to facilitate the development of upcycled foods by providing advice and connections for companies seeking to upcycle. Second Squeeze advises businesses (especially established food and beverage companies) on ingredients that they can upcycle, provides expert advice on product development and marketing related to those ingredients, supplies certain ingredients depending on context, continues to deliver guidance during product development, and provides, where sought, Second Squeeze branding and international distribution systems in the sale of the end product. Thus, it describes itself as: 'We partner with Australian farmers, producing fruit and vegetable powders from produce otherwise discarded. Additionally, we collaborate with Australia's leading food companies to design and develop final products using upcycled ingredients' (Second Squeeze, 2024). They also develop their own line of products using surplus baked goods (breads, cakes and pastries) and fruit waste (peels, seeds and pulp) into drinks (canned soft drinks and liqueurs) (AgriBusiness Connect, 2023).

Figure 3 Screenshot from Second Squeeze website

4.2 Drivers

The drivers for Second Squeeze centre on prior experience and expertise, pre-existing food and drink business ventures that provide facilities, and resources and capacity to identify gaps in the market.

The extensive prior knowledge and experience of the company cofounders and people involved in the business in relation to fruit processing and drink manufacturing were significant factors enabling the business. This collectively includes expertise in business management, food science, food safety systems, sales, and accounting. Moreover, their prior and on-going business ventures also provided the kind of experience and knowledge required, as well as facilities, to develop upcycled foods. This prior and on-going experience included over 20 years of experience running a business that processed fruit (Queensland Fruit Processors) and setting up and administering a distillery. On this, Second Squeeze observed that they were in comparatively an excellent position to start a business focused on upcycling compared to other businesses due to significant expertise and experience the company cofounders and the connections they have. They acknowledged that, unlike their organisation, other upcycled food businesses would likely need to "outsource a number of other functions [which] would probably hinder their ability to grow to scale for commercial success".

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As a result of their other and related business ventures, Second Squeeze had some facilities and resources that could be directed into launching and scaling up Second Squeeze, as well as pre-existing networks, that has also contributed to their development. Because of the industry experience and knowledge at the food processing stage, Second Squeeze was well-positioned to identify market opportunities associated with what was being grown in surplus and what could be processed to build new markets, as well as to identify new sources of inputs into food (specifically drink) processing from surplus and waste. This positioning in supply chains already combined with entrepreneurial skill to identify opportunities has also enabled Second Squeeze. They explained:

> These are all fragmented at different points. You've got people doing product creation, you've got people over here dealing with waste streams, and those people have never come together. Which is probably why this sort of thing hasn't eventuated until now. You work out stuff as you go but the nuts and the bolts of this we realised that not one single business was going to be able to advocate the ability to do everything they needed to turn out waste. Because at the end of the day a [specific food] company, they make [that specific food]. They don't do other things where another company does other things that can utilise that bread. We have seen instances where a waste stream to one company is an ingredient purchased by another and these are $1 billion plus companies.

In Report 1, we also identified how a third-party facilitator may be beneficial for advancing upcycling and that specific businesses may not have the skills and capacity to enter into upcycling where they were highly specialised already.

4.3 Design: Supply Chain and process

Second Squeeze is unique in that their business involves developing upcycled food ingredients and products, sourcing pre-existing upcycled food ingredients and products and combining these to make new products, and facilitating the upcycling product development of other businesses. This model was explained as follows:

> In a nutshell, we've worked out that we can make a certain amount of upcycled ingredients ourselves. We source a certain amount of ingredients through similar type of producers, and then we can get the ingredients and work with manufacturers to incorporate that into their final product. They then full circle introduce that to buyers overseas that are looking for that specific sort of product. It's sort of an end to end process that, like I said, there's not a single part of it that's super crazy difficult or new or whatever. We're just putting all the pieces together for people having upcycled ingredients, to making the products, to people that are looking for it. That's I suppose where it's a little bit different. But the core principle stayed exactly the same in the sense of going well, where is the waste, what is it, what can be done with it and what companies need to partner.

Generally, Second Squeeze identify a potential drink or related product that can be made using products they know are in surplus or going to waste in nearby farms and facilities. Thus, they source surplus fruit from farms near their pre-existing facilities and seek out other surplus or waste by-products from local manufacturers such as bread. Second Squeeze explained: "…we're not going to bring in peels from say Victoria because that defeats the purpose with all the freights and all the rest of it. That's where - at this point we've made a lemon syrup which is really nice. We know that there are lemon producers in and around this area. For me it's – if I know it's there, I know I can get them somehow or other, because we're willing to pay for it".

Second Squeeze also source upcycled food ingredients through existing networks and match these with food manufacturers. They explained:

> Our thing is a combination of sourcing upcycled ingredients and making upcycled ingredients and then once we've got our pool of ingredients, then we can go to a manufacture and go, ok we've got a raspberry syrup, but we also got a green banana flour. We look at their products and we work out, okay you need a gluten free flour, or you need a vegan this… It's this matching thing again. The ginger guy doesn't know where to go but we've got a catalogue of say ginger, beetroot, all these products where we can go to a manufacturer and go, ok here's the two or three ingredients we suggest.

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As a result, Second Squeeze relies on having access to a large range of upcycled ingredients drawing on existing networks and on their identification of existing surplus and waste streams that could provide inputs:

> I suppose we're taking all these people who are standing there with the carrot powder in their hand or the ginger powder in their hand and not knowing what to do, and going we'll put these together as a group of ingredients that can be sold, that are upcycled. Everything we do will be in that sense.

The equipment and processes used by Second Squeeze are not especially high-tech or novel, and so they are able to keep the manufacturing costs lower and they struggle less with affording and accessing equipment than other upcycled food companies that are looking to use more advanced food manufacturing techniques. They explained:

> Well, at the end of the day the food syrups all fall into a very similar processing pattern to our cold pressed juices. There's not one part of it that is anything other than physical or time that's not – there's no fancy machinery. It's time sitting. It's things like filtering, pressing. It's all very simple. With a group of X amount of machines, we could probably train somebody to run that plant over the phone.

The ingredient base for Second Squeeze allows them to adjust to fluctuations in supply, which can be an issue for other upcycled food companies. Specifically, Second Squeeze source some inputs from food manufacturers (i.e., bread), which remains stable in supply, and fluctuations in fruits available suits their other products, namely various drinks, because these are amenable to different flavours. Accordingly, Second Squeeze struggles less with fluctuations in inputs than other upcycled food companies might where the reliance was on the surplus of a particular fruit or vegetable. They explained:

> Well, the main thing is knowing what the ingredients is, how much of it and when it comes through. In the instance of bread, that's all year round, every single day of the year...There's a…tonne of orange peels and lemon and those types of things. So, we're going to be able – even if that was seasonal, we'd be able to really make hay while the sun shined probably during that seasonal time to be able to carry us through to be able to do it again.

When sourcing surplus fruit, Second Squeeze pay farmers for the fruit rather than rely on donations, which also provides stability to their business. As observed in Report 1, some businesses struggle where they were using another grower or company's waste or surplus for free, and then that actor decides to put a price on that input that makes upcycling less economically feasible. Second Squeeze explained: "We're well aware that to get enthusiasm and to actually make this work, everybody in the chain has to actually see a financial benefit out of it. If they do then as we know, that's the only motivator that makes any sense, is financial". This also reflects their pre-existing financial position to be able to afford to pay for the surplus and waste, which other upcycling food start-ups may not have the resources available. Second Squeeze added:

> So, for us, if we can make a top quality final product and we can afford to pay for the ingredients for that product, then all of a sudden, instead of the company throwing out 30 per cent, they're throwing out 20 per cent. Less landfill, they're profitable, we make money. It's a win-win across the board. The difference is that their P&L has reduced waste expense. Probably a slight labour increase for the sorting, but then has the additional revenue from us actually purchasing it. It's a cost-effective solution for them.

4.4 Quantities and scalability

Waste diversion data was not provided. However, Second Squeeze suggests that they can divert significant amounts of waste and deal with different kinds of food waste. Moreover, as the processing methods and technologies used is not high-tech, Second Squeeze could grow by developing facilities in a range of areas where food manufacturing occurs and/or fruit and vegetable growing was relatively concentrated. Second Squeeze explained:

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> Yeah, so for us it's – that's the core basics of it and identifying where the waste is, what could be done with it. That's why we look to larger things like bread and fruit and the bigger sectors where we know that if we set this up, we could potentially turn hundreds of tonnes of fruit peels into fruit syrups and then back into a fruit soda. That could be done in any city around the world…. We could scale this up to any size and tackle all sorts of waste problems in all sorts of areas. It's really just a matter of how fast we can build it, I suppose.

Accordingly, their approach requires an assessment of the local area, including the options and cost of transport, as well as research and development into the kinds of products that could be made from the waste and surplus that is common in that geographical area.

4.5 Relationships and support

Because of their pre-existing commercial relationships and experience, Second Squeeze have been well-placed to source and develop upcycled food products. While other upcycled food companies have struggled to identify and apply for appropriate government funding (as discussed in Report 1), Second Squeeze have been able to dedicate resources towards identifying and applying for relevant government support and have found various potential streams for public funding. Specifically, they have been successful in receiving a grant from AgriBusiness Connect. Despite this, Second Squeeze did observe that they have had to keep track of a range of government bodies and relevant grants, which can be administratively intensive.

4.6 Challenges

A key challenge overcome by Second Squeeze related to working with other businesses to source inputs where those businesses specialised in a specific food or drink and, as a result, lacked some flexibility and adaptability to new product lines and opportunities. In part, this challenge was overcome by Second Squeeze through building relationships and highlighting the alignment between the proposed product and corporate strategy. However, it was also surmountable because of the approach and scale of the businesses involved. Specifically, Second Squeeze hypothesised that they would get less traction with publicly listed companies in terms of developing new products as there would be more processes in place before a product could reach R&D. They explained: "I think that to scale this identification [regarding an upcycled food product] on to correct businesses, [it] would be imperative, and that was because it was able to get to the right people reasonably quickly and they were able to make a decision'.

4.7 Analysis

Second Squeeze illustrates the important role of third-party enablers in advancing upcycled food, which was also highlighted in Report 1. Specifically, third parties are an important part of enabling upcycling where they are designed to (a) identify opportunities to divert food surplus and waste towards food processing and (b) facilitate the development of those opportunities including by connecting companies with public supports and other supply chain actors. Second Squeeze, similar to Zest Element, also revealed the benefits of less high-tech, costly food manufacturing processes for upcycling in terms of scalability. As was shown in Report 1, manufacturing capabilities can be a key barrier, and so focusing on less high-tech processing techniques has significant benefits. Second Squeeze also reveals how organisations that can draw on prior experiences and relationships relating to food manufacturing can be better placed to move into upcycling than actors who are focused on other points in the supply chain such as growing or waste management. This was also observed in Report 1.

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5. FareShare

5.1 Background

FareShare is a not-for-profit organisation that makes and packages meals predominantly from donated food surplus for people experiencing food insecurity. The meals are frozen and single-serve. The organisation has operated for 23 years, and it is Australia's largest charity kitchen operation with locations in Melbourne, Victoria and Brisbane, Queensland. FareShare merged with another food relief organisation, SecondBite, on 1 July 2024. SecondBite primarily collects surplus foods from farms and businesses and provides the foods to people experiencing food insecurity through various avenues.

Figure 3 Image of typical FareShare meal from FareShare webpage

5.2 Drivers

The main driver for FareShare centres around reducing food insecurity informed by a rights-based perspective that emphasises dignity and entitlement to adequate food. FareShare describes its vision as "Everyone has access to a nutritious meal everyday", while its mission is to "Mobilise volunteers to cook delicious, free meals from rescued, donated and our homegrown ingredients to improve the lives of Australians in hardships" (FareShare, 2024b).

The founders of FareShare were involved in catering businesses and observed large amounts of food leftover. They had the skill and positioning to convert these into meals. For instance, where casserole was left over, these were made into pastries and then given out to other charities to provide to food insecure people. This is similar to the other entities in this case study in the sense that FareShare originates from people with pre-existing expertise in food manufacturing (cooking, meal development) and pre-existing connections and exposure to food surplus and waste.

5.3 Design: Supply Chain and Process

FareShare receives food from various sources including directly from farmers, bulk suppliers, supermarkets, and franchise restaurants. At the time of data collection, these foods were collected by Foodbank Queensland and then distributed to FareShare and other food relief organisations, but they also receive donations directly and the Melbourne branch of FareShare supplements its donations with food that it grows on-site. The food FareShare receives includes fresh fruit, vegetables, unprocessed meats, and pantry staples. They are also provided with processed food products that would have gone to waste because they were not commercially competitive for reasons such as market preferences or timing of product release (such as chicken flavoured in a particular way) or which have minor defects on their labelling (such as missing allergen information as FareShare do not provide allergen-free meals). FareShare, through cooking and freezing, extend the shelf life of products, and as such, are often donated

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surplus food that will not sell within certain time periods. Fiona Maxwell, Director of Community, Innovation and FareShare explained:

> We'll get food from a number of stages in the food chain. Farm gate, direct from farmers through things like the Refresh Program [a platform used to sell surplus food], things through distribution, through bulk suppliers… then through supermarket distribution before it even gets to supermarket, but it might be packaged and ready to put on the shelf, through to supermarket and everything in between. It could be food that is - fruit and veg that are imperfect and either are unlikely to be sold in a commercial setting or a don't go in machines because they're odd shaped. It could be protein often because of date ranges.

Because FareShare, like other food relief organisations, relies on donations of surplus food that supply chain actors need to redirect or they will perish and go to waste, they cannot predict what type of food donations they will receive and how much. As Maxwell explained:

> It's the surprise chain of what's coming in, and at the scale that we are working, that surprise chain can be really skewed…if we get 10 pallets of green beans, they'll freeze a bunch of those so that when the 20 pallets of chicken comes in, we've got beans to go with the chicken. We're also dealing with the seasonality of the fruit and veg. In Queensland we get sweet potatoes coming out of our ears for a certain couple of months of the year. In Melbourne we have gardens. We have a couple of small farms where we'll grow veg to level out the ebb and flow of those inputs.

FareShare finds that they receive less donations of foods with long shelf life (i.e. dry goods) because supply chain actors generally do not need to redirect these kinds of foods to avoid waste. These foods include, for instance, pasta, flour and dried spices and flavourings.

Figure 4 Images of produce received by FareShare taken by research team

The donated surplus food gets delivered to the Queensland commercial kitchen by the entity providing the donation, or through partnership with Foodbank Queensland, as FareShare does not have its own trucks and related logistical means to collect the surplus itself. The commercial kitchen is a large facility designed to be able to support the making of millions of meals a year (FareShare, 2017). Once the surplus food arrives, the chefs leading the facility have to determine whether to use the surplus then, and if so in what kind of meal, or whether to freeze the surplus for a particular time with a view to what future meal it may be used in. In relation to this, the goal of the meals, besides nutrition and flavour, is to use all aspects of the vegetables so that it both does not go to landfill but also serves the purpose of improving the meals. Maxwell explained: “The chefs are really creative. We …rarely put thickeners and stuff into things because they can use all the components of the veg that we get to make the sauces”.

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While Report 1 of this research found a barrier to be manufacturing capacity, similar to the other entities engaged in upcycling examined in this Report, FareShare did not generally struggle with access to the necessary equipment as they do not commonly require high-tech processing methods. They have also had success in raising the funds required to purchase the kinds of commercial kitchen equipment required.

However, FareShare have been developing non-perishable meals (retort and freeze-dried meals) that can be transported to remote locations or areas impacted by natural disasters and do not require cold storage or necessarily access to cooking facilities (FareShare, 2024a). In this instance, the specialised equipment and knowledge required is a challenge. Maxwell explained:

> Look, I guess interestingly because we work with industrial scale equipment, ovens and Bratt pans and all those sort of things you can buy from industrial suppliers. While some things were delayed through COVID supply chains, if you wanted an oven, they had to come from overseas, that's not really an issue because we are a small player in an industry that's much bigger. What's been challenging is freeze-drying machines...they're not made in Australia, so they have to come from somewhere else. One of the biggest makers is New Zealand, which is close, at least.

Unlike the other equipment used by FareShare, the freeze-drying machines need, as Maxwell explained, “trained technicians, but there’s simply not yet enough of an industry in Australia to have sufficient experts to maintain”. This experience aligns with observations made in Report 1.

5.4 Quantities and scalability

FareShare estimated that it uses 10 tonne of surplus foods a week to convert into meals, and that across both sites (Melbourne and Brisbane) it makes about two and a half million meals a year. Similar to the other case studies though, and given the fluctuating nature of food surplus, it is burdensome to closely track the amount of surplus and waste being diverted and maintaining such data, other than a broad estimate, does not serve a specific purpose.

Since the merger with SecondBite, FareShare have obtained more food than they otherwise would have had access to. This is because, through use of SecondBite’s national fleet and warehouses, they have been able to have more food delivered to their kitchen that is close to its use by date. FareShare then cooks and freezes the food. Since the merger in 2024, FareShare have increased its kitchen meal volumes by 30% nationally, their total food collection is up by 7% and they began distributing meals in New South Wales and South Australia.

5.5 Relationships and support

At the time of data collection, FareShare primarily relied on relationships with FoodBank Queensland, as the principal food relief organisation for accepting and distributing surplus food, and large retailers that are well-positioned, and have the resources, to distribute surplus foods. Maxwell explained:

> Most of FareShare support comes from donations and from partnerships, as strongest partners are with the big supermarkets, Foodbank Queensland and then other food suppliers and individual donors.

While FareShare does have relationships with primary producers, and does accept donations from primary producers, it is difficult for them to access such donations due to geographical distance, relatedly the perishable nature of the foods, and because the producer has to have the means to pay for the transportation of the surplus. Maxwell explained:

> No, logistics is the block. There will be a farmer in Bundaberg that we will talk to and they're like, that sounds great, we would love to donate our excess to you. We love the idea that our whatever, sweet potatoes get turned into beautiful

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> meals that get sent back out to regional Queensland to help Queenslanders in need. Then they're like, can you come to Bundaberg and collect it?

5.6 Challenges

FareShare indicates that, as more food surplus and waste is sold to consumers as a result of, for instance, upcycling food businesses, changing cosmetic preferences, and advances in technologies, they may have to find other sources of food. Maxwell explained:

> Will we run out of food to rescue? Not anytime soon, but there'll be different things that will - different product types that'll become more or less available. It's good that more people want to eat imperfect vegetables. As things are more mechanised, you get less human error, so all the labelling errors and processing, warehousing is very sophisticated, so you're getting less of the, oh, that pallet was dropped and things were dinged, that sort of stuff. In terms of improvements in the food rescue waste side of things, you would like to think that will get less and less. That's a good problem to have.

Another challenge is access to multi-year operational funding, as opposed to funding for one-off equipment purchases and other such funding requirements.

Finally, logistical issues remain regarding moving surplus fruit, vegetables, and meats from farms to food relief organisations like FareShare. As discussed, these issues are partly due to geographical distance, the costs of harvesting and transporting, as well as the perishable quality of the goods which means they need to be moved within a certain timeframe and under particular conditions. The merger with SecondBite has helped to address this issue by providing access to a national fleet, however, the underlying logistical difficulties persist.

While a Bill was introduced to the Senate in 2024 that sought to provide a tax incentive for organisations regarding the costs of harvesting and transporting foods for food relief, this was not support, and barriers to transportation remain, including the lack of easy access to vehicle. In relation to this, local processing is a potential option, and was discussed in Report 1, however, this would not solve all logistical challenges (i.e.., the food would still need to be transported at some point).

5.7 Analysis

FareShare differs from the other case studies as they are a charitable organisation. However, they are a prime example of upcycling given the use of surplus foods to create new meals. FareShare experiences fluctuations in supply that the other upcycling businesses observed both in this study and in Report 1. Similar to the other entities examined, they have strategies to deal with these fluctuations including growing their own inputs, freezing, and creative menu planning. The use of conventional kitchen and food manufacturing equipment has also been of benefit to FareShare as it has to the other businesses studied. Given the specific nature of FareShare, some of the challenges it faces around operational costs are unique, which is turn, highlights the need for ongoing funding support.

The success of the merger with SecondBite illustrates the benefits that can flow from food aid organisations that are primarily focused on food preparation combing with food aid organisations that have previously focused on collecting and distributing surplus food.

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6. Montague Farms

6.1 Background

Montague Farms is based in Narre Warren North (Victoria) and comprises of orchards, packaging and cold storage facility, and engagement centre (encompassing a retail store, café, and function space). It has expanded over time from merges with other family-run businesses and now combines five family businesses. The original Montague family farm started around 1948, but the earliest plantings associated with the businesses involved can be traced back to the 1800s. Today, Montague Farms produces apples, stone fruits, pears, cherries, grapes, and some citrus. It has 998 hectares of plant fruit trees and vines and employs about 350 people. Montague Farms supplies major retailers in Australia, and provide roughly 10-15% of Australia's total domestic supply for apples and stone fruit, and they also export fruit, for instance, about 20% of the stone fruit they produce is exported.

It is difficult to obtain specific figures for a range of reasons, including supply fluctuations. However, as a rough guide, most of Montague Farms apples and pears are sold to retailers (an estimated 65%), some of their apples and pears are sold onto actors that process it further into, for instance, restaurant or hospital meals (an estimated 15%-20%) and a further 15% is sold to companies for juicing. This leaves a relatively small amount left for waste, in regard to apples and pears specifically. Stone fruit, however, is a primary area of waste for Montague Farms. An estimated 70% of stone fruit is sold to retailers, 10% is sold onto other actors for processing (restaurants etc) and 20% is wasted as there is no current market for juicing. Although Montague Farms do donate to SecondBite and FoodBank, donating surplus fruit to food relief organisations is prohibitive due to the costs associated with harvesting and cold chain transport over long distances. As is widely accepted in food waste policy and consistent with the food waste hierarchy discussed in Report 1, Montague Farms prioritises avoiding waste in the first place, rather than extra food being donated.

6.2 Responses to Waste

Most of Montague Farms waste reduction strategies are not focused on value-adding or upcycling produce that will be wasted. Instead, the focus is on improving farm infrastructure to avoid damage and loss caused by pests and weather, so that more whole fruit suited to retailers can be harvested. This infrastructure includes, for instance, nets to protect the fruit and trellis systems to avoid the fruits hitting each other when it is windy.

The costs of harvesting fruit that cannot be sold as whole fruit leads to growers like Montague Farms leaving the fruit on-farm. If there was an alternate market that could address these costs, then there would be incentives to harvest and sort all the fruit. In the current context, however, if a fruit is not sellable as a whole fruit (and there is no juicing market), then it generally becomes surplus and waste. This is particularly an issue for stone fruit, as stone fruit is not used for juicing.

SecondBite (a food relief organisation) gave Montague Farms a container to collect surplus fruit, which SecondBite collects using its vehicles. This strategy has worked well for redirecting some of the surplus without significant additional cost to Montague Farms.

Montague Farms is also piloting a food dehydrating process (bio-digestion) whereby surplus fruit is dehydrated to create energy. Rowan Little, the General Manager of Montague Farms, explained:

> The other pathway that we've looked at and done a little bit of work is take that waste fruit, and put it into like a bio-processor… It creates heat, it creates some energy, and so the energy becomes available for use. You dehydrate the fruit in the end, and so you're left with maybe 20 per cent of the product that's waste, and you've created an energy byproduct from that.

The product left from the process is then turned into fertiliser.

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6.3 Upcycling

While Montague Farms send some of their produce to manufacturers for juicing, this would likely not be considered upcycling as they are not converting apples that would otherwise go to waste into juice, but rather they are growing and selling apples to companies that manufacture juice. The distinction is blurred, however, as the apples that are sent to juicing are generally suited for juicing rather than for sale as a whole fruit because of their cosmetic appearance and if juicing was not an avenue for Montague Farms than the apples may become waste and surplus. This lack of clarity about what upcycling means and the usefulness of the term does align with the difficulties of defining upcycling discussed in Report 1.

Montague Farms also make some products at small scale, such as apple paste, that could be considered upcycled in the sense that it is a value-added product using surplus apples that may have gone to waste. These products are sold on-site at their retail store. Having the capacity to trial things in the store is useful, however, a number of barriers and uncertainties remain to creating at scale a commercially successful upcycled food product. Little explained:

> The problem I have with that, I mean, it's a great product and everything, but I think we've made 2,000 jars of it or whatever, and we've sold 750. It's a lot of work to create a branded product, unless we actually make it into a wholesale product, and sell it to other parties. I think I would use our shop as a mini market test, a real market test. Okay, we run a short run. We found that it sold. Now, does that mean it's going to translate and be as sellable in a supermarket? Maybe not, because people have come to Montague, they want to buy a Montague product. We've got to be really careful that we don't make A plus B equals C when it doesn't. But I think it's a good first moment. We put this product out there. It sold really well. Now take it to a bigger business and say, okay, let's do some market testing with a broader audience.

While this discussion focuses on market testing and market information requirements, other barriers to upcycling discussed in the next section relate to the processing and transport costs.

Figure 5 Image of Montague Farms Apple Paste

6.4 Rescue Pops: Upcycled Product Example

Montague Farms worked with RMIT and End Food Waste Cooperative Research Centre to develop a product from their stone fruit waste in 2021-2022. While they tried various upcycled foods using lower-grade fruit, or fruit that had obtained some light or cosmetic damage, the plum sorbet was the most popular in the trials. As part of this research project, Peters Ice Cream were approached and agreed to partner in commercialising the plum sorbet after they tested whether they could use the pureed plums in their ice cream manufacturing processes and if so under what conditions. Peters Ice Cream created the specification required to convert the plums (i.e., the composition of the puree they would require to make it into sorbet) and Montague Farms found a processor to convert the plums into a puree to meet that specification. In sum, Montague Farms would send the plums to the food processor in Queensland, who sent it back pureed, and then the puree was provided to Peters Ice Cream for their product, Rescue

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Pops. Woolworths agreed to support and stock the product. Besides using waste and surplus fruit, there were other benefits that could have been claimed by Rescue Pops, namely their nutritional benefits, as the product did not involve removing the plum skin and, as such, had more nutritional attributes and the product was comprised of 45% plum so it was largely comprised of a whole food. Another benefit for some consumers was that Rescue Pops were dairy free.

Once released onto the market, Rescue Pops did not have enough sales to meet Woolworths requirements and so the product line was cancelled. On reflecting why this occurred, a leading theory is that it was due to the marketing angle; that is, Rescue Pops advertising emphasised the fact that the product was made using surplus fruit rather than emphasising the type of plums used, the nutritional benefits of the product, and the absence of dairy. Little explained: “If we'd done even some basic focus groups on the name Rescue Pops, would the barrier have been identified? Probably it would've…At that point, you had the opportunity to pivot, but we didn't. So, I think there has to be, when you get to that tangible branding and marketing point, there needs to be some investment made at that end”. Further to this, the position of Rescue Pops in the store and the amount of competition, given the ice cream section is large with many choices, was also put forward as potential factors leading to a lack of sales.

Another key contributing issue put forward was the cost involved (and therefore the end product price), including the costs of transporting the plums hundred of kilometres to be pureed at a facility capable of de-seeding the fruit and then transporting them for further manufacturing. Little explained “It was a long journey and quite an expensive journey to find the person who could convert it – and so that came with a cost”. Because of the costs involved given the extensiveness of the supply chain, and without other kinds of ways to recover the costs (such as funding sources), Montague passed on the full raw material costs including all the transport into the costs of the puree.

Figure 6: Promotional image of Rescue Pops from Montague Farms

Due to the costs involved, there is a question of whether Montague Farms could/should have invested in their own food processing infrastructure to develop Rescue Pops or a similar upcycled food product themselves. This question, and related significant risk, regarding whether to invest in on-site food processing equipment is commonly experienced by large growers and manufacturing accessibility is often a barrier to upcycling, as discussed in Report 1. On the one hand, the lack of consumer uptake of Rescue Pops to the level required by retailers indicates that such investment from Montague Farms may have ultimately resulted in a significant loss. On the other hand, it is unclear whether, if Montague had been able to reduce the costs of making the puree (for instance), whether the price point would have enabled the consumer uptake required. Little explained:

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> If we had invested in infrastructure, we'd now be sitting there going, that was a complete waste of money. But, equally, if we'd got it at a sharper price point, and then the price point had been cheaper, would that have impacted on sales? Absolutely. So, it's a little bit of this circular argument. How much development of the supply chain do you need to do, or how much should you take as a loss to prove the success of a product? So, for instance, if Peters and Montague had said, actually, let's just get to the sharpest point as if this product was fully commercial, and charge that price, would that have led to the success?

Little also pointed out that the decision to upcycle a food product also comes with trade-offs, explaining:

> You could probably tolerate the food miles to prove the viability commercially of a product. But you couldn't tolerate the food miles when you went to full commercial. At that point, you would need to say, actually, we need to look at the supply chain and go, we need to get costs down, but we also need to get inputs down. Rescue Pops were eight icy poles or sorbets, individually wrapped in plastic, and then put in a cardboard box, which was printed. How much packaging – where do all that packaging – you know. If you really do the supply chain analysis, was that a sensible, like, in terms of carbon, was that the right thing to do?

This issue regarding the environmental costs of upcycling was discussed in Report 1 and 2.

6.5 Future directions for upcycling

In the future, Montague Farms would approach upcycling by doing a much longer phase of market development and testing. Another potential strategy is to upcycle products on the market that are imported and/or lacking in whole food components and substitute these with Australian produced foods that are less processed. Little explained:

> … let's take the dried fruit category in Australia, right, processing. You go into a supermarket and look at the dried fruit on the shelf. Probably 99.5 per cent is imported dried fruit. Or ice cream, if you look at a fruit-flavoured ice cream, probably 90 per cent is either some form of juice that's imported. So, it's a reconstituted juice that's imported from another country, or it's a dehydrated fruit powder or something from another country that's imported to create that flavour. Even worse, it's synthesised in a lab to create the flavour that tastes like this, even though it doesn't have any of that in there.

Related to this, Little suggested that rather than creating a whole new brand, existing brands changing their products or developing a substitutable product line may provide more commercial success and reduce costs. He explained:

> I think if you've got a product, where I would reflect on it, if there's a product in the market that is using – that is existing today but is using a product that is less sustainably sourced, imported, whatever, and you can change the ingredient, but you don't have to create the brand, but you reposition a brand so you've already got brand loyalty, I think that's more likely to have success – is my reflection.

This approach would have the dual purpose of creating a new product that met (expected) consumer demands regarding domestically produced foods that are less processed and less resource intensive and also serve broader sustainability objectives. Little put this as:

> We should be looking at upcycling and saying, here's a product that's succeeding commercially. We are going to replicate it but substitute an unsustainable product with a sustainable product to get an outcome. I think if you took that pathway, you're probably going to have more success because you don't have to do the brand creation and the product creation at the same time. You only have to do one of the disciplines.

Another reflection from the Rescue Pops experience relates to the role of finance from a third-party and when and how that finance is best deployed. While the funding received for Rescue Pops was essential to the development of the project and especially its

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research and development, third-party financial support could in fact focus on the commercialisation component and come in various forms. Little explained:

> …the supplier – like Montague, in this instance – has to take 100 per cent of the risk to get the product going. The benefit in terms of reducing food waste is massive, but all the risk is held by the party who's doing the innovation…Could it be an interest-free loan? Could it be something that you pay back when it goes commercial, or something like that? But I think in that very delicate moment, where you're trying to get optimum price, and you're trying to do a business case for a business to invest to upscale, they're some areas that I think we've got to go, if it's a good idea, if it hits all the criteria, let's support them to that end – would make sense to me.

Report 1 also highlighted the important role of financing, but focused more on financing before a product reaches commercialisation stage, as this was emphasised by the participants. It could be that this different emphasis regarding at what point funding is provided to best enable upcycling reflects the scale and type of business involved. For instance, smaller upcycling start-ups are potentially more likely to emphasise government funding for research and development while established companies like large growers moving into upcycling require intervention at the commercialisation stage, and could potentially receive it from other commercial actors, to ensure the initial product is price competitive.

Finally, Montague Farms emphasised the importance of building relationships with other supply chain actors to develop an upcycled product. Little explained:

> If I'm a fruit salesman, and I get a call out of the blue from someone trying to buy dehydrated plum juice or dehydrated plums, I go, I don't have dehydrated plums. No, I don't have it. So that's what I mean. It's creating a culture where you go, well, actually, no, we don't have dehydrated, but, hey, I'm going to put you onto someone so we can investigate this…

To build these kinds of relationships, Montague Farms have publicly discussed their aim to reduce their stone fruit waste and actively pursue conversations with various actors about how to address it. Rather than wait for another actor to approach Montague Farms, Montague Farms actively seeks collaborations to address its stone fruit waste.

Having said that, Montague Farms acknowledges that it is not a small enterprise, and so it has the capacity to engage in this kind of research and development, which smaller scale growing operations may not have the resources to do (as was also highlighted in Report 1). Little put this observation as follows:

> If I'm a farmer, and my primary business unit is involved with the growing of fruit, the packing and the selling of whole fruit, it's very, very unlikely that it's going to make sense for me to diversify and become the seller of value-added products. Because value-added products, in all probability, are not going to be sold to the same buyers that I have. Therefore, you're most likely to have to partner with someone else.

6.6 Analysis

Overall, Montague Farms experience with upcycling reflects the number of challenges larger growers face when seeking to engage in upcycling. A key challenge related to marketing testing and information, which can be addressed as part of product development, but is an important dimension to successful upcycling at scale. As discussed, we provide findings in Report 4 that could inform the marketing approach taken by public and private entities seeking to promote upcycling.

Other challenges related to the costs of transport and processing, which costs were both environmental and financial. This issue also intersects with a key, potential limitation of upcycling discussed in Report 1 and 2, which is that the additional processing may ultimately undermine claims that the product as a whole is beneficial for the environment. While a product may help reduce food surplus and waste, it could ultimately be more resource intensive than if the surplus and waste had occurred, though this is very context dependent.

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Similar to the other case studies, Montague Farms emphasised the importance of a collaborative approach to upcycling, which requires multiple supply chain actors working together on products and on information-sharing.

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7. Banana Feeds Australia

7.1 Background

Banana Feeds Australia is an Australian-owned, small business with manufacturing facilities in Cairns, Queensland. The company was founded by Robert Borsato and John McArthur, which combines Borsato's generations of expertise in growing produce in Australia with McArthur's food processing and management skills. Their combined skillset, as well as their shared passion for bananas and horses, has provided the springboard for Banana Feeds Australia.

In addition to their passion for animals, the founders are committed to operating a sustainable business that is circular and includes the whole supply chain. As noted by the founders:

> We always were concerned about the sustainability of farmers…always looking at other areas of the business that could hopefully add to the bottom line and to help them become more sustainable…

The company produces a 100% Natural Green Banana Supplement, B-COMPLETE™ which aims to improve the gut health and performance of horses, dogs and bees. In addition to the supplements, the B-COMPLETE™ range includes treats for horses. The company commenced commercial operations in 2020, and their products are now sold in six countries including United States of America (USA), Ireland, United Kingdom UK), Singapore, New Zealand, and the United Arab Emirates (UAE).

7.2 Drivers

The drivers for Banana Feeds Australia include a personal desire to have a positive impact for farmers in terms of sustainability and circular business practices, identification of a gap in the market, and expertise in growing produce in Australia.

One of the key drivers for Banana Feeds Australia was the desire to make their business economically sustainable and circular within the whole supply chain. As noted by McArthur:

> I think that being able to provide growers another alternative revenue stream which is what our model is set up on. We'd love to see it cover more growers, but ultimately, [we] wanted to see that underutilised product being realised rather than it costing money to dump it or to have to rework it.

McArthur went on to add that it was this 'philanthropic approach to the concept' that initially drove their business. Despite the altruistic desire, McArthur acknowledges the importance of commercial viability. He noted:

> Obviously…it needs to make commercial sense. That was probably one of the underlying things, it's just, as a grower, growers don't like seeing waste. They spend every waking moment producing this product from the ground up. Then to seeing such a significant portion of it not making a return, it really does upset every grower. It doesn't matter what category, it doesn't matter what vegetable or fruit you're growing, it's a real personal insult to them when they've got product that's not making a commercial return. I think that was one of the main drivers. Not only trying to improve the grower sustainability outcomes, but I think also when you've got a product that's been done for eons of years, that has supported cultures around the world. To make that available in a usable form for animals just made a heap of sense.

The founder's expertise in growing conditions and seasonality assisted them in planning for, and making use of, what would be waste product. McArthur explained:

> [I]t was all about what can we do with product that does not make it to the markets for any particular reason. Usually, it comes down to small imperfections, size of the fruit that was growing. What we wanted to do was start investigating another suitable use for that product that would be considered a waste product or a by-product of mainstream production for human consumption.

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With the founders combined expertise within the banana growing industry, they were able to realise an opportunity to bring a unique banana product to market:

> The industry can see up to 20, 30 per cent of production not making it through to the markets. Like I said, predominantly through skin markings, size, profiles, shape, whatever you want to call it. Yeah, it's obviously a considerable amount of product that they weren't getting enough economic return for…We started thinking about, knowing full well that bananas have got huge nutritional benefits for humans. Why couldn't we make that available to other species?

The next step for the business was research and development which involved a desktop study into the use of banana products in equines and canines. The results from this study indicated that their product was unique within the marketplace.

7.3 Design: supply chain and process

Banana Feeds Australia sources banana product that does not make it to market — whether the product does not meet specifications due to cosmetic standards, weather or otherwise. The business provides bins to banana growers and growers put bananas in the bins that were not able to be taken to market. The business pays to pick up the bin and transport it to their facility where the product can be processed.

The process used by the business is relatively simple as McArthur explained:

> We've set [the business] up as a standalone business that could cater for numerous growers…For the simplicity of starting out, what we did is we worked with a consolidated packing shed in the first instance where they would represent a number of different growers. Any product that was a by-product from that packing process would go to the supermarkets or the markets around Australia. We would then take that waste and bring that back to our facility.

Part of the success of the business model is the pre-existing relationships the founders had with growers due to their work within the banana industry. Not only did they have the insight required to set-up the business, but they were also able to utilise their relationships to network and organise a stream of waste product for their use.

Similarly to other case studies on upcycled food, Banana Feeds Australia uses relatively low-tech equipment, but at scale. As McArthur explained:

> We have a massive wash bin. We have a massive commercial slicing machine. We have a massive commercial-grade dryer, and then we have our own mills, and then we put it into bulk bags, which is then stabilised, and then we repackage it.

McArthur continued:

> When we set out, we definitely wanted to keep everything as simple as possible. Although the product that we use wasn't available in Australia, they were all overseas manufacturers, and we had to repurpose and we had to make a lot of modifications to suit the job at hand, which took some time and a lot of trial work and whatnot.…certainly the whole goal was to keep it as simple as possible, to be able to do volume, and to be able to manage it and keep it running consistently so that you got the economies of scale as far as the production is concerned. Anything that's too finicky becomes very difficult.

Banana Feeds, which is predominantly funded privately by the founders, has received several grants to support their business including from End Food Waste Australia CRC and Trade and Investment Queensland through the Go Global Project. These grants assisted with things like research and development and matched funding to help with business development.

7.4 Quantities and scalability

Data related to the diversion of waste was not provided by Banana Feeds Australia. However, as noted earlier, one of the driving factors for Banana Feeds Australia was the diversion of product from a waste stream into an alternative market. With the potential

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for waste in the banana industry as high as 30%, it was acknowledged that "[w]e haven't even got close to tapping into the growers that we could".

McArthur further noted that their future plans for the business include scaling up and this may include upgrades to their equipment.

> Our goal as a business is always to be able to access that biggest market, which is the billions of people, population around the world of which you've got starving countries. When you can take a highly nutritional product and make it available, cost-effectively, the world should be our oyster. Trying to find partners to do it is challenging. Trying to find time, again, we're flat out and I know what my time's like. We're flat out just trying to keep our head above water, just keeping up with the business that we've got.

When obtaining surplus banana, Banana Feeds Australia pays to pick up the waste bins they have provided. As noted in Report 1, and similar to the discussion in the Second Squeeze case study, payment for waste product (whether it is per tonne or through the provision of bins and a paid pick-up service), assists in providing stability in the business and ensures a mutual benefit for the farmers and the upcycled business.

7.5 Marketing approach

Banana Feeds Australia identified marketing as a challenge for their business. As noted by McArthur, one of the biggest challenges for the business is around the cost of marketing and messaging:

> It is still the challenge with networking with customers. We haven't attended any inbound trade missions or anything like that. Probably because we don't know what's out there. Probably because we're not as well connected in this space. This is the first time we've run this business. We've run other people's businesses. Again, you don't know what's out there until you know it's out there and [that's the] biggest challenges for businesses.

The business focuses their marketing on the health benefits associated with their product as opposed to the product being an upcycled food product. As McArthur explained, "We certainly talk about it [upcycled food] but it's not something we have a logo on our packaging, or anything like that".

Interestingly, despite Australia not yet having an upcycled food accreditation, as an exporter dealing with overseas markets, Banana Feeds Australia faced some supplier pressure to be upcycled certified. Despite this, the business found that by focusing on the health benefits of the product, they were best positioned to reach their desired target markets.

7.6 Challenges

Banana Feeds Australia has experienced several challenges as a new business including funding, navigating the export market, and competition in the market. These types of challenges were not unique to upcycled food businesses, and as noted in Report 1, small upcycled food businesses face similar challenges to those in smaller start-up type businesses.

In terms of the challenges around export, Banana Feeds Australia faced various challenges around networking with international clients. As noted by McArthur, it can be difficult to network from Australia and costly to travel. McArthur explained:

> At the end of the day, the challenge of growing a business from a little incubator-type style business to trying to get it to that next level is certainly not easy. There are a lot of pitfalls, and there are a lot of things that you live and learn along the way… It's a big world out there, and there's hundreds of government employees in all different parts of the world. It's just a matter of how do you tap into them and how do you really get that benefit from being an Australian exporter with an innovative idea, and get that support, in country, where you're trying to develop.

Another challenge the business faced was government funding, which was also observed in the data from Phase 1 of this project. McArthur observed the importance of obtaining government support, however noted that it can be hard to identify what the opportunities are, and how to access them:

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> With the whole network of government organisations, I think here on Australian soil, it's not as difficult to connect and to realise where some of that assistance sits. I think once you start wanting to get some in-country support, it's really, really still quite challenging to see an impact or to connect with the right people.

In-country support in this instance means government support from the relevant jurisdiction or jurisdictions involved.

Competition in the international market poses a significant challenge for the business in that they are often competing with cheaper products from developing counties. Whilst the selling point for Banana Feeds Australia is that the Australian produce is a better quality, that is often not enough to overcome the draw of a cheaper product. This issue links back to their marketing strategy which has the focus on the health benefits of supplying a premium product.

One challenge which was not unique to Banana Feeds Australia, but also not common in small start-ups, was the specific challenge associated with entering the human supplement market and the related regulations. Banana Feeds Australia's future direction includes transitioning into the human-grade supplement space. One of the key challenges associated with this is the Therapeutic Goods Association approval process, and the potential intellectual property considerations. The business' future directions are discussed in more detail below.

7.7 Future Directions

The next step for Banana Feeds Australia is the development of a human supplement. The business has patents pending in terms of a new product, however the specifics of this were not provided.

McArthur noted that a future challenge for the business may be obtaining Therapeutic Goods Association approval. As noted in our Phase 2 report, seeking approval under the Therapeutic Goods Association can be complex, and many businesses lack the understanding or experience to navigate the regulatory landscape.

A further potential consideration for the business is whether they should develop the human-grade product in-house or seek to sell the ingredient directly to a supplement company. As noted by McArthur, it is not only "about identifying the product opportunities, but it was also about identifying the best path to market". McArthur explained:

> [W]e know that our product is at a threshold that it's perfectly safe for human consumption. We know that we have a market, that opportunity out there for human consumption…There's a lot of people trying to operate in this space, so… it's about networking and it's about trying to find who you can - you either do it all yourself, and then that comes with a lot of other challenges… Whereas the other opportunities is to better network, find better partners, and let them be specialists at what they do…

One of the key challenges for businesses in determining the right strategy (in-house development or a third-party buyer), is determining whether they can afford the associated risks. In-house development has potentially high costs associated with upgrading the facilities, as well as the risks associated with selling the product to the market. The option of selling the supplement to a company would involve less risk as they would have a buyer for the product but would still incur costs in terms of upgrading their facilities. At the time of data collection, Banana Feeds Australia was in the process of finalising their strategy for the human-grade supplement.

7.8 Analysis

Banana Feeds Australia draws on the founders' expertise in farming within Australia, their connections within the industry, and a unique product that fills a gap in the market. Their drivers and motivations were fuelled by their years of industry experience and knowledge of bananas, as well as their desire to make a sustainable business for farmers and their products.

The business was well positioned in terms of knowledge and experience to enter an alternative market, however transitioning their business to the next phase in human-grade products poses a challenge due to the complexity of the Therapeutic Goods

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Association approval process. As noted in Report 2, whilst regulation does not pose a significant barrier, for upcycled products that require Therapeutic Goods Association approval it can be complicated and often there is a general lack of knowledge about the approval process. This can act as a significant barrier for upcycled companies in terms of transitioning into the human-grade market.

Banana Feeds Australia illustrates how third-party enablers can assist in advancing upcycled food. As noted in the Second Squeeze case study, and also within Report 1, the success of upcycled food companies often relies on: (1) the ability of a business to identify an opportunity to divert waste, and (2) the development of the opportunity through business connections with supply chain actors, expertise, and external supports (such as through grants and funding). In the case of Banana Feeds Australia, these two success factors formed part of their business plan.

Banana Feeds Australia currently utilises a simple, low-tech processing system. As noted in the Second Squeeze and Zest Element case studies, there are benefits in terms of scalability when using a process that is cost efficient and low-tech. Findings from Report 1 indicated that manufacturing capabilities can present a barrier in terms of success. Whilst Banana Feeds Australia currently have a scalable, low-tech model, they have indicated that transitioning into the human-grade supplement space may require upgrades to their facilities and processing equipment. They are yet to consider such changes or the potential impact of these, in detail.

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8. Discussion and Conclusions

The case studies provide an opportunity to examine how different entities engage in upcycling providing insights into their supply chains, processes, strategies, challenges and successes. While Report 1 identified broad challenges, opportunities and recommendations for upcycling, and Report 2 examined the regulatory context, the findings in this report provide a contextual analysis that enriches the prior findings towards developing a final set of recommendations. Despite each entity being significantly different in scale and approach, there were some key commonalities that provide lessons for others seeking to engage or facilitate upcycling.

All case studies underscored the importance of collaborations across supply chains, as opposed to one entity deciding to create an upcycled product and creating its own supply chain. Rather, the approach to engaging in upcycling is more about information gathering across the supply chain regarding the kinds of surplus, waste, and product ideas that may exist. While one entity might draw this together to form a product or outcome, there still needs to be a lot of support and engagement across the supply chain and situations where two or more entities work together to create a product are a useful model. This does underscore the role of third-party facilitators in 'connecting the dots', which was also a finding in Report 1.

Another commonality across the case studies, and which differed from Report 1, was the emphasis on low-tech manufacturing methods as opposed to food manufacturing techniques that required highly specialised equipment and knowledge. This kept costs low and improved the potential to increase scale. Potentially, then, a useful strategy is to focus on enabling upcycled foods that come about using low-tech methods. This may also carry the additional benefit of appealing to consumers seeking products that are less processed, as is also consistent with public health nutrition advice, though this would be dependent on consumer analyses (Thorsen et al., 2022).

The case studies also illustrate the ways in which upcycled food businesses, and other entities engaged in upcycling, tend to emerge from actors with pre-existing food manufacturing knowledge and experience as opposed to, for instance, those actors focused more on production or retail. Perhaps this stems from the importance of relationships across production through to retail to develop an upcycled food product as well as the specialised knowledge required to manufacture a product.

Entities engaged in upcycling tend to share common values regarding resourcefulness (using resources that exist effectively) and sustainability (in the sense of mitigating environmental impact). Upcycling, or value-adding to foods that are surplus or going to be wasted, was often not conceived of as only a strategy to reduce waste but as something that needed to be developed in ways that ensured resource use across the lifecycle of the product was minimised. This suggests a broader conception of upcycling is developing. For entities looking to enable upcycling, it suggests that the criteria used to evaluate potential products should be broader and more complex in terms of the environmental impacts considered.

The marketing of upcycled food products emerged as a key area across most of the case studies with various strategies and insights being developed. Findings from Report 4 of this project will advance knowledge regarding consumer perceptions of upcycling and strategies to communicate, and will be relevant for upcycled businesses in terms of understanding messaging around upcycled food products.

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