

Understanding the Opportunities of Central Otago Fruit Loss and Waste with Local Fruit Processors and Growers

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Te Whare Wānanga o Otāgo

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Abstract

The amount of food loss and waste that occurs annually has significant health, social, environmental, and economic implications.

Reported solutions to food loss and waste include greater collaboration throughout the food supply chain (FSC) and creating more circular and resource-efficient systems. While there are existing case studies in the literature that look at collaboration and circulatory practices across supply chains, there is a notable lack of studies investigating the collaboration potential within a geographical region to create better systems to minimise food loss and waste.

Central Otago is a landlocked region near the bottom of the South Island of Aotearoa, New Zealand. It is famously known for its summer fruits, consisting of apricots, cherries, peaches, and nectarines, harvested between December to March, and apples harvested from March to July. Owing to an increased local awareness of food loss and waste, a report commissioned by Central Otago District Council (CODC) identified that that, on average, 12.8% of total fruit was either lost or wasted at the grower's end of the supply chain. This naturally led to the question of 'what could we do with all this waste?'

The CODC saw that the reduction and better utilisation of this loss and waste as being a commercial opportunity for the region and set in place a research group to investigate how best to reduce it. One of the research streams that came out of this initiative was the current project to investigate the opportunities for Central Otago fruit processors to help reduce the regional fruit loss and waste. To address this question, 10 in-depth semi-structured qualitative interviews were carried out with Central Otago processors and growers to discover the key factors impacting on their current and future utilisation of regional resources and the opportunities they believed existed decrease fruit loss and waste. In addition, interviewees were asked about the type of equipment and storage they use, whether it is utilised year-round and where possible, if they would be willing to share it.

A thematic analysis of the interview transcripts revealed four key themes influencing the local fruit processors and growers utilising regional resources more to reduce food loss and waste (FLW) which were (1) factors of processor general operations influencing resource utilisation, (2) influencing systematic structures within Central Otago, (3) processors' regional collaboration outlook and (4) the influence of the market on resource utilisation.

The cost of operations (e.g., labour and distribution costs) was a major influence on the quantities of fruit that was able to be picked and processed and therefore the frequency at which equipment was utilised. There was a consensus that equipment could be used more efficiently throughout the region through the exploration of collaborative initiatives, however, not all processors could or wanted to share equipment, and there were factors that complicated this, such as the specifications required for various forms of fruit processing which differed

significantly (e.g., dehydration requiring higher specifications than juicing). Other collaboration barriers included mistrust with local governing bodies, protection of intellectual property, protection of equipment safety, concerns of creating more market competition and the potential costs that could be associated.

In general, many of the interviewees were very interested in sharing resources (e.g., fruit, equipment, and storage) as they were already collaborating with others in the region or were small producers and lacked the resources, such as a sales and marketing team, that they felt they needed to compete successfully. Smaller processors were also interested in a model whereby they make the product and someone else sells it. Overall, many interviewees believed that increasing equipment utilisation was only seen as an advantage from an operational cost and environmental impact point of view and in doing so, create the viable opportunity to reduce fruit loss and waste for the region.

It is recommended that the CODC should establish a collaborative central food hub that can be utilised by the smaller processors and grower owned businesses in Central Otago. This can be done via facilitated access to a central cool store to facilitate the shared distribution of goods outside of Central Otago. Within this, collaborative funding from the CODC/ growers / processors to then establish the sales and marketing support resource would be of great benefit to many processors and growers, who do not have the resources on their own. Alongside this, the creation of a collaborative online database resource that is accessible to processors and growers within the region to easily share available equipment and storage would be of great benefit to increase the utilisation of resources in the region. To action this, CODC would employ software experts to create the database that considers all the required variables, optimising the success of the initiative.

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Chapter one

Introduction

1.0 Introduction

FLW is a global issue which has significant negative economic and environmental impacts, whilst also contributing to the global hunger pandemic. Solutions to FLW has been touted to be the single greatest solution to climate change (Project Drawdown, 2012).

FLW is also a national issue in Aotearoa, New Zealand, with 224,000 tonnes of food being wasted annually, equating to \$568 million and a calorie loss that could have fed 50,000-80,000 people (Reynolds et al., 2016).

Solutions to FLW in the existing literature include greater stakeholder collaboration throughout the FSC and creating circular more resource-efficient systems. While there are existing case studies in the literature that look at collaboration and circular approaches across FSC, there is a notable lack of studies that have investigated, within a geographical region, the advantages collaboration provides as producers and processors strive systems designed to minimise FLW.

Central Otago is a landlocked region near the bottom of the South Island of Aotearoa, New Zealand. It is famously known for its summer fruits, consisting of apricots, cherries, peaches, and nectarines, harvested between December to March, and apples harvested from March to July. Owing to an increased local awareness of food loss and waste, a report commissioned by Central Otago District Council (CODC) identified that that, on average, 12.8% of total fruit was either lost or wasted at the grower's end of the supply chain. This naturally led to the question of 'what could we do with all this waste?'

To answer this, the factors influencing local processors' current and future utilisation of regional resources and whether opportunity to increase utilisation can decrease FLW in the region is investigated. From these findings, this research aims to then determine how best to engage and work with this stakeholder group in the region's waste reduction/utilisation endeavours.

1.1 Aims

The research project aimed to understand the opportunities for Central Otago fruit processors to help reduce the regional FLW.

In pursuit of the research aim, the following four steps were taken:

- 1) A review of the academic literature pertaining food loss and waste, the barriers and opportunities for small agricultural producers to develop their practices to become more

efficient, the future trends within the horticulture sector of New Zealand, and how collaboration across the FSC may help to minimise FLW

- 2) The use of semi-structured interviews to explore the perspectives of and the barriers and opportunities processors in Central Otago face when aiming to utilise their resources more effectively and efficiently to reduce FLW and their opinions on regional collaboration of equipment, storage and associated logistical considerations
- 3) A stocktake of food processing equipment and storage (cool, ambient, frozen) facilities in the region with the goal of understanding how well utilised they are if and when they may be made available for sharing
- 4) The generation from the primary data and the scientific literature of a list of actions (recommendations) that the Central Otago District Council and producers / processors could take to help reduce FLW in the region

Chapter two

Literature Review

2.1 Introduction

The purpose of this literature review is to clarify the meaning of FLW and upcycling and to relate these topics to the mission of seeking solutions to reduce FLW in Central Otago. Section 2.2 is the growing concept of the circular economy for a sustainable future. Section 2.3 defines and notes the impacts of food loss, waste and surplus and how this works towards the concept of a circular economy. Section 2.4 discusses the barriers and collaborative solutions that small producers face in the agricultural food producing sector. Section 2.5 outlines how collaboration can be structured across the FSC, and the benefits and barriers potentially associated with collaboration. Section 2.6 explores the New Zealand horticulture sector to give understanding of their future goals and thus how these fits into section 2.7, the Central Otago fruit scene. Section 2.7 investigates the key findings from the Understanding Fruit Loss report produced in 2021 for Central Otago fruit, which discusses the findings, barriers, and opportunities of FLW from a grower's perspective. Section 2.8 discusses methods to obtain data through the various interview techniques and use of focus groups and the advantages and disadvantages associated with each approach.

2.2 Circular economy and bioeconomy

In a world where sustainability is at the forefront of society's mind, the term "circular economy" is frequently used. A circular economy has recently been defined by Ari et al., (2019) as "a continuous positive development that conserves, enriches natural capital and optimised resource yield through long lasting design which honours recycling and remanufacturing". Stemming from this concept, circular bioeconomy was a term created in respect to food systems, which looks to use resources efficiently with slower material flows. For the food industry, this means the process of working towards closing the loop for the whole FSC through material recycling, nutrient, and energy recovery (Ari et al., 2019, Teigiserova et al., 2020). This approach differs from what is seen in a system that honours capitalism and where economic sense has been prioritised to create issues such as waste, loss and surplus.

2.3 Food waste, loss and surplus

2.3.1 Definitions

Food waste, loss and surplus food is a known concept, however due to the limited number of publications around the parameters defining these terms, what exactly they refer to can be blurry. The FAO, (Gustavassion et al., 2014; Garron et al., 2014) came up with definitions for food loss, food waste and surplus as they are all terms that are used interchangeably in literature. These definitions create some scope and clarity to guide terminology use in this literature review. Food loss was regarded in terms of "the production and distribution segments

of the FSC that is caused by the function of the food production and supply system or its institutional and legal framework” (Gustavassion et al., 2014). Food waste refers to “food originally produced for human consumption that was discarded or not consumed by humans” (Gustavassion et al., 2014). Surplus food refers to “edible food produced, manufactured, retailed or served that has not been consumed, mainly due to economic reasons” (Garron et al., 2014). These definitions created by academics show significant ambiguity through their similarities, making it hard to know what term applies to a situation. The effect of this makes creating better policies to manage FLW streams, complicated.

In this literature review, food waste and loss (FWL) are the chosen terminology. The definition used is based off the recommendations made by The FAO from the Definitional Framework of Food Loss report, 2014. It is noted that the framework and motivations within the FSC, leading to waste or loss, can differ based on underlying reasons. For example, waste being intentional and loss, not. However, the term ‘food loss’ is believed to encompass ‘food waste’ and therefore the term ‘food loss and waste’ is used (FAO, 2014). The final definition used for FWL is “the intentional and unintentional loss of food in the FSC”.

2.3.2 Global environmental impact

Unlike the model for a circular bioeconomy, FLW involve significant portions of resources being used to produce food that has no benefit nor value. Kummu et al., (2012) estimated that one quarter of food produced is lost in the FSC (production, post-harvest processing, distribution, and consumption), which accounts for 24% of freshwater resources and 23% of cropland area. Alongside this, preventing FLW is the single greatest solution to climate change (Project Drawdown, 2021).

2.3.3 Global economic impact

FLW means that resources (water, energy), labour, processing and transport has been poured into producing a food that is not consumed, thereby it represents a financial loss. It is estimated that the cost of FLW annually is \$1 trillion is whilst households could save up to \$1,400 per year if they prevent FLW in the home (Upcycled Food Association, 2022; Love Food Hate Waste, 2019). Therefore, the financial resources businesses could save, or even gain from creating added value products from their waste streams are considerable.

2.3.4 Global social impact

Not only is FLW an environmental and economic dilemma, but it’s also a social one; with 815 million people undernourished worldwide, higher income countries face excessive consumption and health related conditions that accompany this, while still producing large volumes of FLW, showcasing the disproportion of resources (FAO., 2018). Decreasing FLW is the most promising measure which could lead to better food security in the coming decades whereby if the lowest FLW percentage was taken up globally per capita, an extra 1 billion people could be fed (Kummu et al., 2012).

2.3.5 Food loss and waste in New Zealand

There is limited literature on the extent and thus the effects of FLW in New Zealand, however the global issues as described in sections 2.3.2, 2.3.3 and 2.3.4 are still relevant. Literature that discusses and quantifies FLW at a household and retail level in New Zealand is limited. A study by Goodman-Smith et al (2020) estimated that the total annual retail waste was 13kg per capita, however supermarkets have shown voluntary implemented strategies to avoid this waste ending up in landfill. Of the 13kg/capita/year, only 3kg/capita/year ended up in landfill, therefore suggesting that the strategies that have been put in place are making a difference.

Another study aimed to use macro-economic data to estimate the household waste generated in 2011. It was reported that over 224,000 tonnes of waste were generated from households alone over the year-long period. The economic cost associated with this waste was estimated at NZ \$568 million nation-wide and the calorie lost was estimated to be enough to feed 50,000-80,000 people (Reynolds et al., 2016).

These two studies suggest that New Zealand very much has FLW issues and thus New Zealanders should be concerned about the relevant environmental, economic, and social issues associated with FLW.

2.4 Barriers and collaborative solutions associated with the development of small producers in the agricultural sector

Small producers in the agricultural sector face multiple barriers when looking to develop and upscale operations to create more return for their produce. They can however be more flexible and agile, allowing them to make quick changes where necessary. A study by Yacamán et al., (2020) outlined the barriers in short food supply chain (SFSC) peri-urban farming communities, which supply to the neighbouring urban areas. Advantages of the practices include the better connection of people to food production, a closer distance to market and the ability to skip the middleman thereby retaining a higher percentage of the profit. However, barriers associated with networking, logistics, distribution and scaling up were commonly reported. These barriers prevent small scale producers from achieving increased incomes and developing their operations to become more efficient.

2.4.1 Barriers small agricultural producers face when aiming to develop operations

Common barriers small producers face when aiming to develop their practices to upscale include difficulty to form networks with other producers and supply chain stakeholders, efficient logistical management, and distribution difficulties such as affordability (Yacamán et al., 2020). All these barriers influence the ability of producers to operate efficiently and thus makes operations costly from both a monetary, time and environmental resource point of view, ultimately affecting other abilities such as investing. In addition, Yacamán et al., (2020) has reported that the impact of competition within the organic growing section combined with

distribution costs and a lack of marketing skills were also barriers to creating better food systems.

A review by Mittal et al (2018) analysed a vast range of literature and proposed best practice logistics for regional food systems. It was reported that small regional producers do not have robust systems in place to support large scale operations due to lack of processing capacity, inability to aggregate resources to meet the larger demand or insufficient distribution planning or resources. Like mentioned above by Yacamán et al., (2020), the lack of robust systems prevents smaller producers from further developing their operations and thus the ability to upscale, limiting their potential to earn more and become more resource efficient. Malak-Rawlikowska et al., (2019) mentioned that small producers can be problematic when aiming to create better foods systems in general due to the lower resource efficiencies compared to larger producers. Factors such as lower yields, smaller production runs and less energy efficient equipment contribute to the higher ratio of resource expenditure to product produced. This is not only costly to the producer, but also the consumer, who pay the premium price for the product produced.

Transport and distribution are integral parts of the FSC that needs to be well formulated and organised. However, Bence et al (2018), reported that there is a lack in technological, financial and organisation innovation in the small producer space, are factors which eliminate potential profits and environmental benefits in their wake. Transport collaboration was a solution whereby organisations in different supply chains could better utilise assets and reduce costs through sharing transport for various products or stages of supply chain (Van der Vorst et al., 2005; Audy et al., 2012; Mason et al., 2007). However key barriers include technological barriers of organising the sharing systems and insufficient trust between coordinating producers (Barratt, 2004).

2.4.2 Collaborative solutions small agricultural producers can adopt to develop operations

Smaller producers face multiple barriers and inefficiencies that prevent them from optimising their business. However, the available literature also proposes many solutions to these barriers. Mittal et al (2018) states that for regional agri-food systems to reach their full potential, they must find ways to increase scalability to sell their product to a greater number of consumers while introducing environmental sustainability criteria. An example solution has been outlined by Yacamán et al., (2020), where collaboration across marketing, market access, logistics and distribution, to improve the efficiency and success of smaller producers, has been a suggested approach. Benefits of this approach included resource sharing with producers and processors to better afford more efficient equipment that can be better utilised and reduce competition in the market through collaboration of products whilst inducing mutual support to help combat isolation and stress.

A list of potential solutions helps smaller producers become more resource efficient and observed benefits of the suggestions is reported in Table 1. Alongside the solution are observed

associated benefits, which are explained in terms of potential outcomes for smaller producers if they were to adopt the suggested solution.

Table 1. Summary potential solutions for small food producers in agricultural settings suggested by researched literature, respective to the resources given

Potential solution	Observed benefits	Resources
Collaboration in logistics for small producers across warehousing, transportation, and inventory management	Improve efficiency through shared vehicles, shorter routes and thus reduce costs to increase potential of securing finance to invest in new technologies	(Mittal et al., 2018)
Aggregate products for regional markets using food hubs	Acquire economic scale to meet larger demand customers alongside planned production, help with marketing, distribution and sales enhancing economic viability, enhanced business model and market relationship	(Malakl-Rawlikowska et al, 2019)., (Yacamán et al., 2019)., (Beckerman et al, 2006)., (Yacamán et al., 2020)
Integration of supply chain via online collaborative solutions such as shared databases or third-party logistics	Better control of logistical management through location and thus planned routes leading to reduced time, distance, and cost. Third party logistics for multiple small producers could reduce costs and increase resource efficiency	(Bosona et al., 2011)., (Van der Vorst et al., 2005)., (Chopra et al., 2007)
Collaboration of knowledge, skills, and information	Positive idea generation, product development, increased resilience of the food system by improving collective knowledge (key for small producers to exchange skills and create trust-based relationships) and demand forecasting through sharing post sales data	(Swagemakers et al., 2019)., (Yacamán et al., 2019)., (Lee et al., 2000)
Collaboration and resource sharing for inventory management and warehouse sharing	Reduce costs via group purchasing and shared maintenance costs, improve distribution efficiency through sharing equipment and storage post-harvest season	(Audy et al., 2012)., (Creamer et al., 2012)., (Parry et al., 2011)
Creation of a rent-share model for agricultural equipment with collaborative-based filtering systems	Optimises equipment required for rental via calculated variables. Cost effective, little training changes required, technique improvement, better resource management.	(Rakhra et al., 2022)

In Table 1, five key solutions mentioned from various sources of literature are explained by their relative mechanism and observed benefit. However, with the solutions, there are often associated barriers to implementing these solutions. For example, under “Aggregate products for regional markets using food hubs”, Yacamán et al (2020) acknowledged that the transformative potential of small processors was determined by the governing structures required for business management and regulation (e.g., regulations for food safety). However, it was explained that governing structures also promise to empower producers to create community profit streams whilst also producing healthy food, therefore, shifting to more collective food systems through food hubs would support this. Governing structures also play a role across many of the solutions, for example if a producer wanted to sell a product that contained alcohol, they would require another set of regulations to conform with, complicating the success of the collaborative efforts.

2.5 Collaboration of stakeholders in the food supply chain

2.5.1 General concept

Using a systematic perspective, the causes of FLW have been analysed and it has been suggested that the way a food system is designed influences the resulting FLW (Bhattacharya & Fayezi, 2021; Matzembacher et al., 2021). Concepts such as collaboration, better communication and coordination, have been explored as solutions to not only reduce FLW but also to increase efficiency of material use, spread awareness, and to create better suited food regulations and policies (Matzembacher et al., 2021).

2.5.2 Anticipated benefits

Collaboration between stakeholders in the FSC may require strategies that need to be initiated by these identified stakeholders themselves (Surucu-Balci & Tunam 2022). The goal is to create better communication and to make systematic changes that designs out FLW or diverts FLW into a new, repurposed market.

An example of strategies that stakeholders can use includes enhancing existing communication systems between neighbouring stakeholders in production and processing spheres, allowing for more accurate forecasting of demand and thus product and specifications required, creating less room for error during production and thus potential waste. A broader example is collaboration between production, distribution, and consumption by seeking solutions for produce that does not meet specification standards, e.g., creating discounted produce that does not conform with the standard (Surucu-Balci & Tunam 2022). Following on from this, another example could be the better use of food banks and food rescue organisations, or key stakeholders seeking out alternative destinations for food that does not meet export or retail standards.

2.5.3 Anticipated barriers

A literature review study by Ada et al., (2021) reported that barriers towards collaboration and the creation of more circular food systems could be distilled into 7 main themes: cultural, business and business finance, regulatory and governmental, technological, managerial, supply-chain management and knowledge and skills as described in Table 2.

Table 2. The 7 identified barrier themes from Ada et al., (2021) and how they act as barriers towards collaboration between food companies and creation of more circular food systems, providing examples

Themes	Description and example
Cultural	Talks to the cultural values of a company and thus it's likelihood of investing in more collaborative and circular models (i.e., how much of a priority it is for the company)
Business and business finance	Business finance ties into the business structure and status thus whether investments into circular and collaborative models fits within that structure and budget.
Regulatory and governmental	The rules and regulations currently in place may prevent the implementation of more collaborative concepts e.g., concerns around food safety and thus specification standards.
Technological	Utilisation of technologies that are proven to create more collaborative and efficient processes however many factors can prevent this from occurring e.g., high capital investment, knowledge to optimise the equipment.
Supply-chain management	How management throughout the supply chain values circular and collaborative efforts and therefore their ability to adopt and integrate systems e.g., lack of eco-literacy and therefore understanding or mistrust between two organisations
Knowledge and skills	Relates to the individual within that business, their understanding of the task and how the shift towards collaborative or more circular models may benefit them and the task at hand. A barrier of this would be the lack of knowledge and skill to do so and therefore a lack of awareness

(Ada et al., 2021)

2.6 Food loss and waste in the Aotearoa horticultural sector

2.6.1 Overview of New Zealand horticultural industry regarding food loss and waste

FLW occurs across the whole FSC however, physical audits have only been carried out for some stages and industries, therefore the exact volume of FLW is unknown. According to Love

Food, Hate Waste (2019), the agricultural and horticultural sector only have self-reported data from Bioresource Processing Alliance (a government funded research and innovation co-funding organisation) which recorded 350,000 tonnes of waste, either going to landfill or to low value applications. Factors such as grading, rapid degradation and storage all lead to an increased chance that produce will be lost. However, these factors tend to occur at the beginning of the supply chain and is the reason why there is higher volumes of waste at this stage rather than at the manufacturer or retailer level.

2.6.2 Horticulture future risks and opportunities

According to the Ministry of Primary Industries Situation and Outlook for Primary Industries (SOPI), there is a forecasted 5% increase in New Zealand's horticulture export revenue in the year June 2022 (MPI SOPI NZ, 2022). In conjunction with increase, it has been found that specifications set by retailers and export markets for fruit grades are increasing. Consumers are also expecting higher quality fruit and therefore less fruits can be sold in the higher value brackets (Understanding Fruit Loss in Central Otago, 2021). To achieve larger volumes of better-quality fruit, strategies such as improved orchard management and labour quality have been adopted, however this has been done alongside increasing crop sizes, which can result in more potential fruit waste.

Another consideration of increased crop sizes was the occurrence of uncontrollable events such as poor weather, where larger crops will inherently create more waste than smaller ones, which leads to greater financial risk for many orchards. For example, a single weather event for cherries or frost when apricot trees are flowering can have significant damage on the entire crop yield (Understanding Fruit Loss, in Central Otago 2021). This leaves growers with a monetary forecast that could be entirely inaccurate, therefore diversification of revenue thus risk streams through finding solutions to wasted product could save orchards for years to come, allowing them to continue investing into their business and utilise their resources.

2.7 Central Otago research project

2.7.1 Summary of Understanding Central Otago Fruit Loss report

In 2021, the Central Otago District Council (CODC) commissioned a report with Thrive Consulting, to quantify fruit loss across 15 growers across the Central Otago region (including packhouse operators). Participants managed 65% of planted fruit growing hectares in the region which allowed for extrapolation to give total region estimates. Fruits investigated included apples, cherries, peaches, nectarines, and apricots. It was found that 4.2% of the total crop was harvested, but never sold (Huffadine, 2021). The portion of fruit that remained on orchard (i.e., that is not harvested) was often due to costs, whereby the return that fruit would bring would not break even to paying workers to pick and pack the fruit. Contributing to this was the lack of labour due to covid-19, where prioritisation to obtain the best fruit with less workers was essential for business survival.

2.7.2 Harvest seasons

The Quantification of Fruit Loss report (2021) also provided insight into the seasonality of the fruits with cherries being harvested from mid-December to early February, apricots from January to March, peaches, and nectarines from mid-January to March and apples from late February to May, thereby, highlighting that the busiest harvesting time was from mid-December to May. This information is useful when determining when cool stores will be in available outside of harvesting seasons, creating the potential for increased equipment utilisation through collaboration.

2.7.3 Produce streams

Secondly, the Quantification of Fruit Loss report (2021) provided insight into the various grades and thus purpose of the fruits in relative percentages for each fruit type. In Central Otago, the top-grade fruits are exported, followed by domestic sales, processing grade and then fruit loss (Table 3).

Table 3. Distribution of fruits in percentage (%) of total harvested crop into 4 product streams*

Fruit	Export	Local	Process	Loss
Apples	84	1	15	1
Cherries	71	15	5	9
Apricots	44	32	21	3
Peaches and Nectarines	15	73	0	12

* Huffadine 2021

From table 3 above, key results relating to this literature review include the process grade and loss of the 5 respective fruits above. There is a relationship whereby higher percentage of process grade fruit results in a lower loss percentage, suggesting that fruits that have a processing market will result in better crop utilisation compared to those who don't. For example, 15% of apple crop is processed while only 1% is lost whereas 0% of peaches and nectarines are processed, resulting in a 12% crop loss.

2.7.4 Barriers and opportunities

The Quantification of Fruit Loss report (2021) investigated the fruit loss at the growers and packhouse level, alongside any barriers and opportunities seen within that. A key barrier included the reiteration that many growers believed since their primary business is to grow good quality fruit for domestic sale and export, waste should not occur and thus be relevant to business. This often led to growers not seeing the relevance of seeking out opportunities for their process grade and waste product, rather the creation of inventions such as waste pits. However, as an enabler, there were still some growers not processing that were open to the idea but did not want to lead or process it themselves as they were concerned it would take

away from the primary business (growing fruit for export). Processing options known to growers included juicing, drying, pulp and nutraceuticals.

2.8 Research methodologies

The aim of this research was to understand the opportunities for Central Otago fruit processors to help reduce the regional fruit loss and waste. To achieve this, an in-depth discovery of key factors impacting on their current and future utilisation of regional resources and the opportunities they believed exist to decrease fruit loss and waste needed to be achieved. In addition, interviewees were asked about the type of equipment and storage they use, whether it is utilised year-round and where possible, if they would be willing to share it through determining the visible opportunities and barriers within seeking collaborative innovation to add value to FLW. To achieve this, a qualitative research approach was taken to provide the researcher with the opportunity to ask and thus understand the “why” and “how” of various opportunities and barriers experienced by the participants (Gills et al., 2008).

2.8.1 Qualitative research approaches

Qualitative research is commonly conducted via interviews which can take one of three forms; structured, semi-structured or unstructured (Gills et al., 2008). Semi-structured interviews involve the interviewer referring to a set of questions known as an interview guide. Advantages mentioned in literature (Blee & Taylor, 2002) include how the questions can remain flexible, allowing for adaption to better suited questions as the interview progresses. In contrast, something like a structured interview is more like a questionnaire where the participant must tick all the boxes as they go. Structured questionnaires can also hinder the quality of information you get as participants commonly want to work through it quickly with limited time and patience. Lastly unstructured interviews are performed with little to no organisation and progress from an initial question response. They are usually very time consuming and can be difficult to manage with the lack of guidance (Gills et al., 2008).

The study by Cantor et al., (2009) interviewed 21 participants using a semi-structured approach, with interviews lasting between 30-60 minutes to understand the issues pertaining to smaller scale farms, organic farms and / or organic marketing through talking to key informants, who were selected by their expertise in the given areas. The study was able to achieve in-depth information about the organic sector, marketing challenges and then recommendations to address the given challenges, whereby the semi-structured interview guide allowed for the flexible progression of questioning.

Another qualitative data collection approach was the use of focus groups whereby a guided group discussion is carried out and recorded with a select group of participants and a facilitator (Gills et al., 2008). The advantage of focus groups is to gain understandings of collective views and the meaning that may lie within them. However, it is important that groups are at an optimum size, where too large can be difficult to facilitate, and too small can lead to unsatisfactory discussion (Stewart and Shamdasani., 1990). The main disadvantage to focus

groups is the risk of creating swayed answers from stronger opinions within the discussion (Morgan et al., 1998).

2.8.2 Proposed research approach

Semi structured interviews were the chosen method of qualitative research as it was better suited when interviewing a variety of characters/ members/ experts, which was done in this research (e.g., fruit processors, wine, and spirit makers etc.). This allowed for better inclusion of a wider range of experiences and perspectives, adding in new thoughts/ concepts to consider. However, the risk of the added fixability was the added difficulty to make systematic comparisons against one another when analysing the results.

Lastly, another advantage was the interviewer's ability to scrutinise the semantic context of statements. This therefore allows them to know what the participant means so they can justify where they are coming from, rather misinterpret statements, taking them out of context. This ultimately created more accurate information.

Chapter 3

Methods

3.1 Introduction

This chapter presents the methods used to collect and analysis the data obtained in this thesis. Section 3.2 outlines the steps involved in the recruitment of participants. Section 3.3 discusses the methods used to collect the data. Section 3.4 explains how the thematic data analysis was carried out. Section 3.5 outlines the ethical considerations made during data collection and analysis. Section 3.6 summarises the methods section.

3.2 Participant Recruitment

Participants were selected by the CODC research project group based on if they had any connection to the research theme (i.e., actively trying to reduce fruit loss) or they were recommended by another study participants. Overall, 10 people were interviewed, each of whom held a significant role in decision-making within their organisation. Introductions were made by the CODC project lead, prior to sending out a recruitment email, introducing the researcher to the relevant staff member within each processing facility and formally inviting them to participant in the study. When a participant was recommended by another study participant introductions were made by the participant who suggested them via email or text message, followed by a phone call advising them what to expect, which was followed by a formal invitation via email.

3.3 Interviewing Process

Data was collected from participants using qualitative, semi-structured interviews following a semi-structured interview guide (Appendix 4). This approach enabled a degree of flexibility as the line of questioning depended on how the interview developed (e.g., the next question would follow the previous response). The line of questioning covered the participants company's general operation, the type of equipment they used, including its relevant physical parameters and its degree and times of use. Processors were also asked about their perceptions of FLW in the fruit industry and the barriers and opportunities to upcycling fruit that would otherwise be lost or wasted.

Prior to the interview, participants received an information sheet about the study (Appendix 2) and a consent form (Appendix 3), which they signed either on paper or electronically before the interview. Where possible, interviews were conducted on site, in person at an arranged date and time. On average the interviews took approximately 35 minutes, and they were either recorded and subsequently transcribed or notes were taken (with participant consent).

Recruitment began the week commencing (WC) 13th of June where the research project manager from the CODC sent preliminary emails to the fruit processors, asking them to confirm

their willingness to participate in the interview and informing them that Molly Goodisson, the researcher, would shortly be getting in contact with them. Participants were subsequently contacted by telephone and given a brief introduction to the project. Times for an interview were confirmed and a formal invitation to the study that contained the participant information and consent form was sent via email. Interviews were organised during the week of the 27th of June and the week of the 18th of July. The interviews were completed by 22nd of July 2022.

After the interview the were completed, they were transcribed, the interview notes were checked, and the transcribed interview notes were sent to the participant for checking prior to the commencement of data analysis on the week of the 22nd of August 2022. All participants agreed that they would be happy to be contacted after the interview if required, therefore when the transcribed interviews were returned an accompanying usually contained a couple of specific follow-up questions about data that appeared to be missing from the interview. These questions were most commonly to do with equipment parameters and storage capacity. Most reviewed transcripts and follow up questions were received back by the 26th of August.

3.4 Data Analysis

Thematic data analysis techniques were used to analyse the data set, i.e., the interview transcriptions. Thematic analysis includes identifying patterns and themes within a set of data, creating ideas of interest which can then be organised and interpreted in relation to the research question (Bryman, 2016).

The approach used for thematic analysis was based on the approach outlined in Social Research Methods by Bryman, (2016) and incorporated the following steps:

- Step 1. Familiarisation with data
- Step 2. Generating initial codes
- Step 3. Searching for themes
- Step 4. Reviewing themes
- Step 5. Defining and naming themes

Step 1, familiarisation with the data involved transcribing the recorded data and grammatically editing the note-taken data. The data was then sent back to the respective participant to be checked before being re-read/ familiarised with. Alongside the second reading, an initial categorisation step (step 2) was taken to allocate the data into key codes. This primary organisation enabled more effective data analysis when looking for common themes in each category/ code.

After completing step 2, a mind-map was created considering the key research question: “What are the factors influencing local fruit processors to utilise regional resources to reduce fruit loss and waste?” in the centre. Using the knowledge from the interviews, identification of key influencing factors to the research question (i.e., what is preventing the utilisation of regional resources?) was able to be done. The key factors were then further refined into distinct

categories (e.g., systematic issues and market related) which resulted in the themes use for thematic data analysis, completing step 3.

Associated with the main themes were subthemes (Table 4) which acted as barriers or enablers to the influencing factors, e.g., how processor operations (theme) are influenced by the seasons (subtheme) therefore determining the timeframe to complete processing, which in turn influences the utilisation of the processing equipment (resources) for that processor.

A summary of step 3 is shown in Figure 1

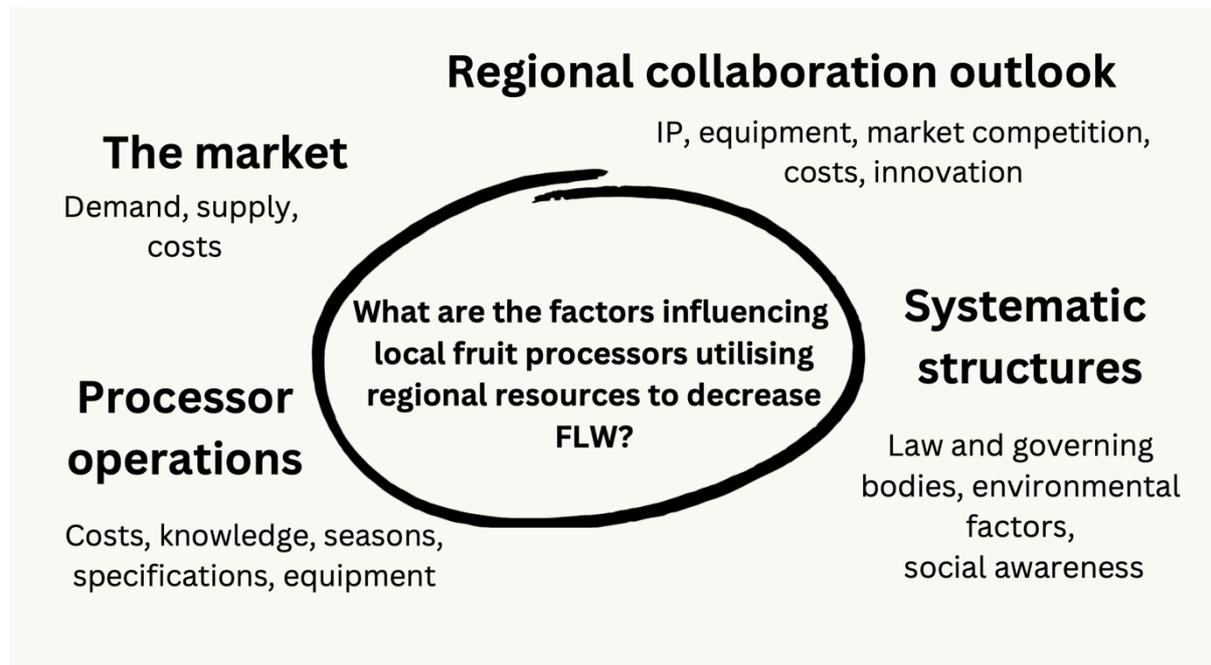


Figure 1. Schematic illustrating the third step (searching for themes) in the thematic analysis

Reviewing of themes (step 4) was completed through printing interview transcripts, highlighting statements, and labelling them under themes and subthemes. For example, a theme could be identified as ‘market related’ but was specifically related to market demand, therefore ‘demand’ was made as a subtheme. Theme reviews were made when relevant statements did not fit well into a theme, therefore required alternation e.g., adding a subtheme to allow the statement to fit into a certain theme. Step 5 was then completed when creating parent nodes (theme) and child nodes (subtheme) in NVivo, when a description was able to be formed from step 4.

To interpret the data, a middle ground approach was used for the qualitative data combining both deductive and inductive thematic analysis techniques. Deductive interpretation techniques use preconceived ideas and hypotheses, created through the researched literature. Whereas inductive approaches analyse the collected data therefore interpreting data using knowledge and trends from the interviews themselves (Bryman, 2016).

Quantitative data (e.g., equipment parameters and seasonal use) was collected and organised into a table, expressing capacities and availability at each location at certain times of the year (e.g., seasonal use).

Table 4. Summary of chosen parent and child nodes to aid the organisation of qualitative data from semi-structured interviews

Parent node	Child node	Description
Processor general operations influencing regional resource utilisation	Associated monetary cost	How utilisation, financial cost, knowledge required, seasons, timeframes, product nature, specifications and the equipment required can act as a barrier or enabler to a business and their processing operations being utilised to their full potential
	Nature and specifications	
	Equipment and storage utilisation	
	Effect of seasons and timing	
Systematic structures within Central Otago	Product and processing knowledge	How systematic structures such as regulation/ laws, seasons, location, processor and consumer awareness and operations pose an opportunity or barrier to fruit processors utilising regional resources to reduce fruit loss and waste
	Law and governing bodies	
	Environmental factors	
Regional collaboration outlook of processors	Social awareness of FLW impacts	How the likes of intellectual property, innovation, the market, equipment required or available and cost can act as a barrier or enabler to processors within the region to collaborate
	Intellectual Property	
	Equipment concerns	
	Costs	
	Market competition	
The influence of the market on regional resource utilisation	Innovative concepts	The current influential factors of the market and how it influences the justification to utilise regional resources more
	Market demand	
	Market supply	
	Market price	

3.5 Ethical Considerations

Ethical approval was granted by the University of Otago Human Ethics Committee (reference number and approval date). Each participant was required to indicate their consent by signing a provided consent form via email ahead of time. On this form, they were asked if they were willing to have the interview recorded. On the consent form, participants were also given the option regarding their anonymity. They were also informed that if they wish to discontinue their participation in the study, they have the right and it is of no disadvantage to them. Only once written and verbal consent was granted did the interview commence.

As per the ethical considerations, a unanimous decision was made to code all participants in the study to ensure that those who wished to remain anonymous, could remain so. A summary of the participants location, brief processing description and the code referred to in the txt is provided in Table 5.

Table 5. Participant location, associated code, and a brief description of their main business interests

Processor location	Code	Description
Teviot Valley	A	Grower who supplies fruit to processors
Cromwell	B	Grower primary business, processing secondary (brewing)
Teviot Valley	C	Growers and processors (juice)
Cromwell	D	Juicing
Alexandra	E	Grower and processor (dehydration)
Cromwell	F	Brewing
Teviot Valley	G	Grower primary business, processors secondary (concentration)
Teviot Valley	H	Grower and processor (brewing/distilling)
Alexandra	I	Processor (juicing)
Alexandra	J	Cool storage

Chapter 4

Results

4.1 Overall themes of qualitative results

From thematic analysis, four themes were identified as key influential factors contributing to fruit processors of Central Otago utilising the regional resources to reduce FLW: (1) factors of processor general operations influencing resource utilisation (2) influencing systematic structures within Central Otago (3) regional collaboration outlook of processors and (4) the influence of the market on resource utilisation.

Under each theme were subthemes which contributed various barriers and enablers to the utilisation of regional resources by processors to reduce fruit loss and waste. The subthemes also offered considerations to the respective theme made by the interviewee, which was noted when discussing the recommendations for potential solutions to the barriers for the respective themes.

The following five sections illustrate the themes and subthemes, defining their relevance to the research question (what are the factors influencing local fruit processors utilising regional resources to decrease FLW?), supported by quotes given by the interviewees, evidently showing the various factors influencing their utilisation of regional resources to reduce FLW.

4.2 Theme 1: Factors within processor general operation influencing their regional resource utilisation

Theme one covers the key aspects of the participant's general processing operations, and the barriers and opportunities they face within them when aiming to increase the utilisation of both their own and other's resources. Processor operations was broken down into 6 key subthemes, which each expressed their own barriers and enablers: associated monetary costs, nature and specifications of the product, equipment and storage utilisation, effect of seasons and timing, and the product and processing knowledge.

4.2.1 Associated monetary costs within general operation influencing resource utilisation abilities

The most mentioned barrier in interviews was the effect cost of general operations had on processors, and how operationally, processors found that increased utilisation of resources (equipment, fruit, staff) was commonly unattainable due to being too expensive. Economic viability of operations is a non-negotiable when running a sustainable business. With uncontrollable factors such as weather events affecting crop yield and COVID-19 affecting labour, fruit growers and processors in Central Otago have never been tighter on money.

Unavoidable operational practices such as leaving more than the desired amount of fruit on trees has become increasingly common throughout the region due to growers being unable to pay someone to pick and pack it.

“Labour constraints from running.... our biggest cost is labour rather than energy” (Participant D)

Alongside cost of labour is cost to run machinery....

“Due to the power cost of the dehydrator, there is a certain level [of fruit] you want to get before you start running consistently. You don’t want to run out and stop. We use our own and other people’s [fruit] and will not stop till last bit of fruit is done. There is a very large energy cost” (Participant E)

Which in turn influences how operations can be run. In the instance above, an enabler can also be observed where the processor has structured their operations to be as energy efficient as possible, not only lowering their operational costs but their environmental impact.

Another observed financial constraint is the effect seasonality and thus the timeframes of which processors are operating within. It was found that with the short harvest seasons and concentrated work within those timeframes, processors and growers find it difficult to invest further into their business when it’s only operating for a matter of weeks.

“Expansion? For what? 6 weeks? Is that worth the while? What is the justification?” (Participant I)

Alongside the seasonality barrier, it has also become clear that each processor is on their own journey when working towards more sustainable operations. Some are finding that investing into new projects is not a feasible task at present, therefore are focusing on processing what they can sell and building capital.

“Shipping, market and staff challenges, we are not in the time to enter new projects. Need to stick to core business.” (Participant G)

However, not all processors are in this position and can make investment into their future.

“We are currently investing more time, and finance into expanding our sales which could significantly increase our production.” (Participant C)

Processors such as the one above was in a position where they were ready to make further investments into their processing side of the business, putting both time and money into developing sales to create the demand at the other end, whilst investing into the operational side where they could then make more product.

A secondary enabler is the positive observed impact growers are finding with the evidently increase in utilisation of process grade fruit.

“With our general business model, we only started becoming reliably profitable when we found a market for our waste product. Before then, we were just dumping it, trying to be commercial on 2/3 of a crop. But that’s how it’s been for cherry growers for years. Since then, juicers have come in and got big enough to do volume, it certainly changed summer fruit business completely” (Participant A)

The effect of this has resulted in a positive incentive to process surplus fruit, both from an economic and environmental standpoint.

4.2.2 Nature and specifications of the product

Specifications of fruit for both processing and wholesale is a fundamental part of operations that needs to be obeyed to keep quality standards of product. However, strictness of specifications has led to ‘imperfect’ fruit, that has been invested equally as perfect fruit, being thrown out, offering no return.

“Waste produce still separated from process fruit as a grade. It still needs to meet a standard” (Participant E)

“But we’re busy throwing out a whole bunch of fruit that’s got a puncture on it, or a mark on the side or the colour isn’t quite right or the shapes not ideal. It’s all had the same amount of investment and work and effort.” (Participant C)

It is agreeable that a standard still needs to be met to sell a product, ensure food safety, and maintain quality. However, it can also lead to FLW and loss of potential income, making processors and growers less reliably profitable when there is no alternative valorisation for fruit that doesn’t meet the required specifications. The quote below demonstrates how a grower found a way to valorise their waste product and the impact that then had on business.

“With our general business model, we only started becoming reliably profitable when we found a market for our waste product” (Participant A)

As an enabler, there are processors within the region whereby the nature of their processing allows the specifications required for the product to be less specific, giving them more flexibility to the fruit quality they can use.

“I argue the point that it’s at least process grade, if not local grade that we are dealing with. And that’s not through preference of, the product I need to deal with, it definitely does not matter to me. As long as it’s not riddled with rot and mould and that sort of stuff, it looks after itself in that regard” (Participant H)

Examples such as above, where the processor is fermenting fruit to create ethanol before distilling it, show signs of opportunity for fruit growing and processing whereby various fruit qualities can be distributed by specifications required, maximising utilisation of process fruit in the region.

4.2.3 Equipment and storage utilisation abilities of the processor and/or grower

The equipment and storage itself can also act as a barrier via capacity constraints and efficiency, ultimately determining the relative utilisation of contributing resources (e.g., how much fruit can be processed). The examples below show how for some processors, steps in the process act as bottle necks to their production capacity.

“5000L a day – vat is that big and is the limiting factor of the production run.” (Participant D)

“We can easily produce a lot more fresh, untreated juice but we are limited to our ability to secondary process, pasteurise, pack and stabilise the juice, So my pasteurising rate limits how much I produce in a week. We might press for one day, but it’ll take me 2 days to process that juice.”(Participant C)

Often simultaneous to this, processors will be working on other sides of business (e.g. processing and growing at the same time) therefore don’t want to become any busier than they already are. However, it is positive to recognise that as an enabler, many processors and growers are acknowledging they don’t utilise their equipment as much as they could and would like to see it put to further use.

“Current machinery can do more – it’s at 60% capacity now.” (Participant I)

Many are already sharing their equipment and storage across the region when it is normally switched off and left unused.

“Yep, so we have plenty of storage here, which is currently full of another growers’ apples at the moment, so we have plenty of storage” (Participant A)

Openness towards further utilising equipment can be seen in section 4.1.3; Regional collaboration outlook, where examples of current collaboration in order to utilise equipment and storage more can be found.

4.2.4 Effect of seasons and timing on resource utilisation abilities

A major consideration in general operations is the movement of seasons and how it determines the timing windows of processing. Harvesting stone fruit is an intensive process from December through to February, processing high volumes which creates the stock required for

the following year. This gives little room for development or spending time on secondary processes which may take away from the primary business focus during the harvesting months.

“Everything is made in about 6 weeks for the entire year – stock for the year Cherries only fresh for those 6 weeks” (Participant I)

“In summer time I am busy with the cherries and I don’t have time for the cider” (Participant B)

However, as an enabler, this isn’t the situation for everyone. The apple season stretched from March-July, where growers who processes and processors have created more work for seasonal workers during that period (i.e., work outside of the December – February harvest seasons), creating more reliable jobs and community.

“It’s generally a wintertime activity, we only press apples once we have finished our export harvest and export packing, which we are just at the end of now (28/06). So, our winter apple pressing is a wintertime job between June/July – September/October.” (Participant B)

“They start processing in March and went through to December. They work 12 hours a day, 4 days a week....Hoping to stop in October so they can clean up and then start cherries from middle December – end of February” (Participant G)

This acts as an enabler as through processing during the winter (i.e., a different time from harvest season), processors and growers can spread work over a range of time, distributing resources more evenly whilst also diversifying the available revenue streams (e.g., exporting apples and cherries alongside processing the lower grade fruit). Many businesses can also store fresh product for a couple of weeks and processing later when it is quieter, stocking up for the year ahead.

4.2.5 The influence of product and processing knowledge on resource utilisation abilities

In some cases, the knowledge required for operations can be very specific or there is a lack of knowledge required to create a process. For example, dehydrating fruit requires specific parameters that can fluctuate depending on the fruits size and relative moisture content. Being able to recognise this and adapt the parameters accordingly requires years of skill and knowledge.

“You need to have an understanding of raw fruit going in which is a limitation for others starting up and training labour. The guy who did own is still around and helps from time to time. For example very small apricots aren’t used as they tend to overcook” (Participant E)

In the same process, to then move onto another fruit requires more years of adapting, learning and trialling product before having something that can be taken to market.

“Moving into cherries we are going to have to learn everything; is it off the tree, grade out, process type product, settings; these are yet to be determined.” (Participant E)

The same concept can be applied to developing any product, especially when collaboration between processors where new/ different equipment, fruit types and specifications may be different. However, as an enabler, the existing understanding of a product can be made and therefore whether it is a viable option is highly valuable. An example can be seen in the quote below:

“No, we could make Apple Cider Vinegar, you would just have to be careful you don't get your bugs mixed up with your beer production and stuff and keeping the place clean. I don't know a lot about making it and how long it takes, I suspect there's quite an aging process involved but that is certainly something I haven't thought of and there is probably no reason why we couldn't, it's basically fermentations of one sort or another” (Participant F)

Information such as above is plentiful in the community, therefore can guide potential product developments with limited money and time wasted.

4.3 Theme 2: Influencing systematic structures within Central Otago

The systematic structures within Central Otago provide processors and growers structures of which their business must work with. The key influencing systems are law and governing bodies, environmental factors, and social awareness of FLW. Within each of the key system comes both barriers and enablers to the increased utilisation of regional resources.

4.3.1 The influence of law and governing bodies on processors and growers

Governing bodies such as the Central Otago District Council (CODC) have created facilities and rules of which fruit growers and processors must systematically structure their business to work within. An example that came up was the local green waste transfer station that was frequently used amongst processors and how with the recent changes to this system have sent growers and processors struggling for alternate options.

“We got asked to stop doing that [disposing waste product at the green waste transfer station] ... We need a home for waste because there isn't anywhere for it and it is a lot of it. Growers give it to manufacturers but manufactures now have the problem” (Participant I)

However, this has enabled innovative concepts such as developing personal worm farms.

“Our site manager is developing worm farm just across the road for the apple pomace” (Participant G)

Secondary to this, there has been observed mistrust between governing bodies, growers and processors, which in turn leads to the unwillingness to collaborate across the region due to the CODC involvement.

“I know of another couple of processors that are not willing to interact with this program because they have had some measures put against them in recent time, in relation to what is happening with their waste product and it’s got to do with, you know, council is just following their rules but it’s not being very pragmatic” (Participant H)

Despite the concern within the region, there are still processors that commend the merit of the Council and the people within it that are trying to create positive change.

“There is a lot of people in council that are trying to do some good things and trying to do some greater good stuff that’s happening, and the likes of this project is a really great example.”(Participant H)

It is not unusual for conflict between governing bodies, who enforce laws and try find compromise among a wide range of individuals, and those in the community to occur. However it is promising that many processors and growers can see both sides of the story, acting as an enabler for the potential opportunity to collaborate with others in the region.

4.3.2 Environmental factors influencing operations thus resource utilisation abilities

Central Otago horticulture requires consideration to multiple environmental factors from a systematic standpoint. An example are the seasonal systems and how operational events are centred around times of year.

“We never have an end of a season because we are always halfway through the next season and we are always in the next 5 year cycle, planning for the next 10 year cycle. There is no end, no beginning, it’s constant.” (Participant C)

Which in turn can act as a barrier when wanting to collaborate with those who do not work within the same seasonal system.

“I would think that the space will be utilised all year round unless of course you can process all your fruit in 3 months, turn it off, to be perfectly frank then, if it were a commercial operation, you would be paying for the space for the whole year because you would want it back again as soon as the fruit season is back again.” (Participant J)

And also when wanting to collaborate with those within the same system...

“The issue will be later, if you haven’t delt with the product in a reasonable time frame before march, the apples come on and all of a sudden all the cool store space within the region is gobbled up with apples.” (Participant H)

The logistics of working both inside and outside the seasonal timings can be problematic for both growers, processors, and those not in the horticultural industry. Demand is often simultaneous, and businesses want to ensure they are steadily utilised throughout the year, which is often not the case for fruit growing.

However, at the same time, many growers who are also processing have managed to organise their processing with various stages of the season to create more consistent work throughout the year.

“It’s complementary seasonal work for some of our staff that we employ during the rest of the year on our orchard and in packhouse. That’s one of the reasons that we value this work in that part of our business. Because we have a high seasonal work need during summer and autumn with our other orchard activities so therefore, we need more work in wintertime. That’s why I would like to expand our processing side to help even out work for our key staff.” (Participant C)

Not only does this systematic structure enable the utilisation of process grade fruit and utilise resources, but it also empowers the staff creating a positive working environment as they are given the chance to stay and thus create community.

Secondary to the seasonal timings, the geographical location of Central Otago comes with a variety of barriers and enablers such as distance to market and thus freight.

“A big challenge is also the geography; many processing places are up north so if they wanted to use some pulp, rather than just driving it, you have to send it at quite a hefty cost. Freight in NZ is almost too expensive to use as an ingredient.” (Participant I)

“And also distance to market, if we are remote we need higher value products that are low volume to dilute the freight cost” (Participant C)

Central Otago is a relatively remote region and the freight cost has been felt amongst many growers and processors regionally. However in the same breath, many have identified the power of the local market and communicating these concepts to the local consumers.

“Small brewers really have to focus on selling to their local market and local people need to start to understand that that’s a better thing to be doing is not buying something that has been shipped the length of the country or from overseas but the balance is, the stuff that’s imported is usually made in a large brewery somewhere which the cost to produce would be 25% of small brewers costs.” (Participant F)

4.3.3 Social awareness of FLW impacts and therefore priority in business

This flows nicely into the next theme of awareness and the understanding processors and growers have on FLW and resource efficiency within the region and thus the level of priority it may have in the business. A common indicator to this was many growers who are processing their own process grade fruit expressed the importance for their primary business of fruit export of fruit to remain primary, rather than developing their processing line.

“Processing is to remove waste. The main focus isn’t profit, but we need to break-even. The core business is growing and packing...we aren’t looking to develop it [processing] at the moment” (Participant G)

Therefore, the motivation to develop this side, as mentioned above, isn’t something many are wanting to do. However, at the same time, many have recognised the importance of resource utilisation and waste minimisation and how it impacts not only the health of their business but their business purpose.

“The whole business was created to reuse the waste and therefore they don’t want to waste flesh [a by-product]. This in turn relates to the business mantra and thus ethos.”(Participant I)

“We have to be economically viable to pay for the other things. We have to be sustainable from a resource point of view to be responsible and to keep doing it and if we don’t look after our people than it doesn’t happen. It’s not triple, it’s really only one. That’s how I see it, like big circle with 3 layers maybe.” (Participant C)

Alongside this, throughout the Central Otago region, there are a lot of smaller players making craft, artisan products on a small scale. However with this, there are resource utilisation concerns.

“That’s NZ small scale stuff...there is a huge amount of small scale stuff going on and my comment from small scale craft all those things are extremely wasteful of resource, equipment and power they are not big enough to incorporate a lot of the waste stream management stuff.” (Participant F)

Small scale, crafty and artisan products have a time and place. However the wide-spread abundance of privately owned small processors, there is a lot of underutilised and similar equipment within the region. The following section 4.1.3 of regional collaboration illustrates the potential for increasing the equipment utilisation via regional collaboration.

4.4 Theme 3: Regional collaboration outlook of processors

Part of the line of questioning in the semi-structured interview guide was understanding the level of willingness processors had to collaborate with each other. For several reasons, processors were both willing and unwilling to collaborate due to 5 key factors: intellectual property, equipment concerns, cost, market competition and creating innovative concepts.

4.4.1 Intellectual property (IP)

Sharing intellectual property is a concern for many processors and growers in the region, especially if they have invested a lot of time and money into establishing it.

“I have been talking to Massey and Auckland to get this [the product] researched but it’s expensive. This then makes you not want to share this information” (Participant I)

Protecting intellectual property is completely within the processors right however creates a significant barrier when collaborating. Although, some have established communities where they are happy to openly communicate with one another, creating an empowering and creative space.

“I have a group of people where we are all open communicators (to each other), I think with a lot of the bigger farms around Cromwell, there is a lot less sharing of information in the Cromwell basin than there is in Alexandra and Roxburgh. A lot more commercial sensitivity around it. But certainly, from my mindset, we are pretty open and I share a lot with the people I share with.” (Participant A)

This acts as an enabler whereby identifying these communities, finding out what works well and how they are able to be open communicators could help establish more communities that feel comfortable doing so.

4.4.2 Equipment safety and integrity concerns

Alongside IP, protection of equipment in terms of safety and equipment integrity (i.e., not being broken) was mentioned several times, especially when the equipment line required significant time and money invested to establish.

“Case by case, individual programs, ensure that the equipment stays safe” (Participant I)

Again, this is completely within the processors right to express concern and processors should not be putting their assets at risk whilst sharing their equipment and with others. A mentioned enabler to this barrier was the discussion of contracting out equipment, so the owners of the equipment still remain the ones that operate it, however are creating product for someone else.

“I contract out my services to distil their gin. And the same could be done with you name it, any other product that we are planning on developing into the future for sure. Always open to opportunities.” (Participant H)

Many processors are already doing it or are at least open to the idea of contacting, some even prefer it to producing their own products.

“For us its easy, its volume we want, we don’t have to worry about the sales, we aren’t set up to manage the sales particular well so that’s quite handy for us, so contract brewing is quite good for us.” (Participant F)

“At the end of the day, anything that adds value to my business is going to add to someone else’s business, whatever, for sure interested in working out of contract basis or another entity to create products” (Participant H)

4.4.3 Costs associated with sharing equipment and storage

A common concern with regional collaborations that processors have is the cost and thus economic feasibility of the project. This has led to the possible barrier of apprehensiveness and therefore the desire to keep processing within the business.

“We think the key to financial sustainability is to undertake any further processing/development ourselves – outside parties will look to take all the margins for the process.”(Participant E)

Processors and growers need to be making a margin, which does ultimately act as a barrier to regional collaboration. The quote below from another processor however has a similar frame of mind, where they would be willing to collaborate if economically feasible and not distracting.

“Yep, I don’t mind. It’s got to be economically viable and not detract from our business but apart from that no I’m not opposed.” (Participant C)

This acts as enabler as through careful planning and consultation, agreements can be made and purposeful, sustainable collaboration can happen. Processors should feel like their business will remain sustainable, if not benefit throughout the process.

4.4.4 Concern of increasing market competition through collaboration

With the abundance of small players in Central Otago, processors often find themselves competing for the same market. This creates a barrier towards processors collaborating, as they fear they are creating more competition in their own market.

“Probably not [collaborate in] joint ventures. Helping others and building their brand will knock you out” (Participant D)

“What they will using and what market? We are interested as long as they are not competing in the same market” (Participant E)

Market competition is the case for processors and growers who are within the same market and not everyone will be willing to come together and collaborate. However, as an enabler, some

participants are completely removed from one another and therefore do not have any market competition. For example, below is a quote from a cool storage company:

“Normally it’s in and out which is why we have excess chilled space...could be a good fit for everybody [storage facility availability]” (Participant J)

Working with those who have no direct market competition with fruit growers and processors could be a viable option when aiming to avoid further saturating the market. Another enabler towards creating collaborative opportunities between local processors and growers are those who see the benefit of collaboration and thus promote it.

“It’s interesting, the export cherry market, we are only a small player on the world stage, and even though there is a little bit of competition there between growers, there’s a lot of room to work together as well.” (Participant A)

It is these individuals that can act as enablers towards their growing/ processing spheres, encouraging them to take part and create collaborative efforts within the region.

4.4.5 Innovative concepts currently existing in Central Otago

Innovative concepts subtheme does not contain many barriers, more so enablers and current call to actions of processors and growers in the Central Otago region to create more innovative opportunities, such as the example below.

“Where is the Research and Development, where is the inspirations? Where’s Otago University and the Polytechnic sitting? Where is our science and innovation that can work on finding essential oils or finding key ingredients from what we grow that might have medical benefits? Why isn’t that happening? Do we need more partnership between research providers, funders and fruit industry for example?”(Participant C)

In the quote above, the sense of frustration and desire to be innovative fuels the processor, motivating them. The questions asked are also valid; why aren’t there more collaborative efforts with research institutes? Collaboration does not have to be limited to the region, it could go beyond and then feed back into the region, such as this project, where the University of Otago is collaborating with the council, creating public knowledge benefiting the greater good. Innovative concepts stretch beyond this, many out there are embarking on their own innovative journey to create some new, never seen before products making the space an exciting one.

Below is an examples of an already existing innovative concept being used to utilise more surplus fruit within a growing and processing business as well as creating some positive social impact within the region.

“[I asked] do you ever get cherries at the mission? And he said ‘don’t be stupid, we can’t afford that. So we took him pack to the shop, got a few boxes and pushed the boat out a bit

further. I just got an email from them last night actually, because this year we want to get 2 homeless people and give them a job in the orchard and hopefully if that works I might split the managers, fly them down here, give them some food and clothes and house them and they might get a job in another orchard, winery, picking grapes” (Participant B)

This processor is wearing the cost of freight to get the cherries up to Auckland themselves, however the innovation poses the question of whether Central Otago could be creating connections outside of the region to give surplus fruit a home that also creates some social good to those in the community.

4.5 Theme 4: The influence of the market on regional resource utilisation

The market demand, supply, and associated costs have had significant influence on the relative resource utilisation of fruit growers and processors throughout the region. Common barriers such as being able to sell product or fierce market competition has strongly discouraged further utilisation.

4.5.1 Influence of market demand on increasing resource utilisation

In respect to market, a key barrier has been the lack of market demand and therefore inability to sell processed fruit products. Frequently, the research has not been done and therefore there is no reason to increase production volumes or to create a new product.

“We should grow demand ahead of supply, so that way when you have a product, you are going into somewhere that you’ve already created the demand for it. Everything should be created with the customer in mind.” (Participant C)

The first quote above illustrates the need for demand and how without it, you cannot you’re your product. However, below is an example of where demand has been created, the market had been established and the processor is able to sell their product.

“The guy who has done the market research and therefore she processes his product for him It’s taken him 6 years to get to that point...They had done all the research. So, they stick basics – stuff they can sell, cherry concentrate and puree” (Participant G)

It has been stressed in many interviews the importance of ensuring market demand before investing in a product. By having discussions with those who have done it and dedicating the time and money into researching it, the barrier was overcome.

4.5.2 The influence of market supply on increasing resource utilisation

Consistent market supply is almost unheard of in the Central Otago horticulture due to the nature of seasons.

“Yeah, there is definite supply issues because we have 3 weeks of the year when that stuff growing on trees and getting harvested, and once that window’s gone, that’s that over so you need to deal with thunderingly large volumes in very short period of time.” (Participant H)

And supply is also important when wanting to create a product...

“You need to guarantee a supply of fruit to put through and a market” (Participant E)

While there is existing inconsistent supply of many stone fruit and stone fruit products throughout the year, there is abundance of supply during the harvesting periods.

“We are constantly being asked by other growers to take additional processing grade fruit – they work with 10 of the largest orchards in Central Otago at the moment” (Participant I)

While there is an abundance during the periods, some processors manage this intense 3 week period, creating product that is in a stable form and can use utilised throughout the year.

“We’ve got plenty of cider at the moment and got plenty of access to apples” (Participant B)

The need to deal with large volumes of fresh product in a time efficient manner is vital to the yield of final product. More in depth discussions with those who are able to do this (e.g., certain processors or food scientists) would be a great enabler when aiming to utilise more fresh product.

2.5.3 The influence of market price on resource utilisation

Preservation of market price has come up as one of the main factors influencing fruit loss and waste. Growers, in some instances, would prefer to not attempt to sell fresh produce in order to preserve the market price, as it makes more economic sense to do so.

“Because of our local market issues, that’s to say there is over supply of cherries in the local market scene, and in order to perverse the prices within the industry, its better for growers at this point to throw it into a bin where it’s going to the tip, than to tank the market locally because it’s very easy to do.” (Participant H)

This is an understandable point, they need to make a margin and if the best way of doing this is selling less for more, then that is the reality. However, options as to what could be done with this surplus fruit that oversupplies the market has also been mentioned.

“Company A takes a lot of our waste product and they would dry it and turn it into pickles; they would take a lot of people’s waste product and they could store it out there a little bit and they would take a lot of growers waste product. They do a good job; they pay for the freight and pay a reasonable price for the product” (Participant A)

This seems to work well with growers as not only is their surplus product being dealt with, they are also getting a price to help cover the costs to produce that fruit, making it a sustainable option. Alongside the company mentioned above, it is important to note that much of this fruit also goes to local processors, however through aiming to maintain market value, there is more waste generated than usual therefore not all of the fruit can be utilised by local processors. Below is an example of a processor, who is currently not paying for their process fruit due to the vast amounts of surplus fruit available in the region. The processor has the goal to give some return to the grower in the future however, making it more sustainable for everyone.

“Don’t get me wrong, the vision is to be paying for those cherries, to add value as, from a growers point of view is trying to, its more cost redemption for growers. If I can offer them the price it costs for them to pick it, that to me is the ultimate end goal here.” (Participant H)

Another market price barrier is the cost to get products to market. Many smaller players are struggling to infiltrate the market and therefore cannot sell their product.

“The biggest barrier to what we are doing is access to market and that side of things. That’s probably as expensive, if not more expensive than the initial outlay for the whole thing.” (Participant H)

Gathering enough resources to commercialise, get a product to market and then sell it is fundamental for a functioning business.

4.6 Summary of qualitative results

The table below summarises the key barriers and enablers revealed for each theme in the interviews. These barriers and enablers were the most influential factors when discussing the utilisation of regional resources to decrease FLW.

Table 6. Summary of qualitative result themes attained from semi-structured interviews

Theme names	Key barriers	Key enablers
Factors of processor general operations influencing regional resource utilisation	<ul style="list-style-type: none"> • Cost of operations (labour being most influential, energy second) • Justification behind further investing into operations for short but intense harvesting seasons • Specification standards leading to wastage, even for processors • Equipment is underutilised however many cannot utilise it more due to costs to run, changes in business model 	<ul style="list-style-type: none"> • Growers who are processing their process grade fruit are starting to see a better return • Existing investments which have led to more efficient and sustainable operations • Processors existing that do not require as strict specifications as others • Recognition of underutilisation but desire to share/ use more
Influencing systematic structures within Central Otago	<ul style="list-style-type: none"> • Mistrust with governing bodies • Location of Central Otago being remote and expensive to transport to/from • Community awareness of FLW often means that it isn't always a priority 	<ul style="list-style-type: none"> • Positive outcomes from changes the council have created • Ability to shape the target market and product made with location in mind • Those who are aware of FLW issue have made it a priority in their business model
Regional collaboration outlook of processors	<ul style="list-style-type: none"> • Hesitation due to wanting to protect IP and equipment safety • Creating additional market competition 	<ul style="list-style-type: none"> • Options around contracting our services and equipment to keep those who own the equipment, operating it • Deliberate collaboration with those who do not compete in the same market • Innovative concepts are already forming and succeeding in the region

<p>The influence of the market on resource utilisation</p>	<ul style="list-style-type: none"> • Concern with development of market demand or non-existent market demand • Inconsistent supply with large and short harvest seasons • Strategically preserving local market price through manually decreasing supply through throwing it out 	<ul style="list-style-type: none"> • Some processors have successfully found markets that they are reliably supplying to • Solutions around product preservation to create a shelf stable supply for the year • Finding alternative options for the waste product so market price and be preserved but fruit is not wasted
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As a generalisation of the status of equipment and storage utilisation in Central Otago, much it is knowingly underutilised. Cost of production is increasingly expensive, with the cost of labour posing one of the largest barriers, resulting in many businesses being understaffed. Systematically, the seasons of growing fruit pose both a barrier and enabler on how operations are created, however one of the largest felt barriers across processors and growers is the role of regulations and governing bodies, and how lack of resources in the region has resulted in problematic outcomes. Regional collaboration a concern for many with protection over intellectual property and equipment safety acting as barriers to achieving this. However, in the same breath, many are already collaborating and have found communities of which they freely share information. Despite the explained financial constraints, many processors are actively investing into their future to create more efficient and sustainable operations, resulting in long term positive effects. Lastly the role of the market has strongly affected many in the region, with demand being low and supply being inconsistent, finding ways to create steady and consistent income is challenging. However, many have found ways around this through increasing shelf life of product, creating stock for the year in a matter of weeks.

To summarise, below is a quote from a participant that summarises just the call to action this project desires.

“I think that’s maybe, you know your project should be about trying to fully utilise that equipment and there is waste product out there and you could keep it in cold storage or something until capacity becomes available in off peak seasons and utilise it. Opportunity for integrating these small businesses and small business people might not like it but a lot of it is unsustainable.”(Participant F)

4.7 Quantitative results

The quantitative results consisted of identifying and quantifying, where possible, what processing equipment and storage (cool, ambient and frozen) is available in Central Otago throughout the months of the year. In table 7 below, the line processing equipment and storage (cool, ambient or frozen) that is not being used in the given month of the year, is listed.

Table 7. Processing equipment and storage not in use for each month of the year in Central Otago

Months	Equipment	Storage
January	<ul style="list-style-type: none"> • Dehydrating line • Juicing line 1 	<ul style="list-style-type: none"> • 3000 bins cool, 500 bins ambient warehouse • 30x10x4m chilled • 30x10m frozen
February	<ul style="list-style-type: none"> • Juicing line 1 	<ul style="list-style-type: none"> • 3000 bins cool, 500 bins ambient warehouse • 30x10x4m chilled, 30x10m frozen
March	<ul style="list-style-type: none"> • Juicing line 1 • Cider line • Dehydrating line 	<ul style="list-style-type: none"> • 30x10x4m chilled, 30x10m frozen • 1000x1000m ambient • 500 bins ambient warehouse
April	<ul style="list-style-type: none"> • Juicing line 2 • Cider line • Dehydrator line • Juicing line 3 	<ul style="list-style-type: none"> • 30x10x4m chilled, 30x10m frozen • 1000x1000m ambient • 500 bins ambient warehouse
May	<ul style="list-style-type: none"> • Juicing line 2 • Cider line • Dehydrator line • Juicing line 3 	<ul style="list-style-type: none"> • 30x10x4m chilled, 30x10m frozen • 1000x1000m ambient • 500 bins ambient warehouse
June	<ul style="list-style-type: none"> • Juicing line 2 • Cider line • Dehydrator line • Juicing line 3 	<ul style="list-style-type: none"> • 30x10x4m chilled, 30x10m frozen • 1000x1000m ambient • 200 pallets cool • 500 bins ambient warehouse
July	<ul style="list-style-type: none"> • Juicing line 2 • Cider line • Dehydrator line • Juicing line 3 	<ul style="list-style-type: none"> • 30x10x4m chilled, 30x10m frozen • 1000x1000m ambient • 200 pallets cool • 500 bins ambient warehouse
August	<ul style="list-style-type: none"> • Juicing line 2 • Dehydrator line • Distilling line • Juicing line 3 	<ul style="list-style-type: none"> • 30x10x4m chilled, 30x10m frozen • 1000x1000m ambient • 200 pallets cool • 500 bins ambient warehouse
September	<ul style="list-style-type: none"> • Juicing line 2 • Dehydrator line 	<ul style="list-style-type: none"> • 30x10x4m chilled, 30x10m frozen

	<ul style="list-style-type: none"> • Juicing line 3 • Distilling line 	<ul style="list-style-type: none"> • 1000x1000m ambient • 200 pallets cool • 500x500m cool • 500 bins ambient warehouse
October	<ul style="list-style-type: none"> • Juicing line 1 • Juicing line 2 • Juicing line 3 • Dehydrator line • Distilling line 	<ul style="list-style-type: none"> • 30x10x4m chilled, 30x10m frozen • 200 pallets cool • 500x500m cool • 500 bins ambient warehouse
November	<ul style="list-style-type: none"> • Juicing line 1 • Juicing line 2 • Juicing line 3 • Distilling line • Dehydrating line 	<ul style="list-style-type: none"> • 30x10x4m chilled, 30x10m frozen • 3000 bins cool, 500 bins ambient warehouse
December		<ul style="list-style-type: none"> • 30x10x4m chilled, 30x10m frozen • 3000 bins cool, 500 bins ambient warehouse

In table 7 above, each bullet point within the respective month represents a processor at one single location and the equipment and storage they are not using on site. Please note that the processor name and location has not been named to maintain anonymity.

While the equipment and storage is not being used, it comes with considerations and limitations to its use. For example juicing line 2 is not in use from the months of April through to November, however the processor does not wish to share their equipment hence it is not available. Juicing line 3 is available from April through to the end of November, however details to the equipment and it's relative capacities are not shared due to intellectual property protection reasons. This juicing line also gets shipped to partners up in Hawkes Bay when not in use, so may not be in the region over the available period. The cider line shares their heat exchanger with processors in the same facility so may require organisation to use. The dehydrating line requires quite specific parameters and specifications to use while also being costly to run. The processor for this line has also expressed concerns with equipment safety as it was a significant investment.

Meanwhile, some equipment such as a juice concentrating line is used year round, however not to its maximum capacity, offering a potential increase in utilisation as 'availability'. Similarly, juicing line 1 is only used once a week when in use and therefore also offers the opportunity for increased utilisation as 'availability'.

In terms of storage, the 200 pallets of cool storage is available between June and October, however the processor does have arrangements with others in the region and is already sharing

the space. The 30x10x4m of chilled and 30x10m of frozen space is available year round, however also does contract work with freight trucks coming through the region that require short term storage. Therefore while it is available, it also needs to remain flexible for business.

In summary, there is willingly available processing equipment and storage within Central Otago that could be better utilised by processing and storing surplus fruit. However, there are still processors that would prefer not to share for various reasons and others who express concerns with the equipment safety, cost, maintenance and intellectual property. As a consensus, most processors with available equipment would also prefer to have a contract that allows for clear communication of expectations that work for all parties involved.

Chapter 5

Discussion

5.1 Introduction

This research aimed to understand the opportunities and barriers towards utilising the regional resources of Central Otago processors and growers to reduce fruit loss and waste. Semi-structured interviews were conducted with 10 processors and growers of Central Otago to create an in-depth understanding of their ability to utilise their own and others fruit processing resources. From the interviews, 4 main themes were identified as key influential factors which have been explored, contextualised, and compared to the researched literature throughout this discussion (Sections 5.2 – 5.5). Section 5.6 discusses the quantitative results of regional processing equipment and storage availability throughout the year. Lastly, in section 5.7, recommendations are made for the Central Otago fruit growing and processing community on how to better utilise their regional resources.

5.2 Processor general operations influencing resource utilisation

A processor's general operations and changes associated with financial cost, knowledge required, seasons, timeframes, product nature, specifications and the equipment required can act as a barrier or enabler to a business and their processing operations being utilised to their full potential.

5.2.1 Observed barriers associated with processor general operations which influence regional resource utilisation

Observed barriers to increasing the efficiency of regional resource utilisation included the cost of operations and how processors struggled to justify investing into anything further as they were trying to cover what they could at the present time. A key comment was the increase of minimum wage and how paying people has become unaffordable, resulting in fewer staff being hired and therefore less fruit being picked and processed. This was a common theme for many of the processors, especially the smaller operators. A lack of cash combined with the seasonality of income and timeframes growers and fruit processors must work was also a barrier against justifying further investment into operations, as any processing of fruit that would otherwise be lost would only occur over a small number of weeks.

From the literature, it has become clear that small producers tend to lack capital and resources due to their small size and scale (Yacamán et al., 2020; Bence et al., 2018). The lack of resource, small size and scale also makes it expensive to produce small quantities of product and therefore changes such as an increase in the living wage would make employing people an unaffordable option. It also makes developing the business to create better margins and more efficient processors nearly impossible to do alone. Similar feelings were expressed by the fruit

growing and processing communities of Central Otago. While a few of the larger cooperations appear to be doing OK, the smaller enterprises appeared to be struggling to make the necessary investments to create more efficient operations. The wider implication of underutilised equipment in the region and inefficient resource use resulted in low energy efficiencies and larger environmental impacts. Supporting this was the statement by Malak-Rawlikowska et al., (2019), where systematically small producers are problematic when aiming to create better food systems compared to larger conventional commercialisation. Therefore, while the economic cost is high to operate, the environmental one can also be an issue when aiming to develop future systems that have a better environmental efficiency for product that is sold.

The specification for products were seen as being more important for some products than other which led to more screening of process grade fruit and thus creation of potential waste. An example was seen with dehydrating, where the specification standard of fruit is much higher compared to distilling or fermenting, as the product still maintains its shape and colour (to an extent) post processing. Meanwhile distilling or fermenting required far less restrictive specifications due to the nature of the process. Currently these product streams are running in parallel, resulting in fruit waste in dehydrating where it would have been used distilling. If the two could communicate to their supplier, providing exactly what kind of process fruit they require, surplus fruit could be more efficiently distributed via specifications required and thus utilised regionally. The barrier of communication with the supplier of fruit is that many processors either grow their own fruit or are bound by contract, therefore a change in business model would be required.

5.2.2 Observed enablers and solutions to overcome the barriers

An observed operational enabler towards increasing the utilisation of regional resources seen from interviews was a positive incentive that growers who have started processing their surplus fruit have received through improvement in their seasonal returns. Alongside this, they have also diversified their revenue and thus risk streams, allowing them to become more financially resilient when uncontrollable events, such as bad weather, occur.

Within the researched literature, a solution posed by Malakl-Rawlikowska et al, (2019) for small producers to work towards more efficient production methods and thus improve business success was to collaborate with other small producers' products to reduce financial risk through diversification of product and revenue streams. Not only would this allow for businesses to become more resilient against uncontrollable events, but it would also allow for more strategic marketing and positioning of product. This will be further discussed in section 5.5 (influence of the market), however the wider implication for diversification within Central Otago would result in far better economic outcomes for the businesses involved. An example can be seen when Central Otago lost a significant portion of cherry crop due to rain, whereby only a small portion managed to get processed and provide a return. In an industry that is heavily reliant on weather, which cannot be controlled, it is crucial to reduce the risk through diversification.

With majority of participants acknowledging their equipment could be better utilised, an expressed desire to share and use their equipment more, offering the solution of collaboration regionally was also observed. A potential solution mentioned in the literature is the collaboration in logistics of warehouse facilities, management and thus distribution for smaller agricultural producers (Mittal et al., 2018). Collaborating in warehousing (e.g., storage), management and distribution logistics has been shown to improve efficiency through providing shorter travelling routes, better organisation of products and increased resource utilisation (e.g., use of warehouses) which resulted in cost reductions through travel time, fuel required, labour costs and energy use. This in turn increased their ability to further invest in their business. In relation to this research's findings, the wider implication of collaborating in logistics of warehouse facilities, management and thus distribution in the Central Otago fruit processing sector would be likely to bring down overall production costs as freight, which has been mentioned for being famously expensive in and out of Central Otago, could be better organised, efficient, and thus less costly.

5.3 Influencing systematic structures within Central Otago

Systematic structures such as regulation/ laws, environmental factors and social awareness also play a role in business structure and operations which inherently influences the utilisation of regional resources by fruit processors and growers. Such structures are difficult to ignore however they can pose either an opportunity or barrier to fruit processors utilising regional resources to reduce FLW.

5.3.1 Observed barriers associated with the systematic structures in Central Otago

Key systematic structure barriers included the mistrust between governing bodies and those processing and growing in the region. The wider implication of this community mistrust leads to unwillingness to collaborate with one another when initiatives are led by groups such as the CODC. Specific examples were given of previous negative interactions. Alongside this, regulations and laws can act as barriers towards shifting a food system or preventing collaborative efforts.

Similar findings were reported by Yacamán et al (2020), who acknowledged that governing structures, of which producers must work within, hold significant influencing power over the transformative potential of a small business. Also, a study by Ada et al., (2021) discussed how regulations can affect the potential for collaborative efforts (e.g., specifications required). The wider implication of governing structures having influence over smaller business's ability to progress often results in frustration and mistrust.

The isolated location of Central Otago and the fact it is landlocked, married with the cost of freight means transportation a difficult systematic structure that processors and growers need to factor in with production decisions. This therefore implies that the market chosen for Central Otago products (i.e., how far the product needs to travel) and the form of which they take (i.e., how heavy the product will be) is influenced by the return that can be achieved for the product

and the cost to get it to market. For example, exporting whole cherries is carried out because although they are costly to transport, they achieve a significant return, making it worthwhile. Similar findings can be observed in the review by Mittal et al (2018), where it stated that across various small processors, many did not have the infrastructure to efficiently carry out distribution alone, frequently creating longer than necessary trips to pick up and distribute product, wasting time, money and resources. Bence et al (2018) also reported that a lack of technology and resources can lead to the elimination of potential profits and environmental benefits for small producers.

These studies all imply that despite Central Otago's location, the need to distribute product in and out of the area will remain. Therefore, the need to create more efficient transportation systems that could collectively minimise the cost for the region whilst also lowering environmental impact would be of great benefit to the Central Otago processors.

Participants mentioned that processing surplus fruit and the better utilisation of resources was not a priority for them. Growers and processors were just coming out of the COVID-19 pandemic, and the effects were still being felt. Many interviewees mentioned that cashflow was tight and they needed to focus on building up capital by selling what they know they can sell. The wider implication is the messages it may send to employees or others in the community. Processors and growers are aware of the need to work towards more efficient and sustainable food systems that utilises resources in the most efficient way; however, a culture shift is likely to be needed to keep progression moving. A study by Ada et al (2021), which looks at collaboration in food systems, noted that the cultural values of a company can influence the likelihood of investing into more collaborative and circular models. The level of importance placed on making these investments will vary depending on cashflow, capital and capacity, but also culture, which is a barrier that can be overcome with external influence.

5.3.2 Observed enablers and solutions to overcome the barriers

Despite some in the community expressing mistrust with the local governing bodies such as the CODC, participants did acknowledge that positive outcomes and changes the council has created. For example, the changes to the local green waste use resulted in the creation of innovative waste disposal such as worm farms or pasteurisation of by products to stabilise for future use. The council has also created a research initiative, which includes this dissertation, which aims to work towards finding opportunities in the region for the fruit loss and waste whilst also looking for ways to reduce it and making it public information. Other working streams of the research initiative include looking for nutritional composition advantages to Central Otago fruit and the potential market demand domestically and internationally, which both aim to seek out opportunities for the regional FLW. Initiatives like the current research involves those growing and processing fruit in the community, giving them the ability to share their opinions, feel that they are being heard and that others may learn from what they have to say. The opportunity is then given to processors and growers to learn and share information with each other and feel empowered whilst doing so, creating more collective knowledge within the community that could improve growing and processing practices. Alongside this,

issues within the region may be brought up for the first time, allowing the CODC to acknowledge them and create the potential for them to be addressed which would ultimately create a better community trust between the two parties.

Yacamán et al (2020) discussed that it is the governing body's duty to look after the profit streams into the community whilst also encouraging the growing of good quality fruit (i.e., in Central Otago; fruit). Therefore, suggesting that the CODC do need to play a role in rule enforcement ensuring quality and safety, but also be part of empowering and supporting the processors and growers within the area. This may look like helping to improve their practices with the aim to create better quality products more efficiently that will receive a better return, positively impacting the economic growth for both business owners and the wider region. An example of this can be seen through the creation of this research project, whereby the information gathered will be publicly available.

Positive enablers from the location of Central Otago included the ability to utilise the local market through tourism. Many processors created product to sell at local bars and cafes rather than to large retailers such as supermarkets. The advantage of this approach was the shorter distance to market and hence lower transportation costs, however the market in Central Otago is small and can become saturated quickly with the many small players within the region. The wider implication of the fierce competition is that it leads to an unwillingness to collaborate with one another due to market competition, which is discussed in section 5.4 (regional collaboration). However, many processors need to or would like to transport their products outside of the Queenstown Lakes and Central Otago regions to sell their product. A solution Mittal et al (2018) suggests is the organisation and collaboration of warehousing, transportation, and inventory management to create more efficient transportation systems for small producers. The wider implication of such an approach is that it would save money, time, and resources, which could be of benefit for many smaller producers in the region if they wish to take part. Alongside this, enough resources could be gathered to target different, higher volume demanding markets than the ones already existing. Such an initiative would also help those who are struggling to get their products to market by offering alternative and collaborative opportunities that could be presented to retailers as a regional opportunity, utilising the Central Otago fruit reputation.

The awareness of the FLW issue was high across all participants in the study and it is also noticed by locals and those who work within the horticultural sector. There is no doubt that participants cared about finding a solution to this issue, it is just the ability to make it a larger priority and seek more ways to avoid or utilise it. As mentioned earlier, those who have made it a larger priority than others are finding they are seeing better seasonal returns from valorising fruit would normally be waste. This has also created a motivational urgency to find more ways to minimise their environmental impact such as moving towards circular or recyclable packaging and valorising by-products in the processing lines (e.g., purposes for pulp from juicing). Swagemakers et al., (2019) stated that collaboration to gain more knowledge about an issue could lead to more positive idea generation, such as product development to create circular processing lines, could not only lead to less waste but community empowerment and

improving collective knowledge in the region. This is key for small producers as they tend to know a lot about what they are creating, however the transfer of skills and knowledge from one another would not only help each other's business but create more trust-based relationships within the region.

5.4 Regional collaboration outlook of processors

This section discusses the role of intellectual property, market competition, equipment safety and how it can act as a barrier or enabler towards the willingness of collaboration between processors, growers, key stakeholders, and the public to utilise the regional resources more efficiently.

5.4.1 Observed barriers to collaboration within the Central Otago horticulture community

As mentioned in the results, commonly found barriers towards collaborating was a hesitation to sharing intellectual property (IP). This was especially true for smaller growers and processors who invested a lot of time and money into creating their products and production lines, therefore, they felt that to share the knowledge freely minimises the efforts they put in to acquire it. It is also important to acknowledge the protection rights businesses can have over their technology and knowledge when addressing this barrier. A study by Ada et al (2021) states that the transferability of knowledge and skills between businesses can be a barrier to collaboration across the supply chain between different stakeholders. However, discussions more in the complexity of the knowledge and skills therefore the ability to learn or apply them to another stage of the supply chain were made, rather than the inability to share knowledge through IP rights. Similar findings were observed in the interviews, whereby sharing knowledge from some processing methods (e.g., dehydrating fruit) was not only problematic from an IP standpoint (whereby the processor has taken a lot of time and experimentation to acquire the knowledge) but also a complexity point of view. In the dehydration example, the methods and parameters used can be highly specific to the fruit type, its moisture content and size, making it information difficult to transfer. The wider implication of this is the variation that can be seen between not just fruit types and varieties, but between different growing locations and the minor variations observed in the fruit between them (e.g., moisture content, sugar concentration and size). Further research into the fruit composition and whether it varies across growing location as well as growing methods and point in harvest season (e.g., late, early or tree ripened fruit) could be of benefit when determining optimum fruit for certain processing methods, allowing for appropriate delegation of fruit across the various processing methods.

Another concern was the equipment safety and how this will be mitigated when collaborating with others. While none of the researched literature discussed the concern of equipment maintenance and safety, it is a barrier that is highly relevant to this study and will need to be considered when looking to collaborate. The wider concern with equipment safety is the protocols of which are followed when things go wrong. Equipment requires certain specifications of which it will operate under (e.g., size, moisture content, consistency) and

mutual respect of these specifications will need to be followed to maintain positive relationships between those collaborating.

A final concern with collaboration was the creation of additional market competition. As mentioned above, many processors and growers utilise the local tourism market to sell their product, which is fierce and saturated in many places. The concern with collaboration was the introduction of more products that could directly compete with what processors and growers already have on the market. Mittal et al (2018) recognised the lack of marketing and sales systems in small producers in their review and how it acts as a barrier towards regional food growth and success. Therefore, the wider implication behind the lack of sales and marketing team could be that many are competing for the same known market as it has been tried and tested. Without people going into the market, looking for new opportunities, the ones that exist become more saturated and fiercer, which results in less product overall being sold.

5.4.2 Observed enablers and solutions to collaborate

As well as the mentioned barriers to the regional collaboration outlook of Central Otago processors and growers, there were mentioned enablers as well as example solutions provided from the interviews. While some interviewees did not wish to share their protected knowledge, some were already openly communicating with one another in smaller communities. Studies by Swagemakers et al., (2019)., Yacamán et al., (2019)., and Lee et al., (2000) talk to the concept of collaborating by the sharing of knowledge, skills, and information, which was briefly mentioned above in section 5.3 (influencing systematic structures). The great benefits of sharing information can lead to positive idea generation which may lead to innovative product development, which in turn can increase the resilience of the food system through improvement of regional collective knowledge and product diversification. Creation of a community where those in the industry can learn from each other's mistakes would reduce the waste of money, resources and time whilst also creating positive and trusting relationships within the region.

A solution to get around the challenge of how to ensure that the equipment is maintained in terms of appropriate operation and thus equipment integrity when making the products was to create the opportunity to contract produce. Contracting would enable those who own the equipment to produce the requested product for a client, which would cover the manufacturing costs as well as give room to create a profit. Discussions around consulting and advising to the processing method given the product specifications would allow both parties to also get their requests addressed (e.g., how the product specifications impact the operational ability of the equipment and thus maintain the equipment integrity), allowing for a quality product to be produced and transparent relationships to form. Alongside this, as mentioned above, many of the smaller processors do not have their own sales and marketing team, therefore an option where the product can just be made without worrying about the selling part, could be of great benefit.

A solution mentioned from interviews to overcome the competing market barrier was collaboration between those who don't directly compete with one another. For example, one of the study participants only operates contract cool storage for freight companies travelling through Central Otago therefore does not directly compete with the fruit producers or processors in the fruit/ fruit products market. In addition, they do not face the same seasonality pressures (e.g., intense harvest seasons) that fruit growers and processors face as the freight companies they contract with are not exclusive to fruit transport (i.e., they provide year-round business). The wider implication of this potential solution could be utilising the concept of a food hub, whereby the cool store could be a central point of contact for product to be cool stored or frozen before being transported to be processed or to a retailer. The creation food hubs for small agricultural producers to aggregate products for regional markets have previously been reported as an effective means to enhance distribution planning and thus reduce monetary and environmental costs by creating a central location for larger freight pick-ups thus creating more efficient transportation of product (Malakl-Rawlikowska et al, 2019; Yacamán et al., 2019)., (Beckerman et al, 2006)., (Yacamán et al., 2020). Therefore, the utilisation of the cool storage participant as a central food hub for distribution purposes could be of great benefit when aiming to reduce distribution costs to markets outside of Central Otago or Queenstown Lakes, which in turn can decrease the market saturation felt by processors and growers in the region through making access to other markets more accessible.

Lastly, a solution that some processors and growers already employ is to send product to stakeholders that often deal with surplus foods such as food banks and food rescue organisations. For example, one grower sends cherries to The Mission in Auckland in food parcels over the summer months, however as the grower covers the cost of the freight, which makes it a costly exercise. Therefore the difficulty with this solution is the location of Central Otago and lack of food rescue organisations within it. This implies that in order for surplus fruit to be donated to food rescue organisation, such as the one mentioned above, it would be currently be reliant upon private funding of the grower/ processor to pay for the distribution of the fruit. Researched literature has mentioned that better collaboration between growers wishing to donate surplus fruit to food banks and food rescue organisations has been reported to be a way to help to reduce FLW whilst also creating positive social impact (such as the food parcels allowing those who usually can't afford cherries the ability to enjoy them) (Surucu-Balci & Tunam 2022). However in this circumstance, the lack of local food rescue organisations and thus the economic viability to do so via transportation costs makes the opportunity less accessible. Supporting this, many participants have mentioned that investment into their own business, let alone something that will not provide a return, is currently not a priority.

A further solution discussed was 'gleening' or 'pick-your-own' was mentioned, whereby an advertisement is put out into the news paper and members of the public are welcome on an orchard for a certain timeframe to pick whatever they wish. Usually much of the picked fruit is donated, while the pickers get to take some home to enjoy. Involvement of the public with the growing and processing community of Central Otago creates cohesiveness and empowerment. Although gleening provides no return for the grower, it was seen as a localised

option to utilise and create purpose out of surplus fruit left on the trees, therefore reducing FLW .

5.5 The influence of the market on resource utilisation

This section discusses the current influential factors of the market and how it influences the justification to utilise regional resources more through market demand, supply and price.

5.5.1 Observed barriers associated with the Central Otago fruit market

Market demand was a concern that came through strongly across many processors and growers in the interviews. Stories were shared about the tonnes of product that was created only to find that there was no market for it. Many growers and processors mentioned that they were not prepared to make the same mistakes. This ultimately has led to a mindset of ‘only selling what we know we can sell’ for many growers and processors. Some of the larger producers, who tend to only supply one large customer, favour their current business model as it coordinates well with the utilisation of their process grade fruit and demand from the customer. The customer will determine the amount of product they will make and therefore ultimately sell so they produce only what they need, minimising waste and maximising returns. In these instances, utilising more surplus fruit would have to be supported with guaranteed demand for the product they make. Meanwhile smaller producers often find themselves competing in the market with other smaller producers, making it a highly competitive environment. This is made more challenging as the small players tend to not have their own sales and marketing team, therefore they rely on word of mouth to sell their product, which does not guarantee demand and thus potential sales well, making it difficult to gage how much product they may need to make for the year to come.

A study by Cantor & Strohlic., (2009) looked at the market barriers for small organic growers in California, where the most common concern was the ability to market and sell the product. Similar to Central Otago, a premium return for their produce was heavily influenced by their volumes where if too much was produced, they would not get enough NZD per unit volume and if too little produce was produced, it would become too expensive to sell. In Central Otago, it was mentioned that manipulation of the local market price can occur when the supply of fruit becomes too high, driving down the local market price (NZD per kg). To bring supply down and thus demand up, producers will throw away fruit, disallowing it to enter the local market which preserves the local market price (NZD per kg of fruit). Oversupplying the market can result in growers selling produce at a loss, which can be more detrimental than if they were to sell less at the preferred market price. However, this process is knowingly inefficient in terms of resource use, alternatives are yet to be found.

Lastly, concerns with the inconsistent supply that comes with a short harvest season was expressed by especially growers in the region. Processors will take the fresh product and turn it into a stable product that can usually be stored at ambient temperatures for 1-2 years. However, fresh product is only available for a few weeks outside of harvesting times before it

perishes. While literature surrounding supply concerns of seasonal fruits is limited, it is a well understood concept by consumers that Central Otago stone fruit is a seasonal produce and therefore expectations to access it outside of the season are limited.

5.5.2 Observed enablers and solutions to overcome the barriers

As mentioned above, many larger producers have arrangements for large customers to buy either their entire stock or the vast majority of it, therefore they can coordinate demand through them relatively accurately. Meanwhile, smaller producers do not have the luxury, therefore find predicting demand difficult and often inaccurate, resulting in either wasted product or a wasted sales opportunity. A solution to this mentioned in the literature and previously in this discussion was the concept of product aggregation for regional markets via food hubs (Malakl-Rawlikowska et al, 2019)., (Yacamán et al., 2019)., (Beckerman et al, 2006)., (Yacamán et al., 2020). Collaboration of multiple smaller producers and their products may still face the barrier of unwillingness to collaborate due to market competition, however benefits would allow them to better plan production where they can collectively control the market through larger market share.

In terms of year-round supply, perishability narrows the potential options down to processing to stabilise product from both a sensory and food safety perspective. It was mentioned in the interviews that the period between end stone fruit season (late February and early March) and the beginning of apple season (end of March) was the most crucial time to deal with surplus fruit in cool storage, otherwise it would be easily forgotten and perish with the commencing of apple season. Stabilisation options that are commonly used amongst processors include pasturing, freezing, and fermenting therefore facilities to do so exist in the region. Advantages of pasturing fruit products allow it to be kept at ambient temperature when packaged aseptically, therefore are not associated with additional energy costs to keep the product cool and thus stable. Freezing is an effective method for preserving fresh sensory properties however can be costly to keep frozen with energy costs and abundance of freezing space in the region appears to be limited, which can be seen in section 5.6 (qualitative results of regional processing equipment and storage availability). Fermentation allows for large amounts of surplus fruit to be utilised however depending on the final product created (e.g., wine, beer or spirit), the yield obtained can vary significantly where from the interviews, spirits (i.e., distilling) obtained a very low yield of alcohol and thus amount of final product, which created significant amounts of wasted by-product in the process. The final product from distilling however (80% ethanol), is extremely shelf stable and versatile in terms of the product that can then be made from it (e.g., addition of botanicals or flavours to make gin, snaps etc.) In addition, future research into the retention of the unique nutritional aspects of the fruits through the various stabilisation methods mentioned above would be of great benefit when decided how to best stabilise surplus fruits and thus the products to make.

In terms of solutions to the preservation of local market price, researched literature suggests that the sharing of sales data for more accurate forecasting in the future will enable processors and growers can meet the demand more accurately and thus waste less resources (Swagemakers

et al., 2019)., (Yacamán et al., 2019)., (Lee et al., 2000). By creating less room for oversaturation of the market, the strategical fruit waste to preserve the market value will also be avoided and thus create less FLW. Alternatively, underdelivering to the market demand, whereby growers and processors are not reaching their full potential, or the market price could be driven too high resulting in fewer consumers being able to afford the fruit, can also be avoided. If growers and processors across the region could forecast together, there could be better market price control resulting in more reliable returns to the region and avoidance of potential FLW from oversaturation.

5.6 Quantitative results of regional processing equipment and storage availability

This section discusses the quantitative data collection of the processing equipment and storage capacities collected which was part of the line of questioning. Alongside this, the relative utilisation, capacities, and willingness to share was also asked, which encounter many barriers, enablers and opportunities for increasing the utilisation of the regional resources and thus reducing regional FLW.

5.6.1 Observed barriers of regional processing equipment and storage availability

From the results it was clear to see that there was an abundance of equipment in the region that is not used year-round. However, whilst the equipment may not be in use, not all of it is available with a key barrier being the preference not to collaborate through sharing equipment and storage. The reasons as to why processors or growers prefer not to collaborate have been mentioned above in section 5.4 (regional collaboration outlook). Alongside this, some processors are happy to share their equipment and storage however there are associated limitations to the use of equipment which are likely to affect the ability to share it (e.g., juicing line 3 being sent to Hawkes Bay during the non-harvest season). For the example given, despite the willingness to share by the participant, it is likely that juicing line 3 would be an unrealistic sharing option as the line is not available to be shared outside of primary business, which is during harvest season, for sharing use due to not being in the region.

Another barrier is the lack of details surrounding each equipment line and storage space in terms of capacity, specifications required and other processing limitations. In some cases, this was due to unwillingness to share this information (i.e., intellectual property) however the nature of the interviews also contributed to the lack of information, whereby processors and growers didn't have the information on them (e.g., equipment and storage capacities), therefore provided estimates. Follow up questioning was done to confirm details, however further discussion would be required in some instances to ensure the correct capacity details have been passed on. This would be to avoid future errors relating to the utilisation of the available equipment or storage, such as running out of cool storage or not providing enough product for a production run.

5.6.2 Observed enablers and solutions to the mentioned barriers to regional processing equipment and storage availability

Despite the mentioned barriers, there are many processors and growers within the region that are willing to be flexible and have proven so. With some growers and processors already sharing their equipment lines and storage with others outside of their harvest seasons, transitioning to a wider group of people and thus creating regional collaboration of equipment and storage to increase its utilisation, is a realistic option. CODC have mentioned hopes to create a database whereby knowledge of available storage and equipment can be a resource to growers and processors within the region, allowing them to collaborate more easily through better communication with viable collaboration options for the timing and specifications required.

Similar examples can be seen from the researched literature, such as a case study in India looking at utilising technology to help farmers share and rent equipment, allowing for better resource utilisation (Rakhra et al., 2022). Algorithms have been created to optimise the equipment required via factoring variables such as crop kind, harvest time, equipment needed and money available for rental. The model has aimed to improve the agricultural techniques used in India holistically, whilst also reducing equipment related costs for the improved access to better farming technology. This was because collectively, they were able to purchase and therefore rent out to one another, more efficient equipment which ultimately provided more efficient resource management and farming practices.

The idea of sharing equipment and storage post-harvest season has been suggested before in numerous sources of literature (Audy et al., 2012; Creamer et al., 2012; Parry et al., 2011) which suggests that implementation of online resources to facilitate the sharing of available equipment and storage throughout the year is a viable option for Central Otago as it has been successfully carried out, with observed benefits, many times before.

5.7 Recommendations

Based on the academic literature and the findings from the interviews this section provides recommendations on actions that will aid in the utilisation of regional resources help to reduce fruit loss and waste.

5.7.1 Creation of a collaborative central food hubs that can be utilised by the smaller processors and grower owned businesses in Central Otago

Part 1: Distribution logistics

Action: The CODC, local processors and growers explore the potential access to a cool store based in Alexandra. This is a central location for the region between Teviot Valley and Cromwell

Rational: Alexandra currently has both cool (30x10m) and frozen (30x10m) storage facilities which are available for contract use.

Action: The CODC, local processors and growers to explore the facilitation of the shared distribution of goods outside of Central Otago.

Rational: small producers in the region will be able to reduce costs if they could share transport out of the region. A central agency is required to co-ordinate this.

Part 2: Marketing and sales support via the food hub

Action: The CODC, local growers and processors to explore the establishment of sales and marketing support resource

Rational: Efficiencies can be gained by the sharing of data for more accurate forecasting regionally alongside:

- Allow for delegation of resources accordingly to predicted demand, preventing waste
- Potential to aggregate some products for larger customers where those involved would hold shares
- Production can be planned according to customer demand to prevent waste
- An example from the interviews was aggregating and distilling mass amounts of bottom processing grade fruit into a vegan ethanol for the alcohol market. This could then be sold onto a large alcohol company
- By-product of distilling could be distributed back to the growers or sold as a nutritious fertiliser

5.7.2 Creation of a collaborative online database resource that is accessible to processors and growers within the region to share available equipment and storage

Action: CODC to create and make available a database of processors including contact details, processing equipment capability and capacity and products able to be produced.

Rationale: Leads to better utilisation of equipment and storage in the region resulting in improved resource management alongside:

- Greater utilisation of fruit in the region
- Sharing of knowledge increases the collective community knowledge, preventing the same mistake from occurring again
- Positive idea generation for product development where discussions around specifications (from those who know the equipment and product well) and new ideas or a market position

- Enable easier contact with those with the knowledge and equipment and therefore aid the set-up of contact work where the product can be made while marketing and sales is covered by the other party

5.8 Summary

In summary, the findings from the interviews and the existing researched literature share similarities, supporting the credibility of the information found whilst also providing some potential solutions to the mentioned barriers. The learnings from both literature and interviews have led to the creation of the recommendations above (section 5.3) to aid the utilisation of local resources by processors and growers and reduce FLW in Central Otago. The next sections (6.0) conclude the research findings, reflects on the strengths and limitations of the study whilst suggesting next steps for further research.

Chapter 6

Conclusions

6.1 Introduction

This research aimed to understand the opportunities and barriers towards utilising the regional resources of Central Otago processors and growers to reduce FLW. Semi-structured interviews were conducted with 10 processors and growers of Central Otago to create an in-depth understanding of their ability to utilise the resources. From the interviews, 4 main themes were identified as key influential factors: 1) factors of processor general operations, 2) influencing systematic structures within Central Otago, 3) regional collaboration outlook of processors and 4) the influence of the market on regional resource utilisation. Lastly, an equipment and storage stocktake was taken which was discussed in terms of availability throughout the year.

6.2 Study strengths and limitations

The method of semi structured, one on one interviews enabled the participant and interviewer to have a conversational line of questioning, allowing for a better audience rapport and thus more thorough information. The average time for interviews was 36 minutes and the average of 3,500 words per transcript. The information was very detailed, resulting in many considerations to be aware of, providing great insights into the horticulture industry of Central Otago.

However, the vast amount of information meant that it was difficult to decide what was most important and relevant for the study. The conversational style of the interview did lead to questions that were not answered properly due to the flow of the conversation, however, follow up questions were asked where only 2 participants didn't get back.

Lastly, a major strength was the friendliness of the participants and their openness towards being interviewed, making the process pleasant and informative. It was straightforward to ask questions and clear up any misunderstandings, helping the results become more accurate.

However, a limitation was the participant variety. At the beginning of the research project, the scope was to interview just processors or growers who are processing in the region. As the research evolved, it became evident that it could benefit from the input of other voices within the region like larger corporate enterprises such as Summer Fruit NZ or other members of the governing bodies such as local Iwi. Involving participants from these communities would bring a different perspective and thus considerations to make in terms of overcoming barriers preventing the increased utilisation of regional resources by processors and growers.

Lastly, the study also revealed that Central Otago holds great opportunity to utilise the current resources within the region more and decrease the amount of fruit lost and wasted through the local processors and growers. This study has shown that there are many motivated members in the community that would like to see that happen and also see great opportunity for the region itself to utilise its reputation.

6.3 Future considerations

Following on from the findings of this research, some future considerations that would be of benefit include further research into the specifications required for processing various products. This may be in terms of fruit composition, colour and microbial activity as well as the size and shape, to gain a better understanding of where the line may be for the various specification standards. This would therefore enable more accurate separation of fruit according to various processing methods, allowing it to be ultimately better utilised.

A recommendation in future studies would find a common definition for the term ‘utilisation’, through the literature review and the interviews with participants. When analysing the data, it became clear that everyone had their own concept on what utilisation of their equipment and storage was and thus whether it was fully utilised or not. Therefore, making it difficult to when compare this information. It would be of great benefit to go into the interviews with a clear idea of utilisation and therefore the preferred measurable units to express the utilisation of equipment and storage and thus its relative capacity.

Another future consideration would be researching the market demand of Central Otago fruits and where opportunities may lie in the market. The CODC have made this one of their next steps towards seeking opportunities for the regional FLW. Through establishing where opportunities in the market lie and creating market demand, ideas for product development can be made accordingly and thus equipment and fruit resources will be better utilised as it will be more likely to succeed.

The idea of collaborating equipment and storage in the region for increased utilisation in this study currently faces the barrier of needing to maintain anonymity for participants who wish to remain anonymous. Therefore, for future actions of working with some of these participants, their identify would need to be protected from association with this study so would need to be contacted externally. However, it would be of great benefit to organise a database where processor’s names and location is freely available so logistical organisation of equipment sharing can occur.

Lastly, while the results gathered in this research are of great benefit, the assumption of uplifting and generalising to another region could not be done. External influencing factors such as location and climate could change how the seasons evolve and thus potentially influence harvest yields growers and processors may experience. Therefore, as a future consideration, if similar work wishes to be done in other regions, unique local factors will need to be accounted for to attain accurate results.

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Appendix

Appendix A: Information sheet for participants

Reference Number: D22/156 **Date:** 18/07/2022



Understanding the Opportunities for Central Otago Processors to Help Reduce Fruit Loss in the Region

INFORMATION SHEET FOR PARTICIPANTS

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether to participate or not. If you choose to participate, we thank you. If you decide not to participate, there will be no disadvantage to you, and we thank you for considering our request.

What is the aim of the project?

This project aims to seek the opportunities of Central Otago fruit processors and their role in reducing fruit loss in the region.

This project is being carried out as part of Molly Goodisson's Honours research, in conjunction with the Central Otago District Council (CODC).

CODC, local growers and processors are on a collective journey to reduce the amount of fruit loss in Central Otago. In October 2021 CODC released the Understanding Fruit Loss in Central Otago report that quantified the fruit that is produced but not used in Central Otago. In November a workshop was held as a first step to identify potential uses for the lost fruit. Understanding the opportunities for Central Otago processors to help reduce fruit loss in the region was identified to be undertaken as the next step in the journey.

Supervising Molly's project are Associate Professor Miranda Miroso and Professor Phil Bremer.

What types of participants are being sought?

Approximately 10-12 participants from processing plants located in Central Otago are being recruited with the assistance of the CODC.

What will participants be asked to do?

Should you agree to participate in this project, you will be asked to meet with Molly Goodisson for a semi-structured qualitative interview. The meeting will take no longer than 40 minutes,

where you will be asked to participate in a series of questioning around what your facility capacity, utilisation, capabilities, barriers, and opportunities are. Suppose you do not work directly with fruit processing. In that case, these questions will be directed to your business and the relationship to fresh or processed Central Otago fruit.

Before the meeting, you will be asked to confirm your consent to the meeting being recorded. If permission is received, the sessions will be recorded; this will allow the researcher to accurately take notes of what was said verbatim during the meetings. Neither the recording nor the meeting notes will be shared with anyone outside the research team. If you do not consent to the sessions being recorded, then handwritten notes will be taken instead. Should you wish, these notes will be sent back to you for accuracy checking following the second meeting.

The data collection will be more like a conversation. The general line of questioning includes questions regarding the processing capabilities, seasonality and your general perspective towards the fruit waste of Central Otago.

Suppose the line of questioning develops in such a way that you feel hesitant or uncomfortable; you have the right to decline to answer any particular question(s). Please be aware that you may withdraw from participation in the project at any time, without any disadvantage to yourself.

Your consent will also be asked for follow up questions should further development be required. To ensure we can reconnect with you at a later date, your contact details will be kept.

Please note that your participation is entirely voluntary, and no payment will be offered for your participation.

What data or information will be collected, and what use will be made of it?

We will ask you questions about your processing business regarding the general operations, the type of equipment you use, including its relevant parameters and times of use. Secondly to this, you will be asked about your perspective towards seeking solutions of upcycling fruit waste and any identifiable barriers and opportunities.

You will be given options regarding your anonymity. Please be aware that should you wish, we will make every attempt to preserve your anonymity. However, there are some cases where it would be preferable to attribute your contributions with your consent. It is up to you which of these options you prefer.

Following your meetings, your data will be assigned an identification number so that your name and organisations' name/identity are not associated with any reporting on this study (unless you wish it to be). Electronic data will be stored only on password-protected University computers. Physical data will be promptly transferred to an electronic format where practical, and the originals securely destroyed. It is necessary to keep data in physical form; it will be held in a locked filing cabinet in Associate Professors Miranda Miroso's office at the University of Otago.

The data collected will be securely stored so that only those mentioned below will be able to gain access to it. The resulting data will be retained for **at least five years** in secure storage. Any personal information held on the participants, including contact details and recordings,

may be destroyed after the research even though the data derived from the study will, in most cases, be kept for much longer or possibly indefinitely.

The project results will form part of Molly Goodisson's honours dissertation (therefore may be published) and a final report for CODC. The Honours dissertation will be available in the University of Otago Library (Dunedin, New Zealand). If it is in your interest, you may wish for a copy of the final thesis to be sent to you; in this case, your contact details will be kept ensuring you receive a copy.

No material that could personally identify you will be used in any reports on this study.

Can participants change their minds and withdraw from the project?

You may withdraw from participation in the project at any time, without any disadvantage to yourself.

What if participants have any questions?

If you have any questions about our project, either now or in the future, please feel free to contact either:

Molly Goodisson

Department of Food Science

University of Otago

goomo475@student.otago.ac.nz

or *Miranda Miroso*

Department of Food Science

University of Otago

miranda.miroso@otago.ac.nz

The Department has approved this study stated above. However, suppose you have any concerns about the ethical conduct of the research. In that case, you may contact the University of Otago Human Ethics Committee through the Human Ethics Committee Administrator (ph +643 479 8256 or email gary.witte@otago.ac.nz). Any issues you raise will be treated in confidence and investigated, and you will be informed of the outcome.

Appendix B: Consent forms for participants



Understanding the Opportunities for Central Otago Processors to Help Reduce Fruit Loss in the Region

CONSENT FORM FOR PARTICIPANTS

I have read the Information Sheet concerning this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that:

1. My participation in the project is entirely voluntary.
2. I am free to withdraw from the project before its completion (October 2022).
3. Personal identifying information such as Zoom recordings and personal information will be destroyed after the project. Still, any raw data on which the project results depend on will be retained in secure storage for at least five years.
4. This project involves an open-questioning technique. The general line of questioning will cover my processing business general operations, equipment utilisation and perspective on local fruit waste and loss solutions. The precise nature of the questions has not been determined in advance but will depend on how the interview develops. Suppose the line of questioning develops in such a way that I feel hesitant or uncomfortable. In that case, I may decline to answer any question(s) and/or withdraw from the project without any disadvantage of any kind. Following the interview, the transcript (or summary notes if handwritten notes were taken) will be sent back to me for accuracy checking.
5. I understand that no health risks are anticipated as the result of this project.
6. I understand that there will be no compensation for my participation in this project. The research project is being supported by the Central Otago District Council.
7. After interviewing a range of participants, the researchers will compile a short report for their wider research group (listed above) that summarises the information collected in the interviews. In this report, common key themes identified across the interviews will be summarised. The summary report will also be sent to all participants who have requested a copy and may also eventually be published and will be available in the University of

Otago Library (Dunedin, New Zealand). Still, every attempt will be made to preserve my anonymity.

8. I, as the participant: a) agree to be named in the research, OR;
b) would rather remain anonymous.
9. I, as the participant: a) agree to be audio/video Zoom recorded, OR;
b) would rather not be recorded.
10. I, as the participant: a) I agree to further questions if needed OR;
b) I would rather have no further questions.

I agree to take part in this project.

.....
(Signature of participant)

.....
(Date)

.....
(Printed Name)

I would like a copy of the final report and to be sent to this email address:

Please return this signed consent form via email before the interview starts.

Appendix C: Interview guide for interviewer

Introduction

I would like to hear about your processing business and general operations. Could you please tell me;

- What are you currently producing and at what quantities?
- Who do you sell your product to? (i.e. retailer, consumer, manufacturer, domestic or international)
- What fruit(s) are used and of what grade?
- Does your operation result in by products/ waste? If so how much, where and why (e.g. quality issue, storage or economic issue)
- Do you experience any production limitations? If so, what? (e.g. supply, market demand or capacity)

Equipment

- What equipment do you use for processing and what are the parameters? (e.g. min and max capacity, form of product)
- How often is each piece of equipment used? (e.g. seasonal, all year round, by month and week)
- Can you give a summary of the general line of production and whether all machines are running at the same time or not?
- Are there any known barriers to any of the equipment you have? (e.g. cost to run, labour)
- Do you believe your equipment is underutilised? If so, are you aware of any opportunities to utilise it more?

Storage

- Does your processing facility contain storage space? If so what is the minimum and maximum capacity?
- Is the storage used seasonally or all year round?
- Are there any significant barriers to the storage space? (e.g. high cost to run, staff required)

Wrap up

- With additional equipment, what more do you think could be achieved (e.g. increased efficiency, utilisation of waste, prolonged shelf life, new product)? If so, have you done any research you are willing to share?
- If your storage and/or equipment has off seasons/ periods, would you be willing to share the facilities locally to utilise local fruit loss and waste?
- Do you see any future trends in the fruit and/or upcycling of fruit space?
- Do you have any concerns/ reservations towards the project?
- Do you think we are missing something/ have anything to add?
- Who else do you think would be worth talking to
- Is it ok if I can contact you again if something is forgotten?

Thank you

