THRIVE
CONSULTING

UNDERSTANDING FRUIT LOSS IN CENTRAL OTAGO

OCTOBER 2021
Prepared for Central Otago District Council

Understanding
FRUIT LOSS IN CENTRAL OTAGO

EXECUTIVE SUMMARY

The ability to reduce food loss and food waste is gaining global attention. It is estimated that globally 33% (Food and Agriculture Organisation, FAO) of food produced for humans does not end up being consumed. Being able to manage food loss and food waste relies on having accurate data to understand the scope and scale of the issue. This report aims to understand and quantify food loss in the Central Otago fruit sector (fruit loss).

Fruit loss is considered fruit that is grown for human consumption but does not end up being sold for human consumption and is lost on property/in production (orchard and packhouse). This includes non-harvested fruit (left on tree) as well as fruit harvested that does not get sold or consumed by humans. This report focuses on the loss that occurs on-property not the loss at the distribution, retail or consumer end of the supply chain (food waste).

This report quantified fruit loss for the following types of fruit in Central Otago – apples, apricots, cherries, peaches, nectarines. Key findings included:

- Fruit not harvested (non-harvested fruit loss) was estimated at 8.6% more of the total crop (4,151 tonnes).
- Fruit harvested that was not sold amounted to 4.2% (2,014 tonnes) of the total Central Otago fruit crop. This fruit was mostly recycled back to the orchard. The FAO estimates that New Zealand's fruit and vegetable food loss is 5.8%.
- Fruit that was sold amounted to 95% of the harvested crop passing through the packing process and included export, local and process grades. Overall, a very high percentage of fruit is sold.
- Export and local market fruit accounted for 85% of fruit harvested and process grade fruit was 11% of harvested fruit.
- Process fruit was of low value to growers and was used for juicing, concentrates, drying and pulp.
- Most growers agreed that fruit loss quantities will increase in the future, driven by substantial new plantings and increasing grade standards.
- More growers are moving towards strip picking which will increase the harvested loss and a reduction of non-harvested loss.
- Variations in fruit loss quantities occur seasonally due mainly to climate events and the current labour shortages.
- There may be opportunities to increase the value of process grade fruit, reduce the non-harvested fruit and better utilise fruit that is recycled back into the orchard.
- All growers were keen to collaborate and find alternatives for process and fruit loss, but some were unsure how to do this. Growers were open to new ideas and opportunities.
- Many growers commented that their focus is on growing high-quality fruit for sale, not fruit loss. Growers considered that managing their crop more effectively could be the best way to reduce fruit loss.

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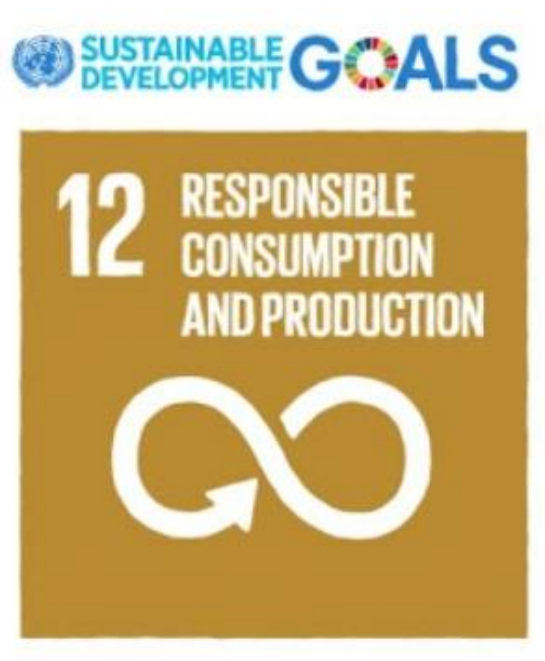
BACKGROUND

Food loss and food waste is a global concern given the efforts to sustainability produce food to feed the world's rapidly expanding population. Globally, there is only a small amount of research that quantifies food loss. This study aims to quantify the food loss in the Central Otago fruit sector. At a national level, the pressure on land for urban development, competition for labour, perceptions and regulations on use of natural resources, and consumer awareness are all contributing to a growing interest in reducing food loss. Fruit loss is primarily reduced through improved growing practices, increased processing options, and changing customer perceptions or the development of niche markets.

The Central Otago District Council has commissioned this report, with a view to try and quantify the scope and scale of fruit loss for the Central Otago fruit industry as a first step in supporting industry to reduce loss. The Central Otago District Council has an interest in supporting the industry to reduce fruit loss to support the most productive use of natural and human resources. It is hoped that having the data relating to fruit loss will enable additional solutions to be developed to reduce loss before it is created and to expand value-added processing options. Additional processing options will build resilience within the sector, and ultimately the wider district economy against weather events and market changes that could affect existing markets.

The United Nations has 17 Sustainable Development Goals. These high-level goals aim to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity. Food loss is considered by the United Nations and falls under goal 12, Responsible Production and Consumption. Specifically, indicator 12.3.1 describes food loss and food waste. The Food Loss Index measures the production losses, and the Food Waste Index focuses on retail and consumer consumption losses.



SDG Indicator
12.3.1

Measuring
FOOD LOSS

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In 2019 the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) published mapping of Australian fruit and vegetable losses pre-retail. This research mapped at a regional level, food loss in the production chain across Australia's horticulture crops. CSIRO defined food loss in the report ,*"as food initially produced for human consumption but was discarded or lost at any stage along the food supply chain. It can include the non-harvested parts of plants, off-cuts and by-products, product which does not meet retailer specifications and product that is abandoned before harvesting due to low market prices".* Essentially this is the on-property loss. Food waste relates to the retail and consumer end of the supply chain. It is common for these terms outside of research to be used poorly, and they are often incorrectly used.

The Food and Agriculture Organisation (FAO) developed a Food Loss Index, in which Australia and New Zealand have some of the lowest losses in the world. The FAO found that Australia and New Zealand had food losses of 9.8% and 5.8% respectively. These figures include all fruit and vegetables and recognise that cereals and pulses losses are much lower, but are included in the food loss total. Fruit is likely to have higher losses due to its perishability. Very limited food loss data exists from New Zealand, and crop specific information is difficult to find.

This survey aims to quantify the losses in the Central Otago fruit growing sector. Food loss for this report will focus on commercially grown fruit and will refer to three categories of fruit loss:

1) Non-harvested fruit loss. Fruit that is not harvested (left on the tree). This could occur due to a variety of reasons such as maturity, quality, market demand or labour availability.

2) Harvested fruit loss. Fruit that is harvested but not able to be onsold for human consumption and is lost on property (orchard or packhouse). Commonly called 'dumped fruit' by most growers.

3) Total Fruit Loss. The combined total loss of fruit non-harvested and harvested fruit loss.

Food waste – is the loss at the retail and consumer end of the supply chain and is not covered in this report.

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Central Otago fruit growers produce fruit for both export and local markets. Fruit is individually assessed against grades also referred to as standards to determine quality and market suitability.

Export fruit is generally of the highest standard, sold to an offshore market and receives the highest return. Not all fruit types covered in this report are focused on production for an export market. This could be due to permissibility, import restrictions, or market demand - an example of this is nectarines.

Local fruit sold on the domestic market, is generally of a lower standard than export fruit and receives a lower price.

Central Otago growers are focused on growing fruit for export and local market as this is where the higher returns are. Due to differences in climate between Central Otago and other New Zealand locations the split between grades and primary markets for the same varieties of fruit are likely to be different.

Process fruit is fruit that is of lower grade/ standard and is sold to processors and processed into a value-added product such as juice, dried fruit and concentrate.

Fruit that does not have an export, local market or processing outcome is fruit loss.

METHODOLOGY

A targeted survey of 15 growers (including packhouse operators) across the Central Otago region was undertaken in July 2021. These growers often managed other owner properties. Overall, the surveyed growers accounted for approximately 65% of planted fruit-growing hectares in Central Otago. Participants were surveyed using an interview template for the collection of data. Interviews were face to face apart from two phone interviews.

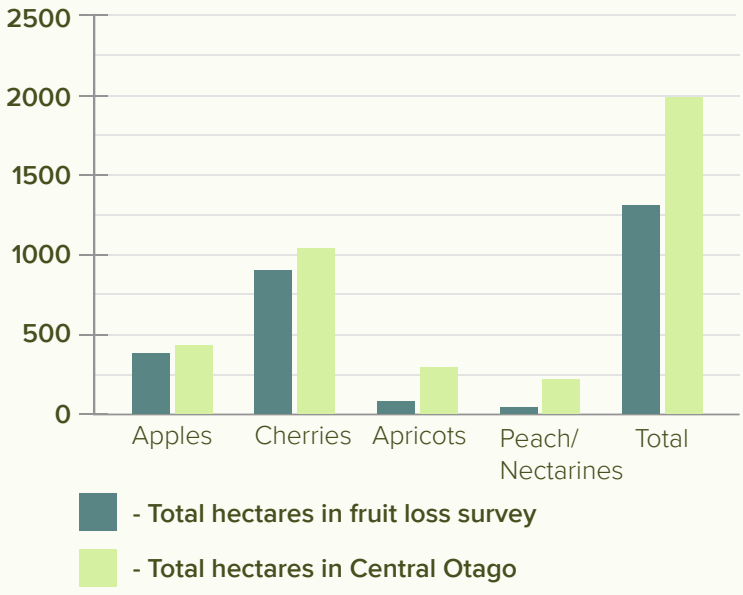
This information collected was extrapolated to give an estimate of the total Central Otago volumes. Scaling was conducted using statistics from the New Zealand Agriculture Census (2017) and the Central Otago Labour Market Survey for Horticulture and Viticulture (2018). A range of crop types were reported on and included cherries, apricots, nectarines, peaches, blueberries, apples and pears. Data was collected for pears and blueberries but is not shown in this report due to the small number of growers and commercial sensitivities.

Growth within the Central Otago fruit growing sector has been substantial between 2017-2021, with planted hectares increasing between 32% and 62% (Central Otago Labour Market Survey 2018). Many of these plantings are still maturing and yet to reach peak production.

SURVEYED AND TOTAL AREA/ TONNAGE

Overall, the survey collected data from 65% (1,306 ha) of the planted area in Central Otago. The total area was extrapolated from the Agricultural Census (2017) data and the 2018 Central Otago Labour Market Survey.

Survey and scaled total crop areas



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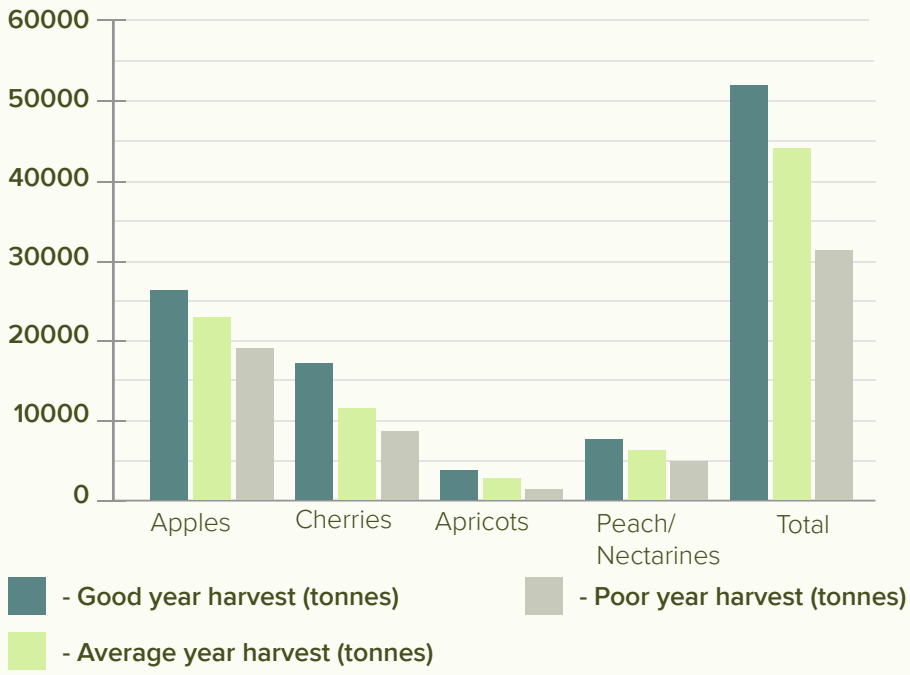
RESULTS

Total Harvest

The data below shows growers expected variation in harvested fruit crops in a good year, average year and poor year, based on production from current plantings. This data shows all fruit harvested which includes export, local, process and harvested fruit loss fruit. This data does not include non-harvested fruit. The data is scaled to estimate the total fruit harvested for the Central Otago region. There is a considerable variation between good, average and poor years. In a good year 52,536 tonnes are harvested compared to 32,180 in a poor year. The variation in harvest quantity will affect the quantities of fruit loss, as will any variation in fruit quality.

With an increase in planted area, the amount of fruit loss is likely to increase as these plantings begin to produce fruit. Growers agreed with this and considered there would be an increase in non-harvested fruit loss and harvested fruit loss.

Scaled fruit tonnage at harvest



	Good year harvest (tonnes)	Average year harvest (tonnes)	Poor year harvest (tonnes)	Variation between a poor and good harvest year
Apples	25,812	23,202	18,173	30%
Cherries	15,847	11,987	7,874	50%
Apricots	3,735	2,886	1,512	60%
Peach/Nectarines	7,142	5,906	4,620	35%
Total	**52,536**	**43,981**	**32,180**	**39%**

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Different crops have different levels of variation in harvest tonnage between years. The results show a smaller proportional harvest variation in the tonnage of apples produced per year. By contrast, with cherries there are large swings in harvest tonnage between good, average, and poor years. With cherries, a single weather event can dramatically drop the volume of export fruit and increase the processed, harvested fruit loss and non-harvested fruit loss volumes. Essentially the volumes will shift between categories with a rain event. Whereas with apples, there is less variation in export, local, process and harvested fruit loss from year to year. For apricots, which are early flowering, frost events can have a large bearing on fruit volumes.

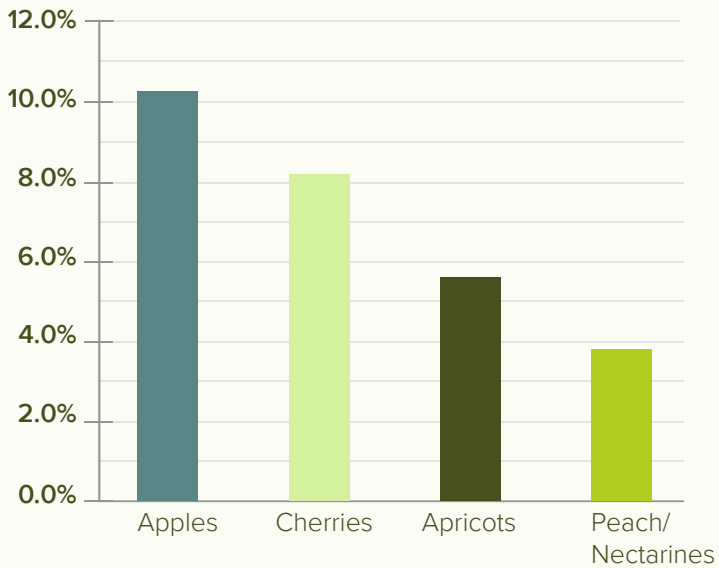
Overall, the relationship between a good, average and poor year is complex. In a good season, more fruit is harvested because of the quantity and quality of the fruit on the trees. This increases the quantities in all fruit grades, with proportionally larger increases to the export grade as growers are less likely to harvest as much if the fruit is not of a high quality.

In a poor season, the quantity and quality can be affected. The flow on from this is variable. With a lower volume, prices can be higher and as much fruit as possible is harvested and potentially exported. There will also be fruit in local, process and harvested fruit loss grades. If quality is the issue, there may be more fruit in the non-harvested fruit loss category, with an economic decision made not to harvest. More research needs to be considered regarding the relationship between good, average and poor seasons, specifically regarding the relationship between seasonal crop loads and the volumes within the categories of non-harvested fruit, export fruit, local fruit, process fruit and harvested fruit loss.

NON-HARVESTED FRUIT LOSS

Non-harvested fruit loss is a grower-estimated percentage of the fruit left on tree in an average year. This is an estimate and, as such, is likely to be less accurate than the harvested figures that are measured through the packing process. Research into consumer food waste has shown that consumers underestimate the amount of food wasted. In season research would be required to assess the accuracy of growers' estimates.

Surveyed percentage of fruit non-harvested based on an average year



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Overall, the volume of non-harvested fruit loss varies considerably by fruit type in an average year. Growers indicated that fruit not harvested is heavily influenced by:

- The crop type – cherries are more likely to be left on the tree than apples, apricots and peaches/nectarines because of several growing issues, such as fruit maturity, crop load and fruit damage.
- The season – crops such as cherries are more prone to climatic issues such as splitting and often this fruit is not harvested.
- Grower picking management – increasing numbers of growers are adopting strip picking. With strip picking, quality is dealt with at the packhouse by optical scanning grading equipment. Others growers choose to grade fruit in the orchard using picker decision-making, and therefore more fruit is left on trees. Some growers report 0% fruit not harvested and while others will have up to 30%. Strip picking could increase process grade with harvested fruit loss. Essentially, non-harvested fruit would most likely move into process grade or harvested fruit loss were it harvested.
- The percentage of apples non-harvested in the 2020 season reflects the labour issues related to the COVID – 19 pandemic. In a 'normal' season the fruit not harvested for apples would be less.

Non-harvested fruit loss could be better utilised if the fruit quality was acceptable, of economic value, and labour was available.

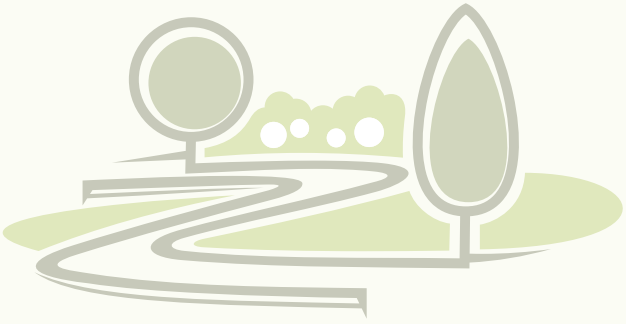
The table below shows the scaled total of non-harvested Central Otago fruit during an average year by converting grower percentage estimates.

	Tonnes of non-harvested fruit
Apples	2,669
Cherries	1,086
Apricots	163
Peach/Nectarines	233
Total	**4,151**

HARVESTED FRUIT LOSS

Harvested fruit loss is fruit that has been harvested and has not been sold. Sold fruit is export, local and process fruit.

Process fruit and harvested fruit loss account for relatively small proportions of total harvest compared to the volumes sent to export and local markets. The graph below shows the proportions of each fruit grade (export, local, process and harvested fruit loss) but does not include the non-harvested fruit loss.



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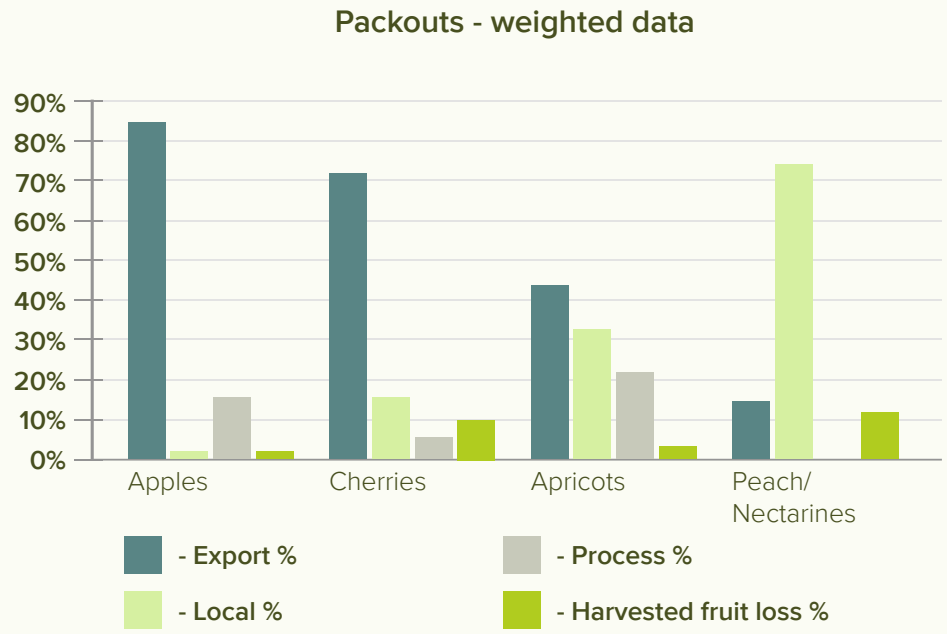

Process and harvested fruit loss accounted for 15% of the total fruit harvested for the orchards surveyed. Overall harvested fruit loss was 4.2% of the fruit harvested. It is important to note that the proportions of process fruit and harvested fruit loss fruit for each fruit type varies. For example, cherry process and harvested fruit loss fruit is 5% and 9% respectively, while apples are 15% and less than 1%.

The following table shows the scaled (estimated total) tonnage for Central Otago in an average year.

	Export		Local		Process		Harvested fruit loss	
	%	tonnes	%	tonnes	%	tonnes	%	tonnes
Apples	84%	19,481	1%	128	15%	3,469	1%	124
Cherries	71%	8,452	15%	1,804	5%	610	9%	1,121
Apricots	44%	1,267	32%	926	21%	617	3%	76
Peach/Nectarines	15%	879	73%	4,334	0%	0	12%	693
Total		**30,079**		**7,192**		**4,696**		**2,014**

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The total tonnage of product is highly variable by fruit type. In an average year for example, the 15% apple process fruit represents 3,469 tonnes, whereas the 5% cherry process fruit is only 610 tonnes.

Seasonal conditions in addition to fruit type can create a greater level of variation as noted in the Total Harvest section of this report. There is variation in crop tonnage between a good, average and poor year.

Fruit	Cherries	Apricots	Peach/ Nectarines	Apples
Harvest dates	Mid Dec - early Feb	Jan - March	Mid Jan - March	Late Feb - May

Growers commented about the harvested fruit loss. From a grower viewpoint, fruit loss was regarded as fruit that was not economically viable to consider, and often growers commented that they were focussed on growing fruit for export and local markets, not the process or fruit loss fruit. Non-growers might have a different view to this and could consider fruit loss as fruit that could be useful and may have possibilities for use, but just not used currently.

TOTAL FRUIT LOSS

Total loss includes non-harvested and harvested fruit loss. Essentially this is all the fruit th at is not sold/consumed.

The table and chart below show the total fruit tonnage in the various grades in an average year.

	Harvested fruit loss (tonnes)	Non-harvested fruit loss (tonnes)	Total fruit loss (tonnes)	Total production (harvested and non-harvested)	Percentage of total production that is lost
Apples	124	2,669	2,793	25,872	10.8%
Cherries	1,121	1,086	2,207	13,074	16.9%
Apricots	76	163	239	3,049	7.8%
Peach/Nectarines	693	233	926	6,139	15.1%
Total	**2,014**	**4,151**	**6,165**	**48,134**	**12.8%**

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FRUIT LOSS VALUES

Growers were questioned regarding fruit value in 2015 compared to 2020 for the various grades. The comments were mixed. Overall, there has been minimal change in fruit value during the period. The mixed view on fruit values showed that this was sensitive to varieties, market demand (local and export), seasonal variations due to weather events, niche lines and whether fruit falls outside other peak fruit times. For some growers the value had increased slightly and for others it had decreased slightly.

Process fruit values are low, but for many growers this was not an issue, given their focus is on the export and local fruit grades, not the process and fruit loss grades. Growers had mixed opinions on whether the value had changed for process fruit since 2015. Overall, opinions show minimal change in value for the process fruit. Growers would like to see a better return for process grades but recognised that freight and logistics makes this difficult. An interesting comment was made by some growers, 'that perhaps it is better to focus on improved orchard management to reduce fruit loss, than focussing on options for fruit loss'. Higher returns are paid for fruit sold to the export and local market compared to harvested fruit loss. Higher returns could make the non-harvested fruit worth harvesting.

Returns for process fruit varied depending on the fruit type.

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Returns - process fruit	Value	Use
Apples	6-25c/kg	Lower value for juice and concentrate, higher value for organic juice
Cherries	50-60c/kg	Juice and puree
Apricots	75c-$1/kg	Dried, pulp and cooking products
Peach/Nectarines	n/a	Not recorded in the survey but some processing does occur in these fruit varieties in the region. Process grade pricing appears as $0.00 below
Other	50c/kg	Juice

The table below compares average prices paid to growers for the different grades of fruit in 2020/21.

Average fruit values per kg	Export grade	Local grade	Process grade	Harvested fruit loss
Apples	$1.42	$1.25	$0.06	$0.00
Cherries	$16.91	$7.38	$0.71	$0.00
Apricots	$4.60	$2.97	$0.88	$0.00
Peach/Nectarines	$8.00	$3.71	$0.00	$0.00

The table below shows the value of fruit, estimated for Central Otago using the scaled data collected from the surveyed growers.

Fruit	Export $m	Local $m	Process $m	Harvested fruit loss $m	Total
Apples	$27.6	$0.2	$0.2	$0.0	$28.0
Cherries	$142.9	$13.3	$0.4	$0.0	$156.7
Apricots	$5.8	$2.7	$0.5	$0.0	$9.1
Peach/Nectarines	$7.0	$16.1	$0.0	$0.0	$23.1
Total	**$183.4**	**$32.3**	**$1.2**	**$0.0**	**$216.9**

The data shows the relatively low value to growers of process fruit compared to export and local market values. However it is important to note that process fruit is made into value added product. Beyond the orchard, value is added through processing, often in Central Otago. The scope of this report does not look at the value added through processing or seek to quantify food losses in processing. This could be an area for future research. Fruit loss currently has no monetary value.

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UTILISATION OF FRUIT LOSS

Fruit loss, either non-harvested fruit, or harvested fruit currently has very limited outcomes.

Non-harvested fruit occurs generally because much of the fruit is of low quality at the time of picking or due to a lack of labour. Low quality fruit left on the tree includes fruit not at the correct maturity at time of the picking, along with fruit damaged or diseased. Often non-harvested fruit is not economically viable to pick due to the small volume of quality fruit when it does mature. In some cases, higher picking rates would apply to account for the slow picking of this fruit.

In some instances, a lack of labour has contributed to fruit loss through not being harvested. In many cases this fruit could be harvested if there was labour available, and if it were economically viable to harvest it.

Harvested fruit loss currently has very limited use. It is often graded out through the packing process because it is of such low quality and may have disease issues. This fruit in most cases is returned to the orchard and mulched into the rows, composted, fed to animals or in rare cases dumped in a pit on the property.

All participants agreed that the process grade and harvested fruit loss will likely increase in the future. Growers believed the drivers were increased plantings, higher export grade standards driven by global competition and higher local grade standards driven by increased supply.

If export grade standards rise, this will have a flow on effect, increasing the local grade quality due to more export fruit appearing on the local market. An increase in export grade standards will see better quality locally. However, it will lead to more fruit ending up in the process grade. If processers don't have capacity to process or market demand for the processed product reduces the harvested fruit loss could increase substantially.

Currently, the main outcome for processing is juicing and drying of fruit. Further investigation is required to understand processors ability to take more fruit. Alternative processing options for this fruit were discussed by growers, but many did not see much use outside the current juice, pulp or drying options. Some however, discussed the potential for nutraceuticals and viewed this as a high value potential outcome for the fruit industry. This would need involvement from external agencies to provide the research and expert knowledge most likely coming from the tertiary sector and research organisations, possibly through support from industry bodies. Facilitation and coordination of these organisations may stimulate new developments.

There appeared to be a lack of understanding around composting practices for harvested fruit loss that was either dumped or mulched in the orchard environment. This practice will not reduce harvested fruit loss but will provide a sustainable and beneficial product. A recommendation from this report would be to follow up with composting seminars on-property, to help growers understand effective composting processes. While the harvested fruit loss may have no direct economic value, it has real value in enhancing the orchard soil environment and may help growers manage issues like SRD (Specific Replant Disorder) and overall long-term soil improvement.

In summary, fruit loss in this survey represents fruit not harvested and harvested fruit loss, which is 12.8% of the total Central Otago fruit crop.

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ABILITY TO HOLD FRUIT LOSS

Most growers indicated that they could hold fruit loss onsite for a period. Most had coolstores which could store fruit loss, but concerns were expressed regarding:

- The potential for fruit to degrade quickly if any disease were present on the fruit.
- Coolstores being at a premium during the harvest, so holding fruit loss could complicate their operations.
- Capacity being there during the off-season more than at harvest.
- Contamination from disease in fruit loss moving onto export and local fruit.

Overall, the ability to store fruit loss product for a period of time did not seem to be a major barrier.

COLLABORATION AND BARRIERS

All growers in the survey were supportive of collaboration regarding fruit loss, and some already collaborated with other growers or third parties to process fruit. There does not appear to be any resistance in working with others regarding fruit loss. The growers were mixed in their view of who they could contact about dealing with fruit loss. Some felt they had contacts and others weren't sure who to contact regarding their fruit loss.

The barriers described by growers in utilising fruit loss better and on a larger scale were:

- Disease/rots in fruit loss - time and quality issues.
- Chemistry of fruit – acid.
- Not being focussed on process/harvested fruit loss - export is their focus.
- The need for pasteurisation.
- High capital investment costs to deal with fruit loss.
- Viability - cost versus return for this fruit.
- The cost of waste.
- Processed products aren't New Zealand's game - let low-cost producers do this.
- A perception that niche markets couldn't deal with the volumes
- Freight costs for a low value item often don't stack up.

Overall, a theme did emerge when discussing these issues with growers. Numerous growers mentioned that their focus wasn't on fruit loss. They were focussed on growing export fruit, and to focus on fruit loss was a mistake. They considered it low/no value, but something they had to deal with. Several growers mentioned that for them, it may be better to focus on growing more effectively for export fruit and trying to reduce fruit loss. They considered this a more effective strategy than trying to focus on, and deal with fruit loss. They considered improved orchard management was key. From a non-grower perspective, the fruit loss identified might provide opportunities within the community or commercially.

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CONCLUSIONS AND RECOMMENDATIONS

The growing system is focused on producing fresh fruit for the export and local markets, due to the financial returns associated with them. Producing fruit for processing in the absence of local and export markets would not be financially viable without the higher returns received from these markets. Often the sale of fruit for processing is used as a way of cost minimisation, or recovery, along with ensuring some nutritional benefit is derived from the fruit, as the processing price received would not on it's own offset the cost of producing it. Social good initiatives may provide outcomes for the community and growers alike. Initiatives that may be cost recovery at best for growers, might have deep and positive community effects.

Several processing options operate currently, and these play a part in reducing potential fruit loss. Fruit that is processed is fruit not of a standard for export or local markets. Processors currently utilise 11% of the total harvest and help prevent lower standard fruit from becoming loss.

Total fruit loss (non-harvested and harvested fruit loss) accounts for 12.8% of the total crop. This is the fruit grown but not consumed/sold. Of this, 4.2% is harvested fruit loss that is often returned to the orchard as mulch or dumped, as it is judged not fit for further use, due to rots and other quality issues.

Both the non-harvested fruit at 8.6%, and the currently processed fruit at 11% have potential for alternative use or a higher value use than at present. Options for these lines could include better orchard management to reduce defects that make the fruit unsuitable for export or local market lines, or the development of higher value processing options to make it viable to pick fruit that doesn't currently get harvested. This fruit could find its way to the consumer through non-traditional marketing channels and/or be marketed as 'second chance' product.

Alternative processing outside traditional juice, pulp and drying needs to be considered. This will come from partnerships between industry groups and research organisations.

Investing in up-skilling of growers to utilise harvested fruit waste for high quality compost will have far reaching benefits for orchard longevity and soil health.

In the future, more detailed work is required to better quantify the grower estimate of non-harvested fruit, and to better understand the implication of a good, average and poor year on the amount of fruit not harvested and the harvested fruit loss. Further research is required to consider high-value alternatives for the quantities identified in this report.

REFERENCES

1. Central Otago Labour Survey Horticulture and Viticulture (2018)
2. Agriculture Production Statistics (June 2017)
3. UN Sustainable Development Goals
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