CASE STUDY

Reducing Fresh Strawberry Loss & Waste in the Retail Supply Chain

Using a whole-chain approach to identify hotspots and solutions

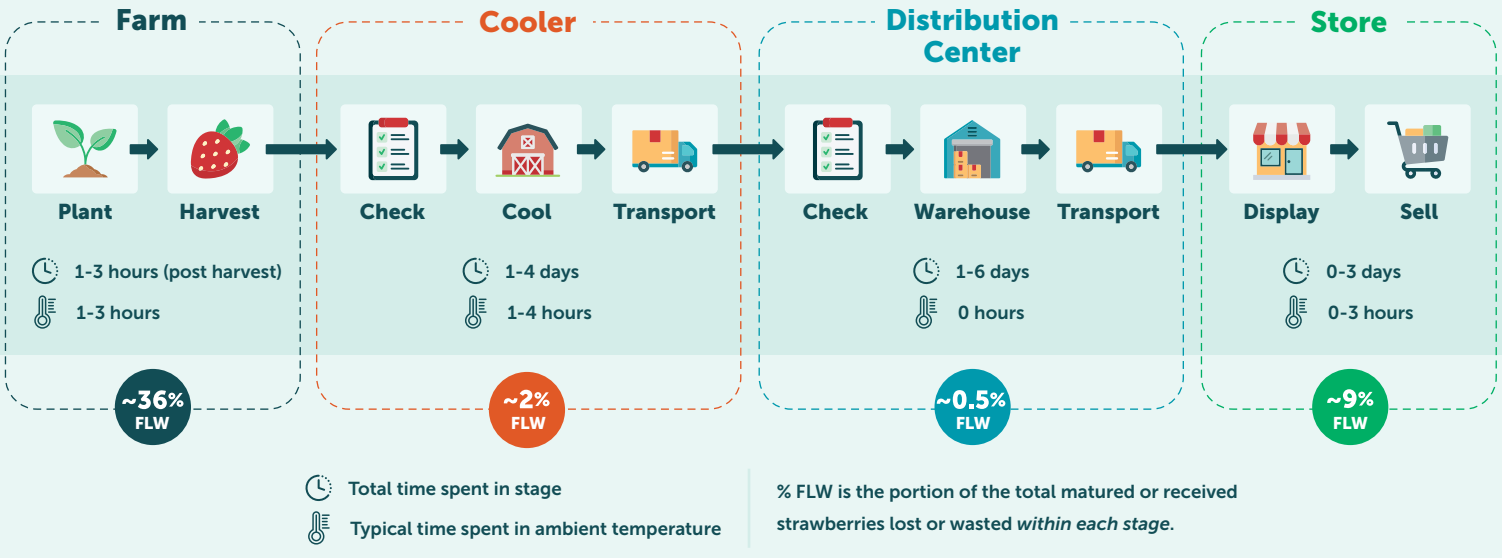
PACIFIC COAST Food Waste Commitment

Winter 2024

Executive Summary

The Pacific Coast Food Waste Commitment (PCFWC) commissioned a study on food waste in the fresh strawberry supply chain to identify hotspots and suggest interventions to reduce food loss and waste (FLW) and maximize profit. Several companies participated in the research, including two growers, one packer/supplier, and three retailers. The consumer, or household stage of the supply chain, was not included in this study.

Fresh Strawberry Supply Chain with FLW Rates by Stage



Identified Solutions

At the Farm

- Track in-field losses across the growing season, giving growers information to develop interventions that recapture the lost economic value of unharvested berries.
- Pair bulk harvesting with automated sorting and packing. Growers could capture most mature, edible berries, reduce labor requirements, and access profitable secondary markets.

At the Store

- Implement enhanced demand planning software to reduce excess backstock and move product to the sales floor more quickly.
- Utilize dynamic pricing technology that automatically discounts at a time and price that optimally captures revenue currently lost as waste.
- Rework strawberries that begin to show defects to salvage the maximum marketable berries.

Introduction

Reducing food waste requires coordination among stakeholders across the entire supply chain. Using a whole-chain approach provides comprehensive insight into the flow of product, relative waste hotspots at each node, and opportunities for waste prevention or redirection.

For this project, the PCFWC gathered stakeholders from across the fresh strawberry supply chain to study FLW from harvesting through retail sales. The team was composed of PCFWC staff, expert consultants, two growers, one packer/supplier, and three retailers.

Over seven months, the team collected data from enterprise software systems; conducted site visits and interviews with on-the-ground workers at farms, coolers, distribution centers, and stores; interviewed numerous subject matter experts; and reviewed industry standards. The group performed on-farm, post-harvest measurements at the beginning and end of the 2023 growing season in central California.

Why study strawberries?

Strawberries are highly perishable, vulnerable to physical damage, and sensitive to exposure in ambient temperature. Effective coordination between growers and retailers is crucial for managing shelf life. Retailers requested this study, since strawberries are a high-value item prone to loss. Strawberries are also highly resource intensive, meaning they require a lot of water, nutrients, labor, and other inputs to grow. Conserving those resources by reducing waste will help the planet, growers, and businesses along the supply chain.

Scope of the Study

Source and Timeframe

Store and warehouse data and on-farm measurement from 2021-2023

Material and Lifecycle Stage

Whole fresh strawberries from harvest to store cull

Waste Destination

Waste was left in fields or sent to animal feed, compost, anaerobic digestion, or landfill

Geography

Farms, Distribution Centers, and Retailers in the Pacific Coast region

Photo Credit: Adobe Stock

Food Loss and Waste at Farm and Cooler

Farm

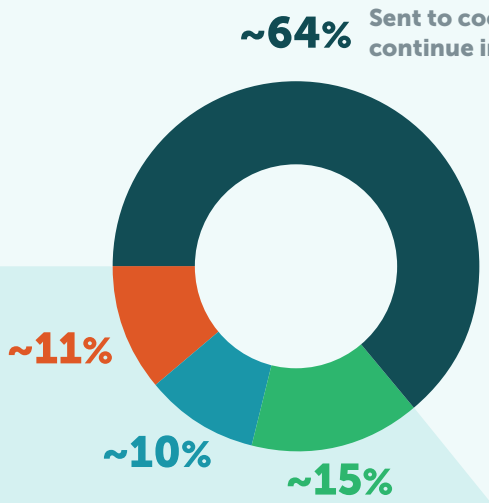
Fresh strawberries are harvested seasonally by hand. The season peaks in June and July in the region studied. Harvesters pass through every row twice weekly, picking ripe, quality strawberries and placing them directly into plastic clamshells. Harvesters pick for only one packaging format per pass, and specifications for the berries may differ across formats (e.g., domestic vs. export).

Losses and Why They Occur

The study found that on average 36% of mature strawberries are left on plants or in the furrows. Strawberries were left in the field because:

- Leaf cover may make it difficult for harvesters to find berries on plants.
- Harvesters, who are often paid piece-rate, focus on strawberries that are easy to see and quick to pick, prioritizing speed over thoroughness.
- Product specifications from retailers exclude some edible strawberries (e.g., strawberries may be edible but too small and therefore out-of-spec).
- The grower is constantly having to weigh the high cost of labor and their profit margins. Harvesting the berries that are edible but out-of-spec can go to the frozen or juice markets, but they bring a lower ROI than harvesting for the fresh market.

Of the Cultivated Strawberries



Food Waste

15% Marketable

- Missed in harvest
- Out-of-spec for retail product standards

~ 10% Edible But Not Marketable

- Too small
- Wrong shape
- Pest damage
- Discolored
- Overripe
- Bronzing

~11% Inedible

- Moldy
- Bruised
- Rotten
- Decayed
- Damaged
- Crushed

Photo Credit: Measure to Improve LLC (strawberry photos)

Fruit that does not meet specifications ("out-of-spec") may be tossed on the ground into furrows. Ripe strawberries that are missed will likely be overripe the next time harvesters pass. Quantities of marketable berries left behind were consistent across the season, but more edible and inedible strawberries were left behind late in the season compared to mid-season. This increase is a result of increased canopy size, greater presence of smaller strawberries, and greater disease pressure late in the season.

Cooler

Just-harvested berries are brought to a distributor's cooler to be inspected, cooled in forced-air tunnels within two hours of receipt, stored until they are allocated to a customer order, and shipped. Once cooled, the cold chain is designed to be maintained until the berries go into a shopping cart.

Losses and Why They Occur

Strawberries that do not meet specifications at receipt or in storage at the cooler are diverted to be processed, sold at terminal markets, donated, or dumped. Only dumped strawberries are considered food waste, accounting for 1.6% of strawberry volume inbound to cooler.

Why are strawberries dumped?

0.3% of the received strawberries are dumped after failing the inbound quality inspection. **(A separate 1.6% of berries that fail inbound inspection are rejected but redirected for other use.)**

0.2% are unsold and discarded, having aged out of the cooler.

1.1% are sold and shipped on a trailer, rejected at the retailer's distribution center, and not redirected for human consumption.

Every hour in ambient temperature before cooling reduces a strawberry's shelf life by one day.

"Strawberry Harvest & Storage/Shipping Considerations" https://rvpadmin.cce.cornell.edu/uploads/doc_98.pdf

Photo Credit: LIDD Consultants Inc.

Food Loss and Waste at Distribution Center and Grocery Store

Distribution Center (DC)

DCs inspect strawberries upon receipt, store them, and then ship to stores. DCs produce the least amount of FLW, accounting for ~0.5% of inbound volume, which is due to:

- Samples for quality inspection use 0.1% of all inbound loads. This material goes to composting.
- Food waste from handling (e.g., damages, ongoing quality checks etc.) within the distribution center is minimal at 0.4% of strawberries received.

Losses and Why They Occur

5.7% of strawberry loads arriving at the DC don't meet quality standards, but about half of these miss the cutoff by a small amount and are nonetheless accepted. These berries may have a higher chance of becoming food waste downstream. The other half of rejected loads are redirected to nearby wholesalers or accounted as loss in the cooler stage.

Strawberries destined for composting after quality control process at DC.

Strawberries for sale in chilled store shelving

Large bin in back of store with material for composting facility (de-packaging done later)

Store

Stores order strawberries daily or near daily based on guidance from forecasting systems. Upon arrival, strawberries are taken to coolers in the back of the store. Employees move product into chilled shelving in the store as needed and simultaneously cull clamshells showing signs of decay.

Losses and Why They Occur

On average across the participating retailers, stores do not sell 9% of strawberries received. This is for three primary reasons:

- Customers have high expectations of quality and uniform appearance. Clamshells are culled if they no longer look fresh or if even a single berry has visible signs of decay.
- There is a mismatch of supply and demand, resulting in excess product. This may result from over-ordering, lower demand than expected (e.g., due to weather event), or lack of tools to discount berries nearing end of life.
- The cold chain may have been broken at the store or earlier in the supply chain, resulting in shorter shelf life. This is difficult to trace in practice.

What Happens When Product Doesn't Sell

Once product is culled, it is either reworked, donated, composted, or sent to landfill. In this study, most culled berries were composted. Donation of strawberries was uncommon. Food bank pickups are not always frequent, and some food banks do not accept clamshells with any bad berries.

Recapturing Value at Farm and Cooler

Solutions

Focusing on the largest hotspots, many potential solutions were examined to reduce food loss and waste in the fresh strawberry supply chain. The solutions in this report are ones that:

1. Meaningfully and tactically address a major waste hotspot;
2. Apply to the context studied: field-grown strawberries serving the Pacific Coast; and
3. Build upon proven success stories.

The solutions are viable but must be developed further. Some solutions span multiple actors in the supply chain; others are focused interventions within one stage. Ongoing collaboration and vigilance around emerging technologies and regulations are essential to sustain improvements in the strawberry supply chain.

Track in-field losses across the growing season

Growers who participated in the study were not previously aware of the volume of marketable and edible strawberries left in fields. Understanding the scale of losses will motivate growers to develop new, ground-up solutions to recapture the lost economic value of the 15% marketable berries left unharvested. Packers/suppliers already support growers in measuring disease, quality, and yield in fields; adding waste as a key metric opens the door to recapture more revenue.

Preliminary measurement data suggests up to half of the edible category (accounting for 5% of all mature berries) are left behind due to small size. Carefully measuring berries that are edible but simply too small could help support changing size specifications or introducing a new product of small berries. This spec change would require cooperation across the supply chain from growers through retailers.

Data Drives Action

One grower participating in this study has already started sending their supervisors to regularly measure post-harvest loss. Supervisors check eachothers' plots, driving friendly competition, and spurring the team to introduce new loss reduction solutions. The grower said that the value is in setting an internal baseline and realistic targets, and then measuring toward those goals. They feel that collecting FLW data 2-3 times per season is feasible.

Pair bulk harvesting with automated sorting and packing to open up secondary markets

In this strategy, harvesters collect all ripe berries into intermediary containers, which are taken to a sorting facility where automated equipment, such as that made by Advanced Farm, sorts and packs berries into clamshells. Bulk harvesting is the harvesting approach of taking all mature fruit out of the field (which growers such as Good Farms and Bobalu Berries have already been able to demonstrate in their operations).

Our research showed that more common harvesting models were leaving a large percent of edible strawberries in the field. Automated technology that harvests, sorts, and packs the strawberries, such as that made by Advanced Farm, can also be used to address labor challenges that growers may face when trying to harvest more of the edible fruit. Bulk harvesting also keeps furrows cleaner, making them less vulnerable to disease and pest pressure, thereby helping reduce input costs. These less common harvesting models that demonstrate a reduction in waste and an improvement in harvesting efficiencies can unlock financing opportunities (e.g., with groups like Rabobank committed to financing measurable progress on food waste and regenerative agriculture).

This solution also unlocks the potential to sell edible berries through secondary channels, such as Planet Harvest, Full Harvest, and Misfits Markets, whose mission is to utilize more of the on-farm surplus being wasted today. These channels pay growers at least 13% more per pound than traditional secondary channels, such as juicing or frozen, which are often saturated by mid-season, helping to improve growers' economic prosperity.

Photo Credit: Adobe Stock

Recapturing Value at Retailers

Implement enhanced demand planning software

Enhanced demand planning refers to software using machine learning and predictive analytics to better estimate store order sizes. An ideal system optimizes fresh produce and takes into account variables such as inbound shipments, recent and historical sales, promotions, inventory levels, display sizes, seasonality, and perishability to make accurate store orders that need minimal intervention. More accurate ordering results in less product sitting in the backroom, reducing the amount of time products age but are not available for sale. Less human intervention in system-generated orders also saves labor. One retailer in this study uses Afresh software designed specifically to generate produce store orders and has seen a significant improvement in reducing backroom stock. In a sampling of Afresh's clients' data, strawberry waste was reduced by 15.5% after implementing its software.

Photo Credit: Adobe Stock

Utilize dynamic pricing technology

Dynamic pricing is a robust approach to match supply with demand in real time, capitalizing on market conditions to drive sales and decrease waste. By adjusting prices according to demand fluctuations, inventory levels, and product freshness, retailers can incentivize purchases of strawberries that are nearing the end of their shelf life. Retailers have long done a version of this through manual rollbacks or markdowns at the item or unit level. Dynamic pricing technology today provides methods that require less store labor and individual decision-making while maximizing revenue. One retailer in this study uses a mobile application to offer rapid e-coupon discounts on excess or marginal store inventory; the greatest increase in sell-through relies on collaboration between in-store produce managers, who know local conditions, and corporate inventory analysts, who bring market insight. Retailers may also find success using digital price tags and advanced predictive software.

Rework to salvage marketable strawberries

Clamshells with a few decaying or damaged berries may be salvageable. One rework option is to consolidate clamshells, replacing bad berries with good ones. Another is to discard bad bits and cut the remaining fruit for a cut-fruit item, salad bar, or the deli and bakery. This provides an opportunity to capture revenue and successfully reduce waste. Most grocery stores have facilities for this transformation, but many lack the necessary labor. Where this was seen in action, it provided an effective outlet for recapturing product for sale.

Solutions Summary

Primary Hotspots	Reasons for Loss	Possible Solutions
Berries left in field at harvest (~36% of berries cultivated)	■ Plant variety and canopy size affect how hard it is to pick ■ Wage structure incentivizes speed over thoroughness ■ Specs may exclude edible berries	■ Track in-field losses across the growing season ■ Pair bulk harvesting with automated sorting and packing to open up secondary markets
Berries show signs of degrading at store (~9% of berries received at store)	■ Mismatch of supply and demand resulting in overage ■ Customers' expectations of quality ■ Weakness in cold chain at store or earlier in supply chain	■ Enhanced demand planning software ■ Dynamic pricing software ■ Rework programs ■ Consistent cold chain storage at store

Photo Credit: Adobe Stock

Challenges

During the study, a few themes emerged consistently that point to the challenges of developing solutions to FLW in the fresh strawberry retail supply chain:

Financial Pressures

- The upfront cost of reducing FLW can often exceed the short-term cost of wasting product, making it financially unattractive to minimize waste.
- When improvements are first implemented, gains are observed. But later, these efforts can be seen as an expense with no additional benefits against an improved baseline.

Labor Cost and Availability Constraints

- Farm level: Harvest labor availability is limited. Labor market structure makes it difficult to experiment for fear of losing harvesters.
- Store level: Stores experience high turnover, increasing the cost of training and the probability of noncompliance.

Technological Interventions

- Promising solutions, like shelf-life extension technology to reduce waste, are still in development and may not yet be cost-effective.
- Conducting pilots at scale is time consuming.

Temperature Control

- Maintaining the cold chain is essential. Lack of chilling speeds up degradation and decreases shelf-life.
- In peak season, strawberries spend more time waiting to be inducted into the cooler.

Weather Impacts

- Harvest quality and quantity are highly weather-dependent and sometimes unpredictable, making forecasting complicated.
- FLW tied to weather events is difficult to mitigate.

Next Steps

The PCFWC plans to investigate piloting and implementing the solutions identified. The suppliers and retailers involved in the pilot at its conclusion indicated interest in exploring whole chain solutions, such as working to establish new SKUs of berries that are currently outside of fresh market specifications. It is critical that such solutions be investigated, as they stand to have the greatest impact on farm strawberry losses where the bulk of the waste occurs.

The learnings and solutions identified from this pilot can also be applied to other supply chains and products, accelerating progress toward food waste reduction. The PCFWC will work with other products, retailers, and suppliers that are ready to adopt these strategies.

Acknowledgments

The PCFWC would like to thank the participating growers and retailers for their collaboration in developing this case study. It serves as an example of the challenging, but critical whole-chain collaboration required to develop best practices and accelerate progress on food waste prevention. The group would also like to thank WRAP, whose whole chain methodology inspired the project.

About the Pacific Coast Food Waste Commitment

The Pacific Coast Food Waste Commitment (PCFWC) arose out of the Pacific Coast Collaborative in 2016 and is an innovative public-private partnership made up of West Coast jurisdictions, U.S. food industry leaders, and nonprofit resource partners that together seek to eliminate food waste in the region by 50% by 2030. Learn more about the initiative and its members at pacificcoastcollaborative.org/food-waste.

Photo Credit: Measure to Improve LLC