



Left-Out

An Investigation of the Causes & Quantities of Crop Shrink

Commissioned by the
Natural Resources Defense Council

Executive Summary

The confluence of exemplary growing conditions, innovative agronomy practices and access to markets has positioned the U.S. as a leader in providing nutritious fresh produce and fruit to the world. The notable gains in productivity realized by the sector in the past thirty years will need to continue, and in fact increase over the next three decades in order to feed a growing population and meet the rising caloric demands of an increasingly affluent population. Historically, increases in volume have been realized through augmentation of the amount of land in production. However, the limited amount of arable land remaining for cultivation dictates that the projected surge in demand be met through increases in productivity and efficiency. In order to identify and address opportunities for increased efficiency in the agricultural value-chain it is helpful to change the yield metric from pounds harvested per acre to pounds converted to human nutrition per acre. By shifting focus to the true objective of food production, feeding people, it is easier to appreciate the significant amount of shrink that occurs between the field and the plate. Getting a higher percentage of the crops available for harvest onto the plate is an effective way to feed a growing population, using the same amount of land, without requiring an increase in inputs such as fertilizers, agrochemicals and water and their associated environmental impacts.

This research report adds to the current body of knowledge surrounding how much safe, edible produce is available for harvest but never reaches retail or foodservice customers, why these crops are diverted, and what appropriate next steps can be taken to reduce the volume of these diverted crops.

METHODS

Primary data collection was performed through a small set of in-person interviews, conducted with growers and produce packers in Central California in July 2012. A total of sixteen large commercial vegetable and fruit growers and shippers were interviewed. Given the low sample size, there was no statistical analysis performed; therefore the data that is contained in this report and which informs the recommendations are considered preliminary until a fuller more robust study can be undertaken.

DEFINITIONS

Even within this small sample size there was wide diversity in the way crop shrink was defined and the how the issue was perceived by the industry. In this paper we provide a working definition of crop shrink as well as definitions for different types of shrink encountered during the research as follows:

Crop Shrink - The difference between the volume of edible crops available for harvest and the volume entered into commerce for human consumption.¹

Which is further divided into:

Pre-Harvest Shrink – Edible crop that remains in the field or orchard where an entire block is not subjected to any harvesting processes, also known as walk-bys.

In-Situ Culls - Edible crop that remains after a field or orchard has been harvested due to cosmetic, size or quality characteristics.

Packing Culls – Edible crop that leaves the field or orchard but does not enter commerce.

ESTIMATING SHRINK VOLUMES

Establishing robust volumes of each type of shrink for the major commodities would allow for calculations of financial and environmental impacts to be made and mitigation strategies developed. However, appropriate measurement methodologies and incentives to measure and report shrink either do not exist or are in very nascent stages of development. This is particularly apparent with in-situ shrink.

Growers, for their particular operations, can accurately estimate volumes of pre-harvest shrink, also known as walk-bys, however, there is often a strong reluctance to disclose the data. The research team relied on producers and packers to provide estimates or ranges of the volumes and types of shrink experienced by their operation. Due to the high degree of variability in the reported data, small sample size, and inability to corroborate data, estimates on the exact amount of shrink that normally occurs between field and retail cannot be estimated with a statistically acceptable amount of certainty.

Although lacking sufficient sample size, the calculations made with the data obtained through the study do indicate the need for a more extensive look into this issue. Survey results were as follows:

¹ More detailed definitions including for 'Entered into Commerce' and 'Edible' are included in the body of the report

Self-Reported Estimates from Producers for Pre-Harvest Shrink

(% by weight of total available harvest)

Type of Shrink	Low & High Estimates	Cherries	Pears	Plums	Head Lettuce	Nectarines	Broccoli
Pre-Harvest Shrink	Low	1%	5%	10%	3%	10%	5%
	High	20%	15%	30%	6%	30%	20%
In-Situ Shrink	Low	0%	0%	0%	1%	0%	1%
	High	0%	0%	0%	4%	0%	2%
Packing Culls	Low	2%	2%	2%	1%	No Data	No Data
	High	10%	30%	30%	4%	No Data	No Data

Using publicly available data from County Crop Reports and Cost Return Studies the shrink estimates obtained from our sample were translated into inputs, both financial and non-financial. One example of these calculations took the low shrink estimates of broccoli grown in Monterey County and multiplied them against harvest, yield and irrigation data provided in crop reports and production cost studies. One of the findings from this example is that approximately 2.5 billion gallons of water were required to grow broccoli that never entered commerce. The use of regional harvest, yield and irrigation figures rather than actual data adds imprecision to findings such as these. But what these calculations do provide is ballpark figures to consider crop shrink through the lens of inputs and impacts rather than just volumes.

DRIVERS

While quantitative estimates of loss involved some guesswork, there was more certainty about the drivers contributing to crop shrink.

Overplanting - It was frequently reported that growers would purposefully overplant what was required to fulfill a marketing contract. At the root of this practice is the common perception that the cost of being short on an order is higher than the cost of planting and caring for buffer crop that may not get sold.

Low market prices - Those producers that grow for the spot market face a tough decision just prior to the harvest window. Low spot prices can mean that the costs of getting a crop from the field to market outweigh the revenue that would be gained from its sale, leading to whole blocks of harvest-ready product becoming pre-harvest shrink.

Labor shortages - Other pre-harvest shrink was caused by a shortage of labor. Increasingly producers are facing difficulties attracting and retaining skilled harvest crews, which means many market-ready fruits and vegetables remain unharvested.

Product grading - Cosmetic and quality considerations such as size, shape, color, blemishes and ripeness also factor into whether product is sold for human consumption or falls into one of the three categories of shrink. In some cases an entire block will be assessed to be below market-grade and will become a walk-by. Harvesting crews are trained to pick to certain specifications. Product that is deemed to be below specifications is left in the field or orchard, consistent with the definition of in-situ culls. Commodities that are not field-packed are then subjected to another quality check at the packing facility. Anything that is selected out at this stage is considered part of packing culls.

Anticipatory packing - Shrink can occur at processing and packing facilities when anticipated daily orders are not as large as forecast, resulting in extra packed product still on the dock at the end of the day.

Shelf-life and spoilage - The costs and logistics of maintaining a cold chain in order to extend a product's life can be expensive and require significant infrastructure. This makes donating or finding other markets for produce more difficult, time-sensitive, and costly than, for instance, surplus clothing.

TOWARD SOLUTIONS

While some of the drivers for crop shrink, like the buyer-seller relationship, are based on entrenched practices that require an industry-wide effort to change, other methods of reducing crop shrink are less complex. Diverting edible crop from the landfill to families who cannot normally access fruit and vegetables represents not only a reduction in the environmental footprint of the products but also results in a social good. There is an opportunity to invest in increasing the capacity of established donation channels such as local food banks while also expanding programs like concurrent picking and cross-docking to expand both the supply and geographic reach of donations.

Going forward, the dearth of data about crop shrink should be addressed through a larger study that benefits from the participation of more growers and shippers that represent a greater diversity of commodities and regions. Being able to identify the commodities with the largest volumes of crop shrink and the specific drivers at play would allow for more precise targeting of mitigation strategies and programs. Gaining this additional participation and developing meaningful solutions in a manner that is appropriate and beneficial to the industry leads to the recommendation that a working group be created of stakeholders spanning the value-chain that can address key issues in a pre-competitive setting. Aligning on definitions, measurement methodologies and security of shared data could serve as the basis for the development of a roadmap that prioritizes efforts and establishes appropriate roles for participants.

Actions that could be assessed by the working group for reducing crop shrink include:

- Considering how the structure of the buyer-seller relationship can be adjusted to remove incentives that lead to overplanting;
- Adapting grading standards in order to allow more safe, edible food to enter commerce and raising consumers' understanding of product attributes beyond just cosmetic qualities;
- Increasing the geographical reach and volume capacity of donation streams;
- Expanding concurrent picking programs in order to reduce in-situ culls and increase the social good;
- Further developing secondary markets and product innovations that utilize off-grade crops;
- Addressing labor shortages through innovations in farm worker management;

The reduction of crop shrink will require changes in practices in the field, at the packing facility and in the buying room. The opportunity for operations to reduce costs and risks while decreasing the environmental impact of their productions and providing a social good through the delivery of nutrient-dense fruits and vegetables to low-income families offsets the disruptive nature of these changes and the inertia of business-as-usual. At a time when the agricultural sector is facing increased risk and scrutiny from consumers and regulators, making meaningful and measurable progress on reducing shrink offers the opportunity for the industry to accompany an increase in efficiency with the development of a compelling and authentic narrative of environmental and social improvement.

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Introduction

The variability that is imposed daily on the production of food from natural forces such as weather has historically required farmers to be particularly nimble in their decisions and actions. Being able to not just grow food, but to do so with long term profitability, requires navigating complexities such as the shifting regulatory environment, changing consumer preferences, reduced availability of labor and agricultural inputs that are becoming less available and more expensive. One of the historical approaches to managing the risk inherent in this environment was to produce as much product as possible and hope that the combination of high yields and a good market would sustain an operation in times when either of those was low. Contained in this model however can be a great deal of inefficiency and negative impacts. One of the most pronounced inefficiencies is illuminated whenever safe, edible food is not converted into human nutrition. For producers and packers this represents unnecessary costs and lost revenue. For society it means that the environmental impact of production is borne without an accompanying benefit of contributing to human food supply..

This research report sets out to determine whether there is a material amount of produce available for harvest that is not being converted to human nutrition. The scope of the investigation is from the field to the point where the product enters commerce at the distribution center of a retail or foodservice customer. The drivers that contribute to the amount of shrink that is experienced within this scope are explored and further actions proposed that can lead to more thorough estimations of the volumes of the shrink and the development of appropriate mitigation strategies.

Methodology & Scope of Study

This paper is intended to address the dearth of data in the literature concerning the volumes, causal factors and mitigation strategies for crop shrink that occurs between the field or orchard and the final customers' distribution center (DC). The geographical focus of the study is the Central Coast and Central Valley of California. These regions were chosen because of the significant production volumes they represent for produce and stone fruits.

Data Collection

Primary data collection was done through in-person interviews with large, commercial produce growers and shippers in July, 2012. A total of sixteen interviews were conducted with people from participating organizations who could provide insight into where crop shrink was taking place.

Interviewees were given anonymity – as a condition of providing data to the research team, they were given assurance that any data used in this report would not identify them as the source. The research team that conducted the interviews, analyzed the data and developed this report was from Common Fields, the sustainable agriculture practice of Milepost Consulting. In order to encourage the participation of organizations that might have reservations about sharing data, there was an agreement at the onset of the project that Common Fields would not give NRDC visibility to any of the interview notes or to any raw data that could be attributed to a specific person or organization. Interviewees were informed of this arrangement at the beginning of each interview.

Limitations of the Dataset

A request to participate in the study was made of many of the largest agri-businesses in the selected geographies. The final list of those who were interviewed was made from those who responded affirmatively and who were available during the period that the research team was in the Central Valley and Central Coast of California. Thirty-four producers were contacted initially and sixteen responded willing to take part in the study.

Due to the selection process, it cannot be assumed that the responses received are reflective of the larger population of producers, shippers and buyers in these regions. Additionally, in the absence of verifiable quantitative data, participants were asked to provide estimates, averages or ranges based on their experience in the industry. Given the low sample size, there was no statistical analysis performed; therefore the data that is contained in this report and which inform the recommendations must be considered as preliminary.

Defining the Issue

For the purposes of this study, crop shrink is defined as - **The change between the volume of edible crops available for harvest and the volume entered into commerce.**

Words Matter

Other common terms that are used to speak about this issue are *food loss*, *food waste*, *crop waste* and *crop loss*.²

Due to the vague concept of when a plant becomes food, we have chosen to refer to crops or product rather than food.

Crop loss is also used to describe an “area infested by pests” and the difference between attainable yield and actual yield that results from an infestation. Since the starting point for this research is edible fruits and vegetables available for harvest, we are choosing not employ this term.

The ambiguity of how “waste” can be interpreted reduces its strength as a precise descriptor. For example, food that is sent to the landfill is easily identified as waste but if it is instead diverted to be cattle feed it may be under-utilized but not necessarily wasted.

Entering commerce is defined as the point at which ownership of edible product is transferred from a grower/shipper to a retail, food processor, aggregator or food service company for the purpose of supplying human nutrition.

There are different types of crop shrink:

1. **Pre-Harvest Shrink** – Edible crop that remains in the field or orchard without being subjected to any harvesting processes. An alternative term for Pre-Harvest shrink is Walk-bys (defined below). In some circumstances the crop is disked under and other times it is left as is.

2. **In-Situ Shrink**- Edible crop that remains after a field or orchard has been harvested due to cosmetic, size or quality characteristics

3. **Packing Culls** – Edible crop that leaves the field or orchard but does not enter commerce

There are many outcomes for culled crop. Product that does not meet the cosmetic standards required for many retail channels is often diverted to a less demanding retail stream or sold on a secondary market such as juicers, processors, etc. While these are not top revenue tiers, the product still qualifies as

² Otterdijk, R. v., & Meybeck, A. (n.d.). Global Food Losses and Food Waste. *fao.org*. Retrieved August 29, 2012, from <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>

entering commerce for the purpose of human consumption and therefore is not considered shrink per this definition.

Many agribusinesses support their local communities through the donation of product including edible, safe items that aren't of a retail grade. **Donated crop** is defined as edible crop that is provided to a non-commercial entity like a food bank at any stage in the value-chain including through gleaning. In some cases food banks pay to receive the product and other times it is a pure donation. Although it is recognized that a food bank is not a commercial entity these donations are a source of nutrition for people and therefore are not included as shrink in this paper. Donations should be considered a legitimate alternative in many cases for product that would otherwise qualify as shrink.

This study is only considering shrinkage of edible rather than inedible fruits and vegetables. One key determinant of **edible** is that the food item is safe to eat and does not contain any known pathogens or toxins that could affect the health of a person consuming it. Once safety has been established the definition becomes more subjective since not everything that is safe is also appealing. Edible product implies that the freshness, taste and physical condition are such that it would be reasonable to consume and enjoy the product. A useful guide for considering what is and isn't edible is to consider whether, if the fruit was grown in a home garden, a gardener would be likely to eat it. Although this is not a measurable specification, this guideline attempts to lessen the importance of physical characteristics but not eliminate them completely. Edible product therefore may or may not be of typical retail grade.

The fruits and vegetables which are referenced in this document are referred to as crops, products and produce. Additionally, the terms field and orchard are both used. In cases where the reference is not specific these terms can be considered synonymous.

Measuring Shrink

Pre-Harvest Shrink

There are a number of reasons for why edible crop that is available for harvest never leaves the field. Three significant factors are:

- The size and cosmetic quality of the crop does not meet the standards of the expected buyers and/or marketing orders;
- The variable costs of harvesting (labor, fuel, packing materials, etc.) are higher than the anticipated revenue that can be generated on the market;
- Labor is not available to harvest the product.

When it is determined prior to sending in a harvesting team that an entire section of field is either not of sufficient quality or not economically advantageous to harvest this is referred to as a **walk-by**. An estimation of the volume of pre-harvest shrink that each walk-by represents can be made using farm management tools employed by the majority of growing operations. These operations conduct a forecasting exercise which takes into account the pounds of crop or the amount of acres that a producer is under contract to provide, expected pest loss, anticipated effects of the weather for that season, and a prediction of the open market price upon harvest for non-contracted crop. Through a growing body of experience and increasingly sophisticated software these estimates tend to be quite accurate. Using these projections or yield data from previous years or from adjacent parcels with analogous conditions, pre-harvest shrink can be easily quantified at the farm level. Calculating these volumes at a commodity or regional level is difficult, not because of the complexity of the measurement methodology, but because of the sensitive nature of the data and the resistance of many producers to share it externally. In addition, quantities can vary significantly year to year, thus requiring several years' data to come up with any sort of average.

In-Situ Shrink

Harvesting teams are trained to select only produce that meet certain thresholds including size, color, evidence of disease, presence of pests, ripeness, and cosmetic qualities. Many of these are subjective decisions that are made thousands, even tens of thousands, of times a day by a harvesting crew. Regardless of whether the commodity is being field-packed or transported to a packing facility, edible produce that they decide to leave in the field is considered in-situ cull.

Measuring the volume of edible crop that is left in a field after all harvesting activities have ceased can be done in a manner that is as simple as it is impractical – that is to harvest ALL edible produce regardless of quality and size characteristics and weigh what is culled. Undertaking this step would provide the highest quality data on in-situ culls but would be costly, hence this is not a current practice undertaken by any of the studied organizations. Developing robust factors that can be applied to establish a reasonable estimate of in-situ shrink is more likely to happen using research methods and funding structures as there is no commercial incentive for a producer to conduct this study.

In lieu of hard numbers measuring in-situ culls, growers were asked to provide an estimate of the volumes that they experienced in a typical year. These numbers and ranges are shown in the Developing Shrink Estimates section below.

Packing Culls

Capturing packing cull data tends to be more straightforward than in-field shrink. Within the definitions set above, culling takes place after the crop has left the field for off-site processing and/or packing. Product is culled from the packing line based upon size, cosmetics and quality considerations. The methodology for measuring packing culls is the total weight brought to the loading dock of the packing facility subtracted by total weight loaded onto outbound transportation. In most cases the data is known by facility operators. In cases where packers/shippers were reluctant to share actual data, they were asked to provide an estimated range.

Transportation

In the produce value chain there are several transportation steps. For shed packed products there is both an inbound and outbound transportation leg. For field packed crop, transportation is required to get packed product to either a cooler or a customer's distribution center (DC). No evidence emerged that a material amount of crop shrink occurred because of practices employed in transporting product. These data therefore suggest that mitigating shrink during transportation is not a priority area to develop.

All Shrink is Not Equal

When considering what happens to crop collected by the packing cull stream, it is important to note that not all outcomes are equal. Depending on the commodity a secondary market can be found that results in the product being used for human nutrition. These alternative revenue channels for high grade retail products can include frozen, food service, juicing or donation to a food bank. According to the definitions offered at the beginning of this section this should not be considered shrink but rather an adjustment to the revenue that the crop is able to be sold for. In all cases where the culls are not converted to human nutrition, then shrink is occurring. Three likely outcomes for this culled product are -

1. Animal feed
2. Spreading onto agricultural lands
3. Sent to landfill/incineration

Composting

Composting was not identified as a common outcome for packing culls though one producer spent some time talking about his methods of composting and the potential opportunity he saw for developing commercial composting capacity in agricultural areas.

He pointed out that while composting does take some instruction initially, it is not difficult to have a large composting site to provide a good nutrient source for the fields and a place to dispose of culls, windfall, trim, etc.

In his view the main issue is with regulations that are ambiguous as to the uses and permits around composting. Many view non-compliance as too significant of a risk and therefore continue with the practices that have worked for them in the past, as noted above.

Another producer described a more sophisticated composting system that was being implemented, and although the details were not divulged, this is an area that is very compelling for future research and presents considerable potential for reducing the impacts of organic waste in municipal landfills.

Both animal feed and the distribution of culls onto agricultural land can contribute to the production of human nutrition by providing nutrients to either livestock or soil. The recovery of nutrients and reduction of emissions is most effective in a composting system. However, under the definitions used in this paper, all of these destinations still qualify as shrink. In fact, the distribution of organic material onto agricultural lands has all the characteristics of shrink that is classified as pre-harvest or in-situ except with more transportation and processing involved.

Every effort should be made to keep organic waste out of the municipal waste stream. When shrink is landfilled, emissions generated from the production and transportation of the crop are augmented by methane emissions that are created as produce break down anaerobically. Methane is a powerful greenhouse gas that is 23 times more potent than CO₂. Because of the temperature and air circulation characteristics of most landfills, organic matter decomposes differently than when it is left in soil. Produce that is landfilled also contribute a significant amount to filling the finite space that is available to municipalities for landfills. For producers, sending product to landfill means that there is no return on the investment that was made to

harvest, pack and ship the crop. In fact, as is also the case with diverting culls to animal feed or a soil amendment, there are often additional costs associated with disposal transportation.

Drivers of Crop Shrink

Overplanting

There are many types of contracting agreements that growers enter into with retail and food service customers for the provision of fresh produce. Some of these arrangements are as simple as handshakes that promise to provide a certain tonnage by a certain date. More complex contracts can dictate a varied mix of terms such as when ownership transfers, growing practices, quality specifications, price variations based on changes in market conditions and penalties for failure to deliver. Not only do producers frequently have to manage a different contract structure for each of their customers, there are instances where there are different types of agreements between the same grower and retailer. The three aspects of contracting that were most frequently reported as contributing to crop shrink were the quality requirements, the penalties associated with not delivering agreed-to volumes, and the buyer purchasing below the contracted volume without penalty.

The immediate price borne by a grower for not delivering a contracted amount to a customer can be calculated by adding the lost revenue with any fines or adjustments to price applied per the terms of the contract. Considering the variability of growing conditions, occasionally delivering light loads could be considered a reasonable cost of doing business. However, the perception of the interviewed growers is that this immediate price isn't the true cost of coming up short on a contracted volume. What is at risk isn't just lost revenue related to that delivery but the relationship with the customer. If the customer represents a significant amount of revenue for the producer, which is often the case with some of the largest food buyers, then an incentive is created to plant beyond the amount normally required to produce the required yield. Essentially, this makes the risks inherent to farming entirely borne by the growers. Therefore, they overplant in case there are weather, pest, fungal or other events that reduce yields. Depending on the commodity and the contractual relationship the amount of overplanting that is done in order to mitigate risks to an important buyer relationship varies. Anecdotally figures such as 10% for head lettuce were shared.

It cannot be assumed that the amount of edible product that remains after contracts have been fulfilled is necessarily shrinkage. Producers will try and find other market channels to sell the products including other customers, secondary or spot markets. These volumes are also frequently directed towards a donation stream. But there is a relationship between overplanting for contractual or other reasons and shrink. It can be that the grower is unable to find a customer and the product is disked or, if already harvested, landfilled. The act of putting additional volumes onto the market also contributes to shrink

because of the price implications of providing additional supply. If demand is static then the volumes made available by overplanting will drive down the price which can close the gap between the variable costs of harvesting and the revenue potential – a key driver of walk-bys.

Market Price versus Harvest Costs

Although the amount of produce being grown under marketing contracts continues to increase there is still a significant volume that is grown for the open market. This is the historic model of agriculture where

$$\text{Spot Market Selling Price} - \text{Fixed Costs} - \text{Variable Costs} = \text{Profit/Loss}$$

Fixed costs for growing generally include lease payments, equipment depreciation, water, fuel, nutrient, and pesticide inputs, cost of genetics and crop (tree, seed or transplant) and taxes. Variable costs include the picking crews, shipping, packing, and packaging. Management overhead and budgets for marketing and sales staff are allocated very differently depending on the organization and its structure.

Estimations of the ratio between variable and fixed costs were made by producers during the interview. These are shown in the Table 3 below. Also in the table are similar estimates from UC Davis Crop Studies. Acknowledging that the sampling that occurred to create both sets of these numbers doesn't allow for them to be robustly applied across a commodity or a region it does suggest, in lieu of better data, that variable costs tend to be just over half of total costs.

The relationship between the market price during the harvesting window and the harvesting costs can determine if a field becomes a walk-by or not. If the revenue that the market can provide is lower than the variable costs then it becomes economically unviable to harvest product, regardless of other factors such as cosmetic quality or nutritional value.

Table 1

	Variable Costs		Fixed Costs	
	Interviews	Cost Study	Interviews	Cost Study
Nectarines	60%	63% ³	40%	37%
Broccoli	40%	52% ⁴	60%	48%
Cherries	50%	35% ^{5, 6}	50%	65%
Pears	50%	29% ⁷	50%	71%
Plums	47%	54% ^{8, 9}	53%	46%

We took yield and cost values from the 2012 Central Coast Broccoli Cost Study¹⁰ to describe the economic decision making steps of whether to harvest or not (Table 2). According to these figures every one hundred acres of broccoli that is ready for harvest has \$291,000¹¹ worth of fixed costs invested in them, and will require another \$315,900 to take the broccoli to market. Total expected revenue using a mid-range price for an F.O.B. carton of 14s¹² of \$8.30¹³ is \$483,060, which translates to \$123,840 below total costs per acre. The producer's decision is then between to not harvest the crop and lose fixed costs of \$291,000 or to harvest, recovering some money, but still enduring a total loss of \$123,840. At an \$8.30 market price the producer is likely to choose the smaller of the two losses and proceed with harvest. But if the price was at \$7.00 the cheapest loss would be to do a walk-by of that particular field.

³ Day, K., Klonsky, K., & DeMoura, R. (n.d.). Sample Costs to Establish and Produce Nectarines. *Cost Studies*. Retrieved September 21, 2012, from coststudies.ucdavis.edu/files/nectarinevs09.pdf

⁴ Dara, S., Klonsky, K., & Tumber, K. (n.d.). Sample Costs to Produce Fresh Market Broccoli. *Cost Studies*. Retrieved September 21, 2012, from coststudies.ucdavis.edu/files/Broccoli_CC2012.pdf

⁵ Grant, J., Caprile, J., Coates, W., Anderson, K. K., Klonsky, K., & DeMoura, R. (n.d.). Sample Cost to Establish an Orchard and Produce Cherries. *Cost Studies*. Retrieved September 21, 2012, from coststudies.ucdavis.edu/files/CherryVN2011.pdf

⁶ Year 5 data

⁷ Ingels, C., Klonsky, K., & DeMoura, R. (n.d.). Sample Costs to Produce Pears. *Cost Studies*. Retrieved September 21, 2012, from coststudies.ucdavis.edu/files/PearsORG_SV2012.pdf

⁸ Day, K., Klonsky, K., & DeMoura, R. (n.d.). Sample Costs to Establish and Produce Plums. *Cost Studies*. Retrieved September 21, 2012, from coststudies.ucdavis.edu/files/plumvs09.pdf

⁹ Year 5 data

¹⁰ Dara, S., Klonsky, K., & Tumber, K. (n.d.). Sample Costs to Produce Fresh Market Broccoli. *Cost Studies*. Retrieved September 21, 2012, from coststudies.ucdavis.edu/files/Broccoli_CC2012.pdf

¹¹ This figure is arrived at using (Total cultural costs + Interest on Operating Capital + Total Cash Overhead + Total Non-Cash Overhead) x 100

¹² 14s is a sizing classification used in the industry

¹³ The Packer N.p., n.d. Web. 24 Sept. 2012. <<http://www.thepacker.com/fruit-vegetable-news/produce-commodity-pricing/?category=%2Ffruit-vegetable-news%2Fproduce-commodity-pricing%2Fvegetables&commodity=%2Ffruit-vegetable-news%2Fproduce-commodity-pricing%2Fvegetables%2Fbroccoli>>.

Table 2

Cost per Acre	Total Cost /Acre	Harvest Costs (Variable Costs)	Cultural & Overhead Costs (Fixed Costs)	Yield (Boxes/Acre)	Breakeven Price (Total Cost/Yield)	Current Market Price (Approx. as of 09.27.12)
Broccoli	\$ 6,069	\$3,159	\$2,910	582	\$10.43	\$8.30

Both market prices and yields are subject to significant volatility over a growing season. In multiple interviews, participants related their experience of prices dropping so low they could not afford to harvest product as well as prices that were three to four times higher than what they would expect to see. One broccoli grower had seen prices go as low as \$6 per case and as high as \$32. This price volatility highlights an important dynamic of production agriculture that results in pre-harvest shrink – growers that are able to stay in business do so because the poor ROI of down years is more than made up for during good years. Currently there is little incentive to reduce shrink because in many cases the fixed costs that go into a walk-by field are in aggregate smaller than the profit margin in a good year. Growers that were interviewed all seemed to have a great deal of hope that a banner year was always going to be the following year. This drives operational decision-making in a manner that is analogous to the gambling concept of ‘doubling-down’ – when loss has been experienced then the next hand, or in this case the next planting, should have the potential to cover the previous losses. This doubling-down psychology can result in commodities still being planted during a low market. This further drives the occurrence of walk-by fields because there is not an immediate reduction in supply and therefore nothing to push prices up to a level that justifies harvesting.

Labor

Lack of available harvest crews was cited as another reason pre-harvest shrinkage occurs. One apple grower stated that because of the ability to store apples for long periods of time, insufficient labor is the primary reason for shrinkage in an apple orchard.

Labor is extremely valuable, and the demand for affordable skilled labor is an ever increasing pressure. A harvest crew that is fast, efficient and knowledgeable about product grading is difficult to secure. If growers cannot keep them employed and busy, a crew will move on to find another operation to work for. Depending on the size of the delta between market price and harvest costs it can be advantageous

to harvest at a loss if it means maintaining a crew of workers and keeping them on for subsequent harvests throughout the season because it's more economical to harvest for a small loss but save money on recruiting new labor.

More and more, harvesting is becoming mechanized. This may help to alleviate a small amount of crop shrink caused by labor shortages but cannot be seen, in the short-term, as an alternative to solving the many issues that are causing skilled farm labor to be in short supply.

Grading

Quality standards involve a number of factors such as size, appearance, and absence of disease or rot. There are five grades, though the names vary by commodity; U.S. Fancy, U.S. Grade 1, U.S. Grade 2, utility grade, and juice grade. Large customers often have stricter specifications as to what constitutes an acceptable U.S. Grade 1 product than the documented USDA grade standards. It can often be a minute blemish, slightly irregular shape, or insufficient size by even a fraction that causes a product to be downgraded significantly. These specifications can also shift depending on supply in the market. If there is a large supply, customers will be pickier and have more stringent requirements around size and appearance; however, if supply is scarce customers relax their specifications so that sufficient crop can be brought to market. The subjectivity and changing nature of what will be 'kicked' by a customer drives over-planting and over-culling because growers have to make the assumption that the grading standards that will be applied to them at loading docks are going to be at the top end of the specifications. Putting together a shipment that is all above-grade requires a large yield and the selecting-out of produce that may be in-grade but marginal in some characteristic.

There are secondary markets such as processed foods and juices, which provide a corollary market for selling utility or juice grade. This isn't available for all commodities. For commodities that do have secondary markets the capacity of processors and juicers to accept packing culls can vary widely. It was reported that cherry juicers would accept almost all packing culls because of the short season when they are available, but a ketchup manufacturer may have contracts for most of the needed tonnage and will only accept a small quantity of off-grade product to augment that supply. In addition, the processors do not always require the same crop varieties as the fresh market so while a non-retail market may exist for a commodity it doesn't necessarily mean that it can be used to reduce shrink.

Anticipatory Packing

In addition to culling, shrinkage in a packing facility can also result from over-packing which occurs when anticipated daily orders are not as large as forecast, resulting in extra packed product. This

product can find its way to food banks and donation programs, but if volumes are too large for food banks within a reasonable distance to accommodate, it usually will end up in a landfill. One of the major challenges with addressing this type of shrink is the need for the facility to have a quick and efficient way to deal with extra product as it appears. The decision point for a packing manager is “What is the most efficient manner the packed product can be moved off of the dock?”

When donation streams can be easily accessed, such as a food bank truck directed towards the facility before the close of business, they are often utilized. But the volumes of available packed product can be greater than the capacity of what a local food bank can handle and the logistics of transporting to a non-local food bank cumbersome. This results in the packed product being transported to a landfill. In one facility it was reported that approximately 1% of product was still on the dock at the end of the day which was donated or landfilled. As a one digit percentage this seems like the cost of doing business. But when that 1% is applied to the enormous volumes that are packed and shipped it translates into a substantial loss of resources and nutrition.

Shrinkage also occurs during handling as large amounts of product move through the line where spills and drops occur. The range reported by interviewees ranged from negligible amounts to 2% of total product entering the facility.

Shelf Life & Spoilage

A critical factor in the shrinkage equation, and one unique to perishables, is the timeframe during which the product stays viable for consumption. For some commodities such as leafy greens, the shelf life can be as short as four days before wilt begins to take a toll on the marketability of the product. Shrink occurs when a crop is judged to not have ‘*the legs*’ to get to market, meaning that despite the current condition of the crop it will begin to deteriorate too quickly upon reaching the shelf for it to have adequate time to be sold.

Requirements because of perishability affect the volumes that can be diverted to a donation stream. The challenges and costs of maintaining a cold-chain can overwhelm the logistical capacity of food banks.

Developing Shrink Estimates

The agricultural sector is under a great deal of pressure to continue to increase yields while simultaneously reducing the inputs, such as land, water, fertilizers and agrochemicals, that are used to produce safe, nutritious produce that is ready for harvest. The pressure comes from many angles. From a business standpoint the ability to maintain slim margins lies in controlling costs which means using expensive inputs judiciously and minimizing waste. Declining resource availability is another factor. Undeveloped arable land is increasingly difficult to find and water sources are under intense pressure as urban centers, industry and agriculture fight to fill an increasing demand for water from a declining supply. Alongside the rising costs and reduced availability of key inputs lies also the increasing awareness and regulation of the environmental impact of agricultural production. Traditional agricultural practices such as converting forests into fields, applying fertilizers and pesticides and drawing irrigation water from aquifers all have environmental impacts that, when done at the current scale of production, represents long-term risks to the industry and the ecosystems that support it. A significant source of pressure to produce food with minimal negative environmental impacts, i.e. fewer inputs, is being born from the increased attention being paid to the issue by consumers and applied through regulations and customer channels such as retail buyers.

The opportunity that emerges from an estimate of crop shrink is to understand if it represents a material amount of inputs that are being used unnecessarily. If the volumes are significant then efforts to reduce shrink can be framed as part of the industry-wide effort to feed more people with fewer resources.

To develop an estimate of inputs used for produce that never entered commerce interviewees were asked for the percentage of each type of shrink that they experienced in their operation in a typical year. The answers, provided in Tables 5 and 6, show a great deal of variability between the respondents. Contributing factors for why one pear shipper, for example, had packing culls of 2-3% of total weight that came into the facility while another experienced up to 30% were not explored.

Table 3

Self-Reported Estimates from Producers for Pre-Harvest Shrink (% by weight of total available harvest)						
	Cherries	Pears	Plums	Head Lettuce	Nectarines	Broccoli
Low	1%	5%	10%	3%	10%	5%
High	20%	15%	30%	6%	30%	20%

Table 4

Self-Reported Estimates from Producers for In-situ Shrink (% by weight of total available harvest)						
	Cherries ¹⁴	Pears	Plums	Head Lettuce	Nectarines	Broccoli
Low	0%	0%	0%	1%	0%	1%
High	0%	0%	0%	4%	0%	2%

Table 5

Self-Reported Estimates from Producers for Packing Culls (% by weight of total available harvest)						
	Cherries	Pears	Plums	Head Lettuce	Nectarines	Broccoli ¹⁵
Low	2%	2%	2%	1%	No Data	No Data
High	10%	30%	30%	4%	No Data	No Data

These shrink estimates were then used in conjunction with publicly available data about harvested acres, irrigation rates and growing costs in order to understand the amounts of those inputs that are

¹⁴ The stone fruit producers that were interviewed reported that during harvesting all fruit was removed from the orchard and graded during the packing process which means that the in-situ shrink estimates that were provided were 0%

¹⁵ Broccoli operations that were a part of this study field packed rather than shed packed so no packing culls were reported

required to grow produce that never enters commerce. It cannot be overstated that these calculations are built from an extremely small sample size and there was no effort to independently verify the shrink percentages that were provided during the interviews. The intent of these calculations is not to provide precise numbers but to demonstrate a sequence of calculations and to begin considering what priority reducing shrink should have for stakeholders as margins slim and resources grow scarcer.

Tables 6, 7 & 8 show high and low estimates of acreage, water use and growing costs for shrinkage of lettuce and broccoli in Monterey County and pears in Sacramento County. While the totals cannot be considered robust what does emerge is that even low shrink percentages, such as the 5% combined figure provided by a lettuce grower/shipper, still represents sizable land, water and financial investments. As fuzzy as these numbers are it would require a substantial lowering of the shrink estimates for the land and water use and costs to not be considered significant and worthy of attention by the industry.

Table 6

Head / Iceberg Lettuce	Estimates of Pre- Harvest Shrink	Estimates of In-situ Shrink	Harvested Acres	Packing Culls	Effective Acres Required for Estimated Pre- Harvest Shrink	Effective Acres Required for Estimated In-situ Shrink	Effective Acres Required for Estimated Packing Culls	Total Effective Acres for Estimated Shrink	Irrigation Water Required for Effective Acres in Gallons	Total Growing Costs of Effective Acres
Sources ⇨	Estimates from Growers ranged from 3% to 6%	Estimates from Growers ranged from 1% to 4%	From 2011 Monterey County Crop Report	Estimates from Packers ranged from 1% to 4%	$((100\% / (100\% - \text{Shrink Estimate})) \times \text{Harvested Acres}) - \text{Harvested Acres}$	Harvested Acres x Shrink Estimate	(Harvested Acres - In- situ Acres) x Shrink Estimate	Sum of Effective Acres	Effective Acres x 17 ac in / acre ¹⁶ x 27,154 gals / ac in	\$2,902 / acre ¹⁷
Low Estimates	3%	1%	34,800	1%	1,076	348	345	1,769	816,513,916	\$5,133,083
High Estimates	6%	4%	34,800	4%	2,221	1,392	1,336	4,950	2,284,822,881	\$14,363,729

¹⁶ Tourte, L., & Smith, R. (n.d.). Sample Production Costs for Wrapped Iceberg Lettuce Sprinkler Irrigated - 40 Inch Beds. *Cost Studies*. Retrieved September 21, 2012, from coststudies.ucdavis.edu/files/2010Lettuce_Wrap_CC.pdf

¹⁷ *Ibid.*

Table 7

Fresh Broccoli	Estimates of Pre-Harvest Shrink	Estimates of In-situ Shrink	Harvested Acres	Packing Culls	Effective Acres Required for Estimated Pre-Harvest Shrink	Effective Acres Required for Estimated In-situ Shrink	Effective Acres Required for Estimated Packing Culls	Total Effective Acres for Estimated Shrink	Irrigation Water Required for Effective Acres in Gallons	Total Operating Costs of Effective Acres
Sources ⇨	Estimates from Growers were 5% & 0-20%	Estimates from Growers were 1% & 2%	From 2011 Monterey County Crop Report	No Packing Culls were reported by Shippers	$((100\% / (100\% - \text{Shrink Estimate})) \times \text{Harvested Acres}) - \text{Harvested Acres}$	Harvested Acres x Shrink Estimate	(Harvested Acres - In-situ Acres) x Shrink Estimate	Sum of Effective Acres	Effective Acres x 30 ac in / acre ¹⁸ x 27,154 gals / ac in	\$5,038 / acre Costs ¹⁹
Low Estimates	5%	1%	50,506	0%	2,658	505	-	3,163	2,576,863,436	\$15,936,557
High Estimates	20%	2%	50,506	0%	12,627	1,010	-	13,637	11,108,663,384	\$68,701,292

¹⁸ Dara, S., Klonsky, K., & Tumber, K. (n.d.). Sample Costs to Produce Fresh Market Broccoli. *Cost Studies*. Retrieved September 21, 2012, from coststudies.ucdavis.edu/files/Broccoli_CC2012.pdf

¹⁹ *Ibid*

Table 8

Pears	Estimates of Pre-Harvest Shrink	Estimates of In-situ Shrink	Harvested Acres	Packing Culls	Effective Acres Required for Estimated Pre-Harvest Shrink	Effective Acres Required for Estimated In-situ Shrink	Effective Acres Required for Estimated Packing Culls	Total Effective Acres for Estimated Shrink	Irrigation Water Required for Effective Acres in Gallons	Total Operating Costs of Effective Acres
Sources ⇨	Estimates from Growers ranged from 5% - 15%	Growers reported no In-situ Shrink	From 2011 Sacramento County Crop Report	Packing Culls were reported by Packers as 2-3% & 0-30%	$\frac{((100\% - (100\% - \text{Shrink Estimate})) \times \text{Harvested Acres}) - \text{Harvested Acres}}{\text{Harvested Acres}}$	Harvested Acres x Shrink Estimate	(Harvested Acres - In-situ Acres) x Shrink Estimate	Sum of Effective Acres	Effective Acres x 30 ac in / acre ²⁰ x 27,154 gals / ac in	\$5,250 / acre ²¹
Low Estimates	5%	0%	5,560	2%	293	-	111	404	328,969,281	\$2,120,116
High Estimates	15%	0%	5,560	30%	981	-	1,668	2,649	2,158,072,136	\$13,908,176

²⁰ Ingels, C., Klonsky, K., & DeMoura, R. (n.d.). Sample Costs to Produce Pears. *Cost Studies*. Retrieved September 21, 2012, from coststudies.ucdavis.edu/files/PearsORG_SV2012.pdf

²¹ *Ibid.*

Preventing Shrink

Shared risk across value chains

Contractual structures were cited by several interviewees as obstacles to reducing overplanting. Penalties for being “short” on product incentivize over production as a way to ensure contracts are fulfilled. Even more importantly, the consequences for failing to meet a customer’s expectations in this highly competitive market are perceived to be very high, and it is thus considered preferable to have too much product rather than not enough. This in turn has ramifications on the spot market as extra production floods the market and overall prices are reduced, which can then lead to walk-bys of the overplanted crop.

Many producers during the interviews voiced their frustrations with the current system that requires them to shoulder the majority of the risk in the supply chain. Retailers are perceived to have very stringent contract requirements, and the grower must meet them or potentially be at risk of losing that customer to a competitor. If events beyond a grower’s control such as disease or hail reduce the forecasted harvest, it is the grower alone who must navigate the consequences.

Having some mechanism to build longer term relationships or ways for other actors in the supply chain to share the burden of risk (and thus the consequences of harvests that do not meet forecasts) would help growers to plant quantities more in line with expected yields and reduce the necessity for overplanting. A solution to this issue would require significant participation of many stakeholders in the value chain and presents challenges in aligning incentives. However, the potential for partnership and more innovative deal structures holds promise for not only the reduction of over planting but addressing other financial and sustainability challenges as well.

Concurrent Picking

Concurrent picking is a system pioneered by the California Association of Food Banks in partnership with California Department of Food and Agriculture and IFCO Systems that allows for off-grade row crops, such as broccoli and cauliflower that do not meet market grade standards, to be harvested and distributed through food banks.

As part of the Farm to Family (F2F) program, a concurrent picking pilot was run in 2010 with the participation of Ocean Mist Farms and Pacific International Marketing. In the program, off-grade produce is picked at the same time as market grade, packed into reusable plastic containers (RPCs), vacuum

cooled and stored in shipper coolers for pickup by food bank carriers. The produce is donated by the participating growers but the food bank pays the variable costs of the harvesting, cooling and storage. Because the RPCs are provided rent-free by IFCO the variable costs of concurrently picking does not include packaging. And because the crews are already in the field there is an efficiency of both scale and logistics that allows for lower labor costs than putting a second harvesting team together for only off-grade product. Furthermore, these workers are trained in food safety and skilled in harvesting techniques. These factors result in the food bank being able to access fresh produce at below market prices.

Concurrent picking can also be used for retail grade crop that would otherwise be disked to enter the donation stream. Harvesting broccoli during a time of low market prices can be used as an example of this model. Where the revenue potential of the third pick of broccoli is lower than the variable costs of harvesting concurrent picking can be employed on the second pick to get product out of the field that is still too small to meet grade specifications. Without concurrent picking this third pick would have been disked under and would constitute in-situ shrink.

During the first eighteen months of the pilot over 5.7 million pounds of broccoli, cauliflower and celery were concurrently picked and subsequently distributed by food banks within California. There is still potential for significantly more volumes as this tonnage came only from two companies. This not only represents avoided shrink but also significant social good by making nutrient-dense produce available to the low-income families and individuals served by Food Banks, or even other programs that give or sell produce to the underserved.

Participating shippers have commented that it has numerous benefits:

1. Harvest crews like participating

The additional harvesting increases their compensation and often they appreciate that the additional product is being used to feed low income families

2. Tax Credit

In California producers who participate in concurrently picking qualify for the 10% state tax credit for the wholesale value of the product donated. A few other states have similar programs.

3. Good public relations

Concurrent picking is easily understood by the general public and can be used to demonstrate a producer's contributions to communities

The scaling up of concurrent picking is an important strategy for the industry to reduce both pre-harvest and in-situ shrink. Issues that need to be addressed in order to facilitate the expansion of the program include:

- o Expansion of Distribution Channels

Although the produce ends up being made available at below market costs there is still a cost related to the harvesting, storing and shipping. Currently, financial constraints limit volumes being concurrently picked to a maximum of six truckloads per week.

Many growers are not familiar with the program, and have not been solicited because distribution has yet to be established. Identifying alternate channels for less than perfect product beyond just food banks would create a pull for more produce that would otherwise end up as shrink. More research is needed to identify and cultivate channels that are in need of a low-cost supply of produce to address the underserved/those with limited access to nutrition. These additional channels would also allow for expanding the number of producers and the range of crops being concurrently picked.

- o Expanding Geographical Reach

IFCO currently allows for the use of donated RPC's only for California food banks. Bringing in Food Banks from outside of the state in order to expand both the total budget available for concurrent picking as well as the number of Food Bank clients that can be served requires an adjustment to the current agreement with IFCO or the inclusion of additional partners that can supply RPCs

Tax Credits for Donations

In 2011, California passed a bill (AB 152) that creates a 10% tax credit for farmers who donate fresh fruits and vegetables to a food bank. This law provides some added incentive for producers to further develop donation channels and offsets some of the expense in using their own resources to coordinate donations. Other states such as Colorado and Arizona have similar laws, but a federal law of this kind could help encourage farm-level donations even further.

The law went into effect January 1, 2012, so measuring the full impact of the law on donation volume will require more time for data to become available. However, anecdotal evidence collected during this study indicates that producers are aware and taking advantage of this new law.

Increasing the Logistical Capacity for Donations

Throughout the interview process producers enthusiastically embraced the idea of a more robust channel for donation and distribution of excess product. There are many organizations working at the local level as well as regionally and nationally. Several producers and packers identified the opportunity of leveraging excess capacity on trucks and cross-docking. The complications of coordinating multiple pick up and drop off locations was cited as one of the barriers to further adoption of this practice. Aligning and incenting stakeholders across the value chain, particularly those responsible for logistics, would allow for an increase in the volume of produce that can be brought into the donation stream as well as expanding the geographical reach where they can be distributed.

Product Innovation & Branding

Finding opportunities to market product that doesn't meet the cosmetic thresholds for size, shape, or quality has been, up to this point, challenging for the fresh produce industry. Notable examples include products like baby carrots, which utilized undersized or misshapen carrots to produce a new product category. Several producers mentioned the inclusion of apples in McDonald's restaurants Happy Meals and the effect that had to increase demand for peeler grade apples. Of particular note was the development of marketing and sales channels for broccoli florets that results in very little crop being left in the field because of sizing issues.

Some producers had plans or even prototype products they planned to introduce to attempt to utilize product that may have been lower grade or even destined for the cull chute. It's a challenge to find the right product, channels, packaging and marketing, but it can be a significant source of revenue if an innovative solution is found.

Most of the producers that were interviewed pointed out the strong need for more fresh produce in the national diet. They are well aware of the beneficial role their product can play in helping people make more nutritious food choices. Many of the barriers to making significant reductions in crop shrink cannot be overcome by producers acting alone. Collaboration with secondary markets, packaged food manufacturers, retailers and institutional buyers has the potential to identify ways to access the market need with the excess product that is available.

Potential for public-private partnerships also presents opportunity for further exploration. A large amount of anecdotal evidence points towards successful pilot programs with schools, universities, prisons and other government institutions as well as charitable food distribution systems like food banks. Building on

these initial pilots and budding efforts is important, as is collaboration across sectors to identify opportunities.

Communications are also an area that holds more opportunity for producers to build on the laudable efforts already being made. One producer has developed compelling marketing and greater brand recognition through communicating their commitment to recovering shrink and the results of the programs they have implemented.

Gleaning

Gleaning is the practice of harvesting edible product after the initial harvest for market is complete. This can take the form of harvesting fields that have already been designated for walk by or passing through harvested fields to collect cosmetic or size rejects that weren't picked during the initial harvests.

Gleaning has proved to be a valuable tool in recovering significant sums of shrinkage from the field as well as engaging the public with the issue of food waste. The Society of St. Andrews, one of the leaders in national gleaning efforts, was able to collect 16.2 million pounds of fresh produce from January to August in 2012. Ag Against Hunger, a non-profit that operates in Monterey County, gleaned over 144,000 pounds of fresh produce in 2010.

These important efforts are largely performed by volunteers, who often become more involved with the issue and their local agriculture community as a result of participation. Their efforts are important and laudable. However, while the amount of food these programs are able to recover is impressive, it is also a fractional percentage of what is estimated to be available.

Cooperative Model & Information Sharing

Competition among growers is incredibly fierce, and although cooperatives and industry groups have attempted to form and provide more leverage for growers, large scale and long-term efforts have difficulty taking root. Some of the reasons cited by interviewees include the complexity of negotiating amongst diverse stakeholders and the difficulty in gaining the critical mass of buy-in and trust required to make the model work.

There are examples of growers banding together under one brand to increase efficiency and negotiating power. In the citrus industry the Sunkist label has seen some success from a cooperative model. This type of coordinated approach to controlling supply and therefore price is not considered to be anti-

competitive under federal law and helps to solve the imperfect information problem where producers are making planting decisions in isolation rather than as a block.

However when this model was discussed with producers during interviews they invariably responded that the likelihood of a successful cooperative model being constituted for their commodity or region was extremely low or non-existent.

Another tool for solving the imperfect information problem that leads growers to make decisions in isolation that lead to an over-supply of a commodity would be an anonymous, real-time database of what is being planted. If, for example, the database showed that a significant amount of acres were being allocated to broccoli in the region then a strategic assessment could be made to plant a different crop that has a smaller projected supply and therefore better market price prospects. Like the cooperative model this type of system would require growers to provide authentic and timely information to each other about their plans and activities. The obstacles that would have to be overcome within the culture of growers are considerable and the feasibility of this strategy is extremely low.

Recommendations & Next Steps

This report is a critical first step towards understanding the landscape of the drivers of crop and the opportunities for reducing it. Going forward, further research will be needed, pilot projects must be launched, best practices must be spread and results must be communicated.

There are many opportunities and best practices for individual producers making simple and inexpensive changes to reduce some of the shrink in their operations and these stories need to be told. At the same time, making significant impact and getting more product onto plates will require innovative thinking and partnerships across the value chain. Two concrete recommendations are as follows.

Developing a Better Dataset

This report is the result of extensive research and many hours of interviews with producers on site at their orchards and fields, and it uncovered important insights about where and why crop shrink occurs. However, the sample size and lack of specific quantitative data were challenging aspects of the analysis process. In order for mitigation priorities to be set and progress evaluated, there is a need to both dive deeper into the commodities that were included in this study as well as expand data collection to other commodities and geographies.

Further research done in conjunction with partner companies willing to provide hard data rather than estimates could provide a more concrete picture of crop loss and its drivers within specific commodities and help identify efficiencies, cost savings, and PR benefits in the process. Some of the producers interviewed indicated a willingness to move forward on a more in-depth study, which could identify potential pilot projects aimed at shrink reduction and provide real world examples for other producers to emulate. To move forward with this, it would be important to find the right structure, indicators, communications and funding for the project to ensure that participants' competitive position is maintained.

Roadmap Summit

Shrink is a systemic issue that requires cooperation from the full value chain and beyond to find solutions. This points towards the value of a summit that gathers stakeholders and looks across the silos of their position in the value chain to identify what could be achieved through pre-competitive collaboration. The goal of such a summit would be to develop a roadmap that defines roles, responsibilities and milestones for reducing shrink, with a focus on increasing donations. There are already enough disparate but related efforts currently ongoing and under consideration to provide momentum for this kind of summit to draw participants and make a significant impact in the amount of shrinkage being diverted to food insecure communities.

Several of the producers interviewed expressed interest in participating in such a summit. Some provided suggestions for contacts they could include from the distribution, transportation, NGO and retail sectors as well. Gathering representatives from every link in the value chain to have the entire system in the room allows for rapid prototyping of ideas and vetting potential models for feasibility. A structured and facilitated workshop could legitimately yield breakthrough solutions to reducing shrink and feeding those who need fresh produce most.

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