

Why Quality Consistency Matters

Reducing Waste and Maintaining Shelf Life in Our Fresh Food Supply

Statistics vary, but about 30% of the produce harvested is wasted and around 18% never makes it to the family dinner plate. Think of it. After all the months—often years—of labor, material, land and water use and even the logistics to produce what appears to be a bounty of fresh fruit and vegetables, for all that effort and cost, we never really gain the full value—both in human nutritional benefits, or in business value.

Business 101 is clear: If you can sell only 70%-80% of what you harvest, you have to charge more per item to recover costs. Each player in the food chain is impacted by profit losses and inconsistency in quality.

Is this the best we can do?

Over the next decade demand will increase for quantity and variety. But increasing production won't be the answer with increasing costs and shrinking resources. Fact is, we can no longer bear the burden of inconsistent quality if we are going to meet that demand.

As a grower or retailer we may assume this is the best we can do. But there are tremendous opportunities to achieve so much more by confronting the gaps in our supply chain and reaching for a higher level of excellence.

In this series of articles we will look at the issues of the fresh food supply chain and offer diagnosis and remedies to achieve consistent quality and realize improved benefits for all players in the chain.



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Introduction: Why Quality Consistency Matters in the Fresh Food Supply Chain

In a world of increasing demand, that usually means more production. No doubt the last hundred years' agriculture has made epic strides in the ability to *produce* food. However, achieving continued increases in production is going to be a big problem in the future due to shrinking resources.

But what if we *look at the problem a little differently*? According to the UN's Food Agriculture Organization (FAO) and The International Food Policy Research Institute, they estimate "global food loss of 27% to 32% of all food produced in the world."¹ "Food losses² and waste amount to roughly US \$680 billion in industrialized countries plus US \$310 billion in developing countries."³ That is a lot of economic loss!

Do More with Less

The good news is that governments, NGOs and some major corporations have initiatives to drive down waste and increase sustainable practices.⁴ But many initiatives are just goals today, as studies this year still show ~30% fresh food waste - more needs to be done.

Think of this: according to a study sponsored by the FAO estimating that "halving the current losses and wastes (in the food supply chain) ...would reduce the expansion of food production needed to meet the demand by more than 20%." Remember the old saying, 'do more with less.'

Easy to say, but without understanding, diagnosing and addressing the sources of food loss, we won't be able to solve the problem. The dollar and human benefits that would accrue from addressing even 20% of that loss would *return hundreds of billions of dollars to businesses along the food chain*— while delivering highly nutritious food at a reasonable cost to the consumer. Controlling quality is not a new concept and has successfully been realized in manufacturing and process industries for decades, achieving dramatic improvements in throughput—production volume—and profitability. To achieve

Digest this!

Estimates by the UN state that around 30% of the world's food supply is lost. That amount of waste, they state, could feed over 800M people!

According to the USDA, estimates for the loss in the US are 31% across all food groups. More than ½ of that value never arrives at the 'kitchen.'

For fresh produce, losses are estimated at ~33%, with supply chain loss to the point of sale ~18%, while post purchase "plate waste" is about 15%.

Measurements for loss and waste

vary by goals. For government, NGOs and families, their concerns are nutritional—so they measure loss based on calories—to avoid hunger and achieve optimal health. Business measures loss based on value—% of cost of goods or retail dollars, as well as inventory turnover.

Calories: 24% of all the calories produced worldwide are lost. In the US that is 2 million calories per family of four at the cost of \$1,500 per year!

Dollars: Economic loss of roughly \$1 trillion.

¹ [The 2016 Global Food Policy Report: Toward a More Sustainable Food System](#)

² Definitions vary, but food loss refers to the total of supply chain, retail and post sale (i.e. food service and the home), whereas waste refers to post sale that is food thrown by food service or consumer.

³ [Key facts on food loss and waste you should know!](#)

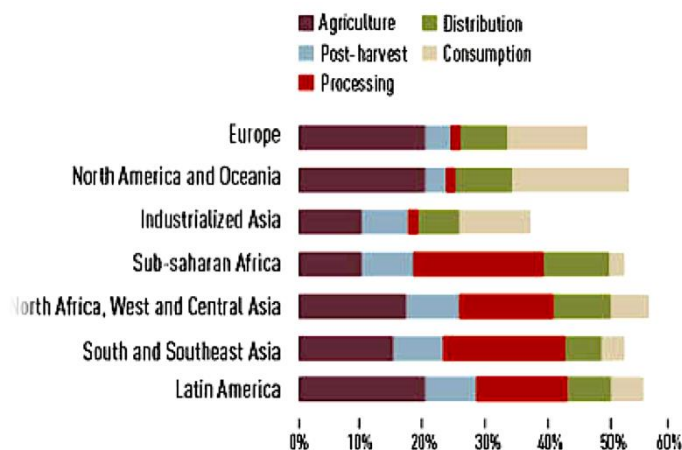
⁴ For example, Walmart's aspirational zero waste initiative, or Unilever's sustainable *living* strategy. And big producers such as [HJ Heinz](#), Nestlé's, and others have major programs working back through the chain to produce higher quality yield with lower impact on the environment. In fact, most of the top 100 food producers in the world have sustainability programs in various states of emergence.

this, key metrics must be collected to diagnose where issues occur. Of course the food industry has implemented quality in manufacturing, but fresh food has been limited by the characteristics of the supply chain and the lack of methods to consistently monitor product. Today those tools exist; so now is a good time to begin.

Diagnosing the Sources of Food Loss and Waste

According to the FAO, fresh fruits and vegetables have the highest percent of food loss than any other food group. And yet, that is where consumers are most interested in increasing their consumption. A body of research by the FAO, industry groups and academics has pegged food loss in the post harvest phase—the supply chain—at around 17% to 18%. That loss is *spread at each stage in the supply chain* (See Figure 1).

As a grower, distributor or retailer you may be thinking: *we have implemented many technologies,⁵ best practices in processes and more optimized logistics. And these changes have made improvements, such as cutting days out of time to market and reducing bacteria and spoilage.* Yes, we are doing more. But with a lingering 30% loss, the issue, then, is consistency of practice. In manufacturing, quality improved through conformity of process. And that was achieved through implementation of data collection, analysis and corrective feedback across the *whole process*. This is what we are talking about. But unlike manufacturing, which is within a four walls operation, the supply chain has diverse environments, so the ability for data collection as well as cross-enterprise data analytics is only a recent opportunity. Now, armed with this data, the true sources and remedies can be found. Let's look at a few issues in the fresh food chain.



Source: FAO 2016

Figure 1

Following the Chain

In research from the University of South Florida and Georgia Institute of Technology⁶ the team tracked the fresh fruit supply chain and evaluated the sources of spoilage as well as conducted pilots to diagnose and validate their findings. No doubt there are several sources of loss.⁷ But their research found that “increasing temperature usually

⁵ Refrigeration, packaging films preserving some shelf life, improved testing equipment, warehouse management systems, etc.

⁶ We reviewed several compelling research studies and pilots on food quality in the fresh food supply chain references: The Royal Society - Improvement of the fresh fruit and vegetable logistics quality: berry logistics field studies 2014; Preliminary and Regional Reports - Quality of strawberries shipped by truck from California to Florida as influenced by postharvest temperature management practices where they summarize chemical and physical fruit analysis to diagnose food spoilage and its sources; Other sources include [Post Harvest Biology Technology Journal](#) and [Food Chemistry Journal](#).

⁷ Too high or too low temperatures; respiration rates, sun light; moisture—too wet or too dry; vibration; improper ventilation—are all common issues. For simplicity's sake in this article we will focus on temperature as well as shelf life as the metric.

results in the accelerated loss of quality and shelf life ...and *is the major source of post harvest loss.*⁸ And although there are disagreements between players—growers think retailers are arbitrarily rejecting product; or the DC managers think there is poor handling at the store causing these losses—the research found that *variable practices at each stage in the chain contribute to food loss.* In other words, each entity has contributed to the problem. Thus, this shouldn't be a finger pointing exercise to fix the problems.

Growers - Harvest, pack and pre-cool - Harvesting is a phase when produce is most vulnerable to poor handling, as well as exposure to heat and sun. Here seeds are sown for variable quality. Studies have shown that per-pallet shelf life can vary significantly over a single day of harvest.⁹

Temperature deviations at a pallet level means that each pallet is losing shelf life at a different rate.

The University of Southern Florida team also found that pre-cooling practices are often inadequate to address the need for effective or accurate cooling within the pallet or container.¹⁰ So inconsistent non-uniform cooling may not thoroughly cool the incoming produce, which can *introduce more variability.* Thus each pallet may already have significantly different shelf life even before leaving for market.

Pre-cooling non-uniform or over/under cooling. Product moves to market with inconsistent shelf life within each shipment.

Growers already incur some loss due to the variability of nature, and therefore operate on narrow profit margins. And today most growers invest to differentiate their brand. Thus losses due to inconsistent quality not only impact those *narrow margins* but *also their reputation*, which may have greater impact to the business, reducing their market opportunities in the future.

Transportation - Cold chain logistics has become a hot topic in recent years with many of the transportation carriers implementing more tracking and monitoring of their refrigeration processes to ensure proper container temperature throughout the journey. However, there is more work to be done, as one study has shown that trailer *temperatures varied up to 30% by pallet position* during the journey.¹¹ That means that shelf life may deteriorate at a much faster rate than the days of transit time for these pallets.

Inconsistent non-uniform and variable temperature in containers. Shelf life loss varies per pallet.

Other studies show that there is not necessarily a *uniform temperature throughout the container.* Researchers found that shelf life varies at a much more granular level—by the pallet. “The temperature inside the pallet is the factor that determines the rate of shelf-life loss” beyond “the ambient air of the container or trailer.”¹² Thus a *portion of, or the entire shipment's* shelf life can deteriorate by days without *consistent temperature management* methods by the carriers. So again, the shelf life of *one pallet* will now vary versus another in the same trailer.

⁸ *italics are mine*

⁹ During harvesting, fresh picked produce may stay out in the field in hot temperatures for up to eight hours. So the earlier picked fruit for example, would have a shorter shelf life than that picked later, before the harvest is picked up and taken for pre-cooling.

¹⁰ Pre-cooling often is inadequate – non uniform or incomplete cooling process for some pallets in the center of the pallet.

¹¹ Deloitte and Touche – An Intelligent Cold Chain project employed sensors to monitor temperature in chill containers. This showed temperature variations up to 35% on the journey from Latin America to U.S. destinations. - *Capturing the Value of Pervasive Computing for Supply Chain Transformation.*

¹² Ibid - the Royal Society

Distribution - Several pilot studies where pallets were tracked found that even those that ultimately had much shorter shelf life *showed no visible differences during inspections* at the distributor, or later when the retailer was inspecting and accepting shipments. Since inbound inspection cannot differentiate between which produce may have shorter shelf life, all produce is treated the same. Without accurate pallet-level shelf life, no corrective actions to avoid waste can be identified or taken. For a distributor/food broker, once they accept product, they will incur the risks and costs of the next stage in the chain—that may mean retailer rejections and chargebacks.



Retail Receiving/Acceptance - At the retailer DC, receiving inspection is usually a visual spot check where the shipment is either accepted or rejected. Again, visual inspection generally can't differentiate remaining shelf life. With perishable produce and the need for rapid rotation to shelf, consistency in quality won't be achieved by manual methods. Consumers take note of poor quality, and retailers have to rapidly mark down or throw food.¹³

Inventory rotation outbound shipping unable to differentiate shelf life variance, thus FIFO vs. first expired- first out.

Ultimately all along the chain, from harvest to retail, quality is impacted. Yet we are dealing with such vast quantities – tens of millions of pallets. How can this be addressed?

Inability to differentiate item shelf life, thus no remedies to mitigate variability at a product level.

A Fresh Look at the Fresh Food Chain

In the last decade much effort has been put into optimizing logistics. Yes, local sourcing does provide shorter chains that preserve some shelf life of the overall shipment. But as we have learned, each shipment does not have uniform shelf life for each pallet, and that accelerated *shelf-life reduction can be introduced at any stage* in the chain. Therefore, avoiding loss should be the first order of business. *The goal is to achieve consistent quality from the outset and then maintain it throughout the chain.*

Think of this: Many of the systems used, from farm, over the road, and to the warehouse, *don't actually monitor the physical product at all*, but use static data such as bar-coding or EDI. A fresh approach would be to actually *collect data from the products* and consistently monitor and share that data across the chain. Today's technology innovations are moving beyond process and single enterprise to provide 'item intelligence' with an inter-enterprise, or supply chain-wide perspective.

For the grower, from the field through pre-cooling, alerting to time and temperate deviations (or other factors) allows for real-time corrections to processes or equipment so that each pallet is pre-cooled within the correct time and temperatures before it begins the journey. This would improve not only the quality at the outset, but protect revenue and brand later on.

¹³ Retailers report between 5% to 10% waste at retail for fruits and vegetables - That includes the DC and the store.

For transport companies, more granular sensor usage that detects temperature at the unit level will allow for adjustments in transit. Longer term, this may also mean different types of refrigeration equipment and methods. But those are bigger expenses. First order of business is to be able to monitor and know how and where the problems are emanating from. Simple adjustments may be all that is needed. But having the pallet level data is required to know that, and to justify—or avoid—equipment investments.

For distribution practices, with more granular produce temperature monitoring at a pallet level, we can determine the inventory and logistics strategy to preserve quality for the retailers and ultimately the consumer. Inventory policy methods are nothing new. Many industries rotate and ship inventory based on efficacy or shelf life. But *data is needed about the product* in order to determine the best policy,¹⁴ and in the fresh produce chain we have only used static methods—harvest date on a barcode label—to make the choice of when and who to ship to.



What we are advocating here is more granular produce¹⁵ temperature tracking systems that monitors product throughout the supply chain from the field through to the retailer. With information comes better choices—intelligent decision making. Given dozens of pallets with varying days of shelf-life data, the shipper—a grower or distributor—can distinguish between pallets, and which have the longer shelf life. They can then make intelligent routing decisions on where to ship to end markets. For example, a pallet with 15 days of shelf life can easily make the cross country route of four days transit time with a remaining shelf life of 10 to 11 days left, vs. produce with a shorter shelf life of say 10 days which can be shipped to a local market (2 day transit time), preserving 8 days of shelf life. (There is more to be discussed about smarter routing and other supply chain and logistics practices which we will address in subsequent articles.)

In the last few years technology has advanced: The ability to cost-effectively sense and monitor actual product, in real time, provides opportunities to intervene and prevent erosion of product quality. A body of knowledge—algorithms and pattern analytics—to rapidly interpret the data and make recommendations about *this shipment* are also available.¹⁶ Cloud-based databases allow each entity in the supply chain to have access to temperature data, and can then take action to preserve quality and reduce loss of shelf life.

¹⁴ FEFO or FIFO

¹⁵ Or whatever would be the appropriate individual packing level. Researcher from University of Southern Florida [recommended](#) one tracking device (sensor) per pallet

¹⁶ The best example to date is [ZEST Fresh™](#) who has invested in the whole platform, which includes pallet level sensors/monitoring, pre-cool, routing and in-transit monitoring/visibility to support food quality and analytics for the fresh fruit and vegetable chains. We will discuss platforms and monitoring in a subsequent article.

Conclusions: Finding the Green in Fresh Food Quality

In the U.S., fresh produce represents more than 10% to 15% of the typical grocery revenue¹⁷ of approximately \$700B business. Worldwide, that number is almost double. Produce sales are expected to grow by 2% to 3% annually for the foreseeable future. That's a lot of green! If the industry is continuing to incur the cost of 10% to 18% annually, that's a lot of loss. All along the chain, each player can experience losses from spoiled product which results in higher costs with lower profit, sales loss, and decreasing competitiveness. So each player has a lot to lose, or save.

Major food producers and retailers have been piloting new cold chain solutions. These projects results are demonstrating the ability to monitor product and processes and to identify and mitigate quality issues at each stage of the chain. Maintaining quality and thus shelf life¹⁸ ensures that more products arrive at the point of retail, as well as a sustaining shelf life, for the consumer.

For the grower, retailers reject on average 5%-7% of produce, reducing their revenues after an *entire season's investment*. For the fresh produce industry in the U.S. alone, this represents greater than a \$2B loss each year to growers. By implementing product monitoring, those losses could be cut in half.



For retailers, the opportunities are even greater. The competitive pressure to capture the high margin business of fresh produce is intense. Lost competitive position and sales are clearly a concern for all the major grocers today. But there are other financial savings. About 11% of produce is culled. Cutting that in half would result in nearly \$1.5B reduction in losses.

With today's cloud, mobile and supply chain-wide monitoring technologies, we *can* do better. Gains for growers and retailers are not just in reducing cost of production, but increasing sales now and over the long term as demand continues to increase. And beyond material gains there are other values—a greener earth and a healthier customer.

¹⁷ That number is larger for grocers who cater to organic/whole-food buyers.

¹⁸ We plan to share some case study data in subsequent articles in this series.

References:

USDA: [Ag and Food Statistics: Charting the Essentials](#)

USDA: [The Estimated Amount, Value, and Calories of Postharvest Food Losses at the Retail and Consumer Levels in the United States](#)

USDA: [Selected New and Ongoing USDA Food Loss and Waste Reduction Activities](#)

The [2016 Global Food Policy Report: Toward a More Sustainable Food System](#)

[Food Agriculture of the United Nations](#)

Food Marketing Institute - [research on food quality](#)

For more on issues in pre-cooling read [Improving Produce Quality During Pre-Cooling](#)



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