



NRDC ISSUE PAPER

AUGUST 2012 IP:12-06-B

Wasted: How America Is Losing Up to 40 Percent of Its Food from Farm to Fork to Landfill

AUTHOR

Dana Gunders

Natural Resources Defense Council



Getting food from the farm to our fork eats up 10 percent of the total U.S. energy budget, uses 50 percent of U.S. land, and swallows 80 percent of all freshwater consumed in the United States. Yet, 40 percent of food in the United States today goes uneaten. This not only means that Americans are throwing out the equivalent of \$165 billion each year, but also that the uneaten food ends up rotting in landfills as the single largest component of U.S. municipal solid waste where it accounts for a large portion of U.S. methane emissions. Reducing food losses by just 15 percent would be enough food to feed more than 25 million Americans every year at a time when one in six Americans lack a secure supply of food to their tables. Increasing the efficiency of our food system is a triple-bottom-line solution that requires collaborative efforts by businesses, governments and consumers. The U.S. government should conduct a comprehensive study of losses in our food system and set national goals for waste reduction; businesses should seize opportunities to streamline their own operations, reduce food losses and save money; and consumers can waste less food by shopping wisely, knowing when food goes bad, buying produce that is perfectly edible even if it's less cosmetically attractive, cooking only the amount of food they need, and eating their leftovers.

Acknowledgments

Great thanks to the following people for reviewing the contents of this report:

Jose Alvarez, Senior Lecturer, Harvard Business School and former CEO, Stop & Shop/Giant Landover
Jonathan Bloom, Author of American Wasteland

Brian Lipinski, World Resources Institute

Jean Schwab, U.S. EPA National Food Recovery Initiative

Andrew Shakman, LeanPath

Reviewers do not necessarily concur with the paper's recommendations but have advised on portions of its content.

About NRDC

The Natural Resources Defense Council (NRDC) is an international nonprofit environmental organization with more than 1.3 million members and online activists. Since 1970, our lawyers, scientists, and other environmental specialists have worked to protect the world's natural resources, public health, and the environment. NRDC has offices in New York City, Washington, D.C., Los Angeles, San Francisco, Chicago, Livingston, Montana, and Beijing. Visit us at www.nrdc.org and follow us on Twitter @NRDC.

NRDC's policy publications aim to inform and influence solutions to the world's most pressing environmental and public health issues. For additional policy content, visit our online policy portal at www.nrdc.org/policy.

NRDC Director of Communications: Phil Gutis

NRDC Deputy Director of Communications: Lisa Goffredi

NRDC Policy Publications Director: Alex Kennaugh

Lead Editor: Alex Kennaugh

Design and Production: www.suerossi.com

Cover photo © Uli Westphal/<http://uliwestphal.com/mutates.html>.

© Natural Resources Defense Council 2012

TABLE OF CONTENTS

Executive Summary	4
Efficiency Losses in the U.S. Food Supply System.....	7
Losses in Farming	7
Losses in Post-Harvest and in Packing.....	8
Losses in Processing.....	9
Losses in Distribution.....	9
Losses in Retail	10
Losses in Food Service	11
Losses in Household	12
Losses during Disposal.....	14
Toward More Efficiencies in the Food System	15
Businesses Should Help Remove Inefficiencies in the Food System	15
Government Should Help Remove Inefficiencies in the Food System	16
Consumers can Also Help Remove Inefficiencies in the Food System	17
Steps to Pursue at Each Stage in the Supply Chain	18
Appendix: Summary of Food Waste by Supply Chain Stage.....	21

EXECUTIVE SUMMARY

Food is simply too good to waste. Even the most sustainably farmed food does us no good if the food is never eaten. Getting food to our tables eats up 10 percent of the total U.S. energy budget,¹ uses 50 percent of U.S. land,² and swallows 80 percent of freshwater consumed in the United States.³ Yet, 40 percent of food in the United States today goes uneaten.⁴ That is more than 20 pounds of food per person every month.⁵ Not only does this mean that Americans are throwing out the equivalent of \$165 billion each year,⁶ but also 25 percent of all freshwater⁷ and huge amounts of unnecessary chemicals, energy, and land. Moreover, almost all of that uneaten food ends up rotting in landfills where organic matter accounts for 16 percent of U.S. methane emissions.⁸ Nutrition is also lost in the mix—food saved by reducing losses⁹ by just 15 percent could feed more than 25 million Americans every year¹⁰ at a time when one in six Americans lack a secure supply of food to their tables.¹¹ Given all the resources demanded for food production, it is critical to make sure that the least amount possible is needlessly squandered on its journey to our plates.

This paper examines the inefficiencies in the U.S. food system from the farm to the fork to the landfill. By identifying food losses at every level of the food supply chain, this report provides the latest recommendations and examples of emerging solutions, such as making “baby carrots” out of carrots too bent (or “curvy”) to meet retail standards. By increasing the efficiency of our food system, we can make better use of our natural resources, provide financial saving opportunities along the entire supply chain, and enhance our ability to meet food demand.

The average American consumer wastes 10 times as much food as someone in Southeast Asia,¹² up 50 percent from Americans in the 1970s.¹³ This means there was once a time when we wasted far less, and we can get back there again. Doing so will ultimately require a suite of coordinated solutions, including changes in supply-chain operation, enhanced market incentives, increased public awareness and adjustments in consumer behavior.

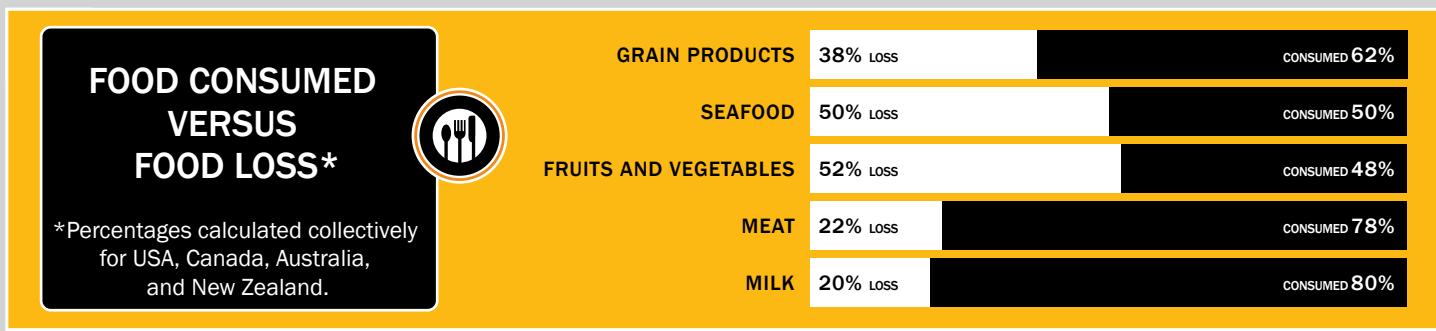
Much can be learned from work that is already underway in Europe. Both the United Kingdom and the European Union have conducted research to better understand the drivers of the problem and identify potential solutions. In January 2012, the European Parliament adopted a resolution to reduce food waste by 50 percent by 2020 and designated 2014 as the “European year against food waste.”¹⁴ An extensive U.K. public awareness campaign called “Love Food Hate Waste” has been conducted over the past five years and 53 of the leading food retailers and brands there have adopted a resolution to reduce waste in their own operations, as well as upstream and downstream in the supply chain. Gains can be made quickly. In just five years, avoidable household food waste in the United Kingdom has been reduced 18 percent.¹⁵

The complexity of the issue cannot be ignored. At the heart are two basic realities that must be acknowledged upfront. The first is that food represents a small portion of many Americans’ budgets, making the financial cost of wasting food too low to outweigh the convenience of it. Second, there is the plain economic truth that the more food consumers waste, the more those in the food industry are able to sell. This is true throughout the supply chain where waste downstream translates to higher sales for anyone upstream. Overcoming these challenges as well as the other drivers of food waste discussed in this document will require all hands on deck from the U.S. government to consumers to business. It will also require raising the priority of reducing food waste to the significant level it merits.

The time to act is now. In fact, a recent report by consulting firm McKinsey ranks reducing food waste as one of the top three opportunities to improve resource productivity.¹⁶ Key prospects for change agents include:

- The U.S. government should conduct a comprehensive study for food losses in our food system and establish national goals for food waste reduction. One key action will be to standardize and clarify the meaning of date labels on food so that consumers stop throwing out items due to misinterpretation. A waste reduction organization in the United Kingdom has estimated this type of clarification could prevent about 20 percent of wasted food in households.¹⁷
- State and local governments should lead by setting targets and implementing food waste prevention campaigns in their jurisdictions as well as their own operations. One key opportunity for this is education alongside municipal composting programs.
- Businesses should start by understanding the extent and opportunity of their own waste streams and adopting best practices. For example, Stop and Shop was able to save an estimated \$100 million annually after an analysis of freshness, shrink, and customer satisfaction in their perishables department.
- Americans can help reduce waste by learning when food goes bad, buying imperfect produce, and storing and cooking food with an eye to reducing waste.

Increasing the efficiency of the U.S. food system is a triple bottom-line solution that requires a collective approach by decision-makers at every level in the supply chain. Investing in these food waste reduction strategies, together we can reap the tremendous social benefits of alleviating hunger, the environmental benefits of efficient resource use, and the financial benefits of significant cost savings.



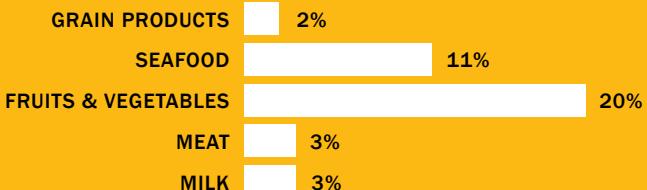
Source: Food and Agriculture Organization 2011

NORTH AMERICAN* FOOD LOSSES AT EACH STEP IN THE SUPPLY CHAIN

*Percentages calculated collectively for USA, Canada, Australia, and New Zealand.

01.

PRODUCTION LOSSES



02.

POSTHARVEST, HANDLING AND STORAGE LOSSES



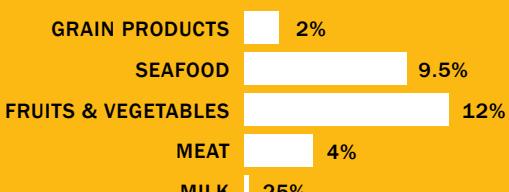
03.

PROCESSING AND PACKAGING LOSSES



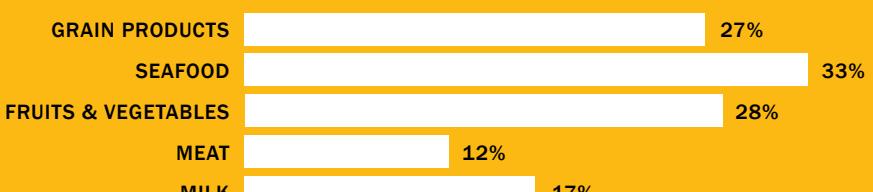
04.

DISTRUBUTION AND RETAIL LOSSES



05.

CONSUMER LOSSES**



**Includes out-of-home consumption

Source: Food and Agriculture Organization 2011

EFFICIENCY LOSSES IN THE U.S. FOOD SYSTEM

Given all the resources demanded for food production, it is worth our while to make sure that food goes to good use and the least amount possible is lost on its journey to our plates. Our nation's agricultural production accounts for 80 percent of consumptive water use¹⁹ and more than half of all land use.¹⁹ It releases hundreds of millions of pounds of pesticides into the environment each year, is the leading cause of water quality impairment in the nation's rivers and streams, and is the largest emitter of nitrous oxide and methane, two powerful greenhouse gases.

Losses in our food system occur throughout the supply chain. Food is lost on farms; during processing, distribution, and storage; in retail stores and food service operations; and in households for a variety of reasons at each stage. However, the significant inefficiency of the food system has received virtually no attention to date, resulting in a dearth of data that might illuminate key drivers of the problem or possible solutions.

The most comprehensive report on food loss in the United States was issued by the U.S. Department of Agriculture (USDA) in 1997 and includes information only about retailers and consumers. That report explicitly cites the need for more data, yet almost 15 years later, not much more is available. The USDA has updated some of the estimates from the 1997 report and provided new information on supermarket and consumer losses, but a comprehensive study of food loss across the supply chain is still lacking.

Of the few available studies, each analyzes food losses in a different way making it difficult to use one study to corroborate another. For instance, one study uses a caloric evaluation of the entire food supply, while another evaluates losses at only the consumer level, combining in-home and out-of-home meals. Even more confusing, some studies combine losses to cooking (such as fat or water that burns off) with discards, making it difficult to draw conclusions about how much is actually being wasted. Virtually all of the studies addressing food loss conclude that in developed countries, the majority of losses occur at the consumer and food service levels, where as in developing nations most food loss occurs between harvest and market. However, many of those studies omit the farm, post-harvest, and sometimes processing portions of the supply chain.

Particularly in the fresh produce sector, anecdotal evidence suggests that volumes lost at the farm and processing levels could be significant.

This paper presents an overview for each stage of the food supply chain using the best available data to estimate how much loss occurs at each stage, in many cases these numbers are estimates or extrapolations from narrow data. So

although the findings of this paper spotlight the scale of the food waste challenge, it also highlights the need for greater information gathering within the U.S. context. We still can't answer with any certainty, "How much food is lost at each stage of the supply chain?"

LOSSES IN FARMING

Production losses are greatest for fresh produce. Meat, seafood, and dairy have different issues that are not discussed here. At the farm level, food loss falls into two categories: (1) food that is never harvested, and (2) food that is lost between harvest and sale.

Given the variation and risks inherent to farming, it is difficult for farmers to grow exactly the amount that will match demand. Produce may not be harvested because of damage caused by pests, disease, and weather. In other cases, it is due to economics. If market prices are too low at the time of harvest, growers may leave some crops in the field because they will not cover their costs after accounting for the costs of labor and transport. In addition, growers may plant more crops than there is demand for in the market in order to hedge against weather and pest pressure or speculate on high prices. This further lowers prices in bumper crop years, leading to more crops not warranting the cost of harvest. Called "walk-by's", as a consequence of both natural phenomena and market effects, entire fields of food may be left unharvested and plowed under. This is not a complete loss, as nutrients are returned to the soil. However, it still represents a lost opportunity to provide nutrition and not the highest use of the water, energy, and chemicals used to grow those crops.

Another cause of unharvested produce is food safety scares. For example, in 2008 a warning was issued by the Food and Drug Administration of possible *salmonella* contamination in tomatoes. The warning was eventually discovered to be unfounded, but in the meantime it created a negative perception among consumers and decreased overall demand. As a result, some 32 percent of total U.S. tomato acreage went unharvested.²⁰

Labor shortages are another reason that produce is sometimes left in the field. With changing immigration laws, this problem has become more commonplace. In 2011, for instance, the Georgia Fruit and Vegetable Growers Association estimated labor shortages for harvest and packing would cost the state US\$140 million in crop losses—about 25 percent of total production value for those crops.²¹

All told, approximately 7 percent of planted fields in the United States are typically not harvested each year.²² This number can vary widely and can occasionally be upwards of

50 percent for a particular crop or operation.²³ For example, 6-year averages show that acreage left unharvested is about 2 percent for potatoes, 8 percent for sweet corn, and 15 percent for wheat.²⁴ At least 97,000 acres (6 percent) of fruit and vegetable row crops were not harvested.²⁵ According to an estimate by Feeding America, more than 6 billion pounds of fresh produce go unharvested or unsold each year.²⁶

Even fields that are harvested may have significant amounts of food left behind. Workers are trained to selectively harvest, leaving any produce that will not pass minimum quality standards in terms of shape, size, color, and time to ripeness.

Ideas for Increasing Efficiencies in the Harvest Phase

- A farmer who saw that 70 percent of his carrots were going to waste because of irregular shape or size decided to sell “baby carrots.” After cutting the irregular carrots small, he was able to sell them for \$.50 per pound compared with \$.17 per pound for regular-sized carrots.²⁷
- Farmer’s markets, which have more than doubled in number in the past 10 years,²⁸ are allowing growers to sell good-quality products that might not meet size, shelf life, or other criteria imposed by retailers.
- California recently passed a bill allowing growers to receive a tax credit for donations of excess produce to state food banks, joining Arizona, Oregon, and Colorado.



for small and medium size farmers. Much off-grade produce also goes to animal feed. Loss from improper storage or handling has decreased but can still be significant. For instance, fresh produce can spoil in storage if a buyer is not found quickly enough.

LOSSES POST-HARVEST AND IN PACKING

Once crops have been harvested, culling is the primary reasons for losses of fresh produce. Culling is the removal of products based on quality or appearance criteria, including specifications for size, color, weight, blemish level, and Brix (a measure of sugar content). Quantities vary significantly by product and situation, but consider these anecdotes.

One large cucumber farmer estimated that fewer than half the vegetables he grows actually leave his farm and that 75 percent of the cucumbers culled before sale are edible.²⁹ A large tomato-packing house reported that in mid-season it can fill a dump truck with 22,000 pounds of discarded tomatoes every 40 minutes.³⁰ And a packer of citrus, stone fruit, and grapes estimated that 20 to 50 percent of the produce he handles is unmarketable but perfectly edible.³¹

Together, these post-harvest losses are considerable. Although some off-grade products—those that are not of a quality grade to sell to major markets—go to processing, many do not. Most large processors have advance contracts with suppliers and often require specific attributes that make the product amenable to processing. In addition, even if a processing facility is willing to accept products that might otherwise be discarded, the location must be close enough to justify transport costs, and the facility must have the capacity to process the product. This can be particularly challenging

Ideas for Increasing Efficiencies at the Post-Harvest Phase

- Grocery Outlet, a \$960 million business with 148 stores,³² has made a business out of selling closeouts and overruns, with 75 percent of products coming from those streams.³³ This includes fresh produce offerings.
- The Farm to Family program in California recovers more than 120 million pounds of produce per year from farms and packers for distribution to food banks.³⁴ In 2010 this program recovered more than 17 million pounds of potatoes alone. Instead of relying on volunteers, the California Association of Food Banks Farm to Family program has pioneered an approach it calls concurrent picking, whereby workers harvest unmarketable produce alongside the marketable grades. The program covers the costs of additional labor, handling, packaging, refrigeration, and transport. In the end, food banks receive fresh produce at a greatly reduced rate and growers are able to deduct the charitable donation of the produce from their taxes. Workers and growers have been thrilled with the program; the challenge to date has been that even at only \$.10 to \$.15 per pound, only 6 of the 41 member food banks have been able to afford the produce.³⁵ This model also has the potential to serve secondary markets such as discount stores, after-school snack programs, or other low-budget outlets.

LOSSES IN PROCESSING

Processing facilities generate food losses mostly through trimming, when both edible portions (skin, fat, peels, end pieces) and inedible portions (bones, pits) are removed from food. Overproduction, product and packaging damage and technical malfunctions can also cause processing losses, though these may be difficult to avoid. In some cases, trimming at the processing stage, rather than by the end user, may be more efficient in terms of quantity lost and potential use of scrap by-products.

The efficiencies of processing vary widely by product. A study by a U.K.-based waste-reduction and recycling organization estimates that food manufacturers lose about 16 percent of their raw materials during manufacturing, amounting to 23 percent of total food losses produced by manufacturing, distribution, retail operations, and households.³⁶ A separate study by the European Commission estimates that 39 percent of total food loss, excluding loss at the farm level, was generated at the manufacturing stage. The study notes that lack of clarity over the definition of food waste by manufacturers (as distinct from by-products) "makes this estimate fragile." According to one plant engineer, "The rule of thumb in processing potatoes is that 50 percent of the potato goes out the back door as finished product."³⁷ Though by no means representative, this indicates that processing waste could be significant in some situations.

ABOUT 10 PERCENT OF THE U.S. ENERGY BUDGET GOES TO BRINGING FOOD TO OUR TABLES.

Source: Webber, Michael, "How to Make the Food System More Energy Efficient," *Scientific American*, December 29, 2011.

One recent trend that deserves more evaluation is the emergence of precut produce or other packaged, fresh, ready-to-eat food. To the extent off-grade or slightly damaged product is made marketable and usable through trimming, this trend may help to increase overall efficiency in the system. Trimming creates more waste at the processing level but may be less wasteful than if those products were trimmed at home. Trimmed produce also tends to use more packaging than untrimmed produce, which means more associated environmental impacts from packaging production and disposal. Trimmed produce spoils more quickly than whole produce once the package is opened but may be more protected en route. Packaged produce and ready foods are also subject to sell by date wastage (discussed later) and are likely discarded when past the date whether spoiled or not. Whole produce does not have a printed sell by date, thus leaving more flexibility to evaluate its condition once at the

store or in the home. However, because it is precut, packaged produce may lead to increased consumption rates at the consumer level due to its ease and accessibility. A similar trend toward precut produce can be seen in food service. A holistic analysis is necessary to determine the ultimate impacts of this trend for both produce and other foods, and should consider implications for packaging and nutrition as well as food utilization.

Ideas for Increasing Efficiencies in Food Processing

- Heinz redesigned their sauce packing process to directly fill machines from intermediate holding tanks instead of using lining bags to hold sauce. This switch saved an estimated 3,000 plastic lining bags which used to have residual sauce inside, amounting to 40 metric tons of combined sauce and plastic waste annually.³⁸
- General Mills began using a new system to heat pizza toppings so they adhere better to the pizza prior to freezing, saving thousands of pounds of cheese and other toppings each year.³⁹

LOSSES IN DISTRIBUTION

Proper transport and handling of food are critical throughout the supply chain, particularly with perishable goods that require cold conditions. Inconsistent refrigeration is less of a problem today than in the past, but it still occurs when trucks malfunction or are involved in accidents. Other handling problems occur when produce is kept at improper temperatures, such as when it sits too long on loading docks. Imported products can wait days at the ports for testing, significantly reducing their shelf life.

A larger problem that occurs at the distribution stage is that of rejected shipments. Rejected perishable shipments can be dumped if another buyer cannot be found in time. If these perishables do make it to a store, they have a shorter shelf life by the time they get there. Sometimes they are brought to food banks if the food banks have the capacity to take them. Even food banks sometimes reject these loads because they cannot use them in the quantities being shipped, for instance a truckload of beets. Distribution centers can also find themselves with surplus product when individual stores don't require what they had forecasted.

Ideas for Increasing Efficiencies in Distribution

- Online exchanges to find markets for rejected product could lead to faster delivery and less waste. Overall, however, distribution probably offers limited opportunities for increased food efficiency.
- Employee training to ensure proper handling and storage, as well as proper maintenance of distribution vehicles, help to keep losses low at the distribution stage.

LOSSES IN RETAIL

In-store food losses in the United States totaled an estimated 43 billion pounds in 2008, equivalent to 10 percent of the total food supply at the retail level.⁴⁰ But that doesn't tell the whole story. Through their influence both up and down the supply chain, retailers actually are responsible, at least in part, for a much bigger proportion of total losses.

Most of the loss in retail operations is in perishables—baked goods, produce, meat, seafood, and, increasingly, ready-made foods. The USDA estimates that supermarkets lose \$15 billion annually in unsold fruits and vegetables alone. Unfortunately, the retail model views waste as a part of doing business. According to a former President of Trader Joe's, "the reality as a regional grocery manager is, if you see a store that has really low waste in its perishables, you are worried. If a store has low waste numbers it can be a sign that they aren't fully in stock and that the customer experience is suffering." Industry executives and managers view appropriate waste as a sign that a store is meeting quality control and full-shelf standards, meaning that blemished items are removed and shelves are fully stocked.⁴¹ In 2005 and 2006, annual supermarket losses averaged 11.4 percent for fresh fruit and 9.7 percent for vegetables, with losses varying from 0.6 percent for sweet corn to as high as 63 percent for mustard greens.⁴²



ONE INDUSTRY CONSULTANT ESTIMATES THAT UP TO ONE IN SEVEN TRUCKLOADS OF PERISHABLES DELIVERED TO SUPERMARKETS IS THROWN AWAY.

Source: Beswick, P. et al., "A Retailer's Recipe for Fresher Food and Far Less Shrink," Oliver Wyman, Boston. ergoeditorial.biz/worksamples/OW%20grocery%20shrinkage.pdf.

Some of the main drivers for in-store retail losses include:

Overstocked product displays. Most retail stores operate under the assumption that customers buy more from brimming, fully stocked displays, preferring to choose their apples from a towering pile rather than from a scantily filled bin. This leads to overstocking and overhandling by both staff and customers and damage to items on the bottom from the accumulated weight.

Expectation of cosmetic perfection. Many customers select stores based on the quality of perishables, and therefore retailers feel compelled to have only produce of perfect shape, size, and color—leading to much of the culling discussed above.

Pack sizes that are too large. Produce arrives in preset quantities according to case size. This limits the flexibility for produce buyers to purchase exactly the amount needed. For example, if a grocer wants 50 grapefruit but they come in cases of 80, the store is then stuck with 30 extras.

Availability of fresh, ready food until closing. Stores are increasingly offering more prepared, ready-made food in their delicatessens and buffets. On the one hand, this can be a good way to make use of marginally damaged or nearly expired products if the labor is available to do so. However, as with produce, store managers often feel compelled that displays of ready-made items remain fresh and fully stocked instead of letting shelves hold fewer items as they run out. Rotisserie chickens, for instance, might be thrown away and replaced after four hours on display. One grocer estimated that his store threw away a full 50 percent of the rotisserie chickens that were prepared, many of those from the last batch of the day.⁴³ Ready-made food makes up a large portion of food lost at convenience stores, which discard approximately 25 percent of their food products.⁴⁴

Expired "sell by" dates. Products are discarded when sell by dates—almost none of which are regulated by law—are near. Different from use by or best by dates (see section on reducing expiration-date confusion that follows), sell by dates are designed to help the store with stocking and ensure freshness to consumers. One industry expert estimated supermarkets on average discard \$2,300 per store worth of out-of-date food every day.⁴⁵ Almost all of this food is still consumable but may have a limited shelf life left. In most states, it is not illegal to sell product after the sell by date, but stores don't do so out of concern that their image of carrying fresh products will be damaged. Most stores, in fact, pull items 2 to 3 days before the sell-by date.

Damaged goods, outdated promotional products, and unpopular items. Products are also discarded due to damaged packaging or promotions that have passed (post-holiday discards are most common, but other time-sensitive products may go to waste as well). In addition, many of the 19,000 or so new food products placed on grocery store shelves each year⁴⁶ are not popular with consumers and may be discarded when they fail to sell. In addition to in-store waste, this can lead to large volumes of overruns left with the manufacturer without a market.

Low staffing. Stores that prepare food on-site are able to use damaged food or food that has passed its sell by date as ingredients. With tight staffing, there is less labor to prepare food on-site and therefore less opportunity to use those products.

Although in-store retail losses are significant, they are only a portion of the losses driven by retailers both up and down their supply chains. Out-of-store losses driven by retailers also are contributing factor. Anecdotally, large commercial food buyers can demand tough contract terms including quantity guarantees and the ability to change orders at the last minute. Growers often overplant beyond their contracts for fear of not fulfilling them.

And downstream of the retailer, consumers are directly affected by their retail experience. Much food waste begins with choices made at the grocery store, which often are influenced by store promotions. Bulk discounts, merchandising that encourages impulse buys, and high-volume promotions such as buy-one-get-one-free all contribute to consumers' purchasing items or quantities that they are unlikely to consume.

Stop and Shop saved \$100 million by reducing food waste

Analyzing product loss, or shrink, can lead to big savings. In 2008, a \$16 billion grocery chain called Stop and Shop/Giant Landover with more than 550 stores was able to save an estimated annual \$100 million by conducting a thorough analysis of freshness, shrink, and customer purchases in all of their perishables departments. They began with an analysis of product displays and discovered alternatives to overflowing displays as well as whole stock-keeping units (SKUs) that weren't necessary. They also found that overfilled displays not only led to spoilage on the shelf, but also could displease customers due to spoiled product and require more staff handling to sort out the damaged items. In the end, the "pile 'em high, watch 'em fly" philosophy did not ring true. Customers did not notice reduced choice and less-full displays, but in fact customer satisfaction rose as produce was on average three days fresher than before. A shift in the staff culture played an important role in this achievement as well. Similarly, PriceChopper conducted an analysis that led to elimination of 680 SKUs from their bakery department, reducing shrink by \$2 million and producing a 3 percent lift in sales the first year after implementation. In both cases, item-level analyses were critical to determining how and when to alter inventory.

Sources: Telephone interview with Jose Alvarez, former president and CEO, Stop & Shop/Giant-Landover, February 28, 2012. Mathew Enis, "Retailers Reduce Shrink, Improve Fresh Food Waste," *Supermarket News*, July 27, 2005, supermarketnews.com/archive/retailers-reduce-shrink-improve-fresh-food-sales.

Ideas for Increasing Efficiencies in In-Store and Out-of-Store Retail

- The popular Berkeley, California, grocery store Berkeley Bowl estimates it sells \$1,500 per day of produce off its bargain shelf, which offers bags of damaged or nearly expired produce for \$.99.⁴⁷
- Tesco and Marks & Spencer, both U.K. retailers, are both testing use of an ethylene-absorbing strip to prolong produce life. The retailers estimate it could save 1.6 million packs of tomatoes, 350,000 packs of avocados, and 40,000 packs of strawberries.⁴⁸
- Musgrave Group/United Biscuits in the United Kingdom improved forecasting for promotional items and reduced promotional waste by 13 percent.⁴⁹
- Warburtons in the United Kingdom removed "display until" dates from its bread product packaging to reduce consumer confusion.⁵⁰
- New labeling encouraged consumers of a U.K. grocer called Sainsbury to freeze food up to its use-by date is estimated to save 800,000 metric tons of food annually.⁵¹
- The Co-operative Group in the United Kingdom provides storage instructions for fruits and vegetables on its produce bags and displays "Love Food Hate Waste" ads in 12,000 stores.⁵²
- Instead of buy-one-get-one-free promotions, the Co-operative Group has run half-off promotions,⁵³ Tesco has buy-one-get-one-later,⁵⁴ and Sainsbury's is piloting a buy-one-give-one-free program.⁵⁵

LOSSES IN FOOD SERVICE

According to the USDA, households and food service operations (restaurants, cafeterias, fast food, and caterers) together lost 86 billion pounds of food in 2008, or 19 percent of the total U.S. retail-level food supply.⁵⁶ Approximately 4 to 10 percent of food purchased by restaurants becomes kitchen loss, both edible and inedible, before reaching the consumer.⁵⁷ Another significant portion is served but never eaten. Other drivers of waste in food service include large portions, inflexibility of chain-store management, and pressure to maintain enough food supply to offer extensive menu choices at all times.⁵⁸ In addition, staff behavior and kitchen culture can contribute to food waste.

Plate waste is a significant contributor to losses in food service, resulting primarily from large portions and undesired accompaniments. On average, diners leave 17 percent of meals uneaten⁵⁹ and 55 percent of these potential leftovers are not taken home.⁶⁰ Portion sizes have increased significantly over the past 30 years. From 1982 to 2002, the average pizza slice grew 70 percent in calories, the average chicken caesar salad doubled in calories, and the average chocolate chip cookie quadrupled.⁶¹ Today, portion sizes can be two to eight times larger than USDA or FDA standard serving sizes.⁶²

Extensive menu choices make it challenging to achieve proper inventory management because large menus require more inventory to be on hand at all times. Unexpected sales fluctuations also make planning difficult. Particularly wasteful are large buffets, which cannot reuse or even donate most of what is put out because of health code restrictions.

Centralized chain-restaurant management can also make it harder to manage waste because although chain restaurants have advanced software for inventory planning, there is often a lack of flexibility at the individual restaurant level that prevents local managers from reusing food in creative ways. In addition, fast-food outlets often must adhere to time limits. For example, McDonald's fries must be thrown out after 7 minutes and burgers after 20 minutes. These time limits cause approximately 10 percent of all fast food to be discarded.⁶³

Ideas for Increasing Efficiencies in Food Service

- Using LeanPath software to identify waste sources, UC Berkeley dining services reduced preconsumer waste by 43 percent, saving more than 1,000 pounds of food and \$1,600 per week.⁶⁴
- Sodexo operates trayless cafeterias on more than 300 college campuses. By discouraging the overloading of trays, it has reduced food waste by as much as 30 percent.⁶⁵
- TGI Fridays, Au Bon Pain, Maggianos, and Cheesecake Factory all offer smaller-portion options.⁶⁶
- London restaurant Obalende Suya Express charges a £2.50 fee for unfinished food and donates the proceeds to Oxfam.⁶⁷
- Unilever offers extensive advice for food service establishments to reduce waste, including a Waste Audit Toolkit with tracking sheets, signage, and case studies.⁶⁸
- Programs in schools, such as salad bars, allow children to choose their food, helping to reduce the amount discarded.

LOSSES IN HOUSEHOLDS

American families throw out approximately 25 percent of the food and beverages they buy.⁶⁹ The cost estimate for the average family of four is \$1,365 to \$2,275 annually.⁷⁰ Consumer food waste also has serious implications for wasted energy. A McKinsey study reports that household losses are responsible for eight times the energy waste of post-harvest losses on average due to the energy used along the supply chain and in food preparation.⁷¹ In the United Kingdom, about two-thirds of household waste is due to food spoilage from not being used in time, whereas the other one-third is caused by people cooking or serving too much.⁷² However this ratio is unknown for the United States.

At the retail and end-consumer stages of the supply chain, perishables make up the majority of food losses due to the high volume of consumption and the food's tendency to spoil. In terms of total mass, fresh fruits and vegetables account for the largest losses, followed closely by dairy, and meat/poultry/fish (see: Total Food Loss from Retail, Food Service and Households). Note that loss numbers are based on mass and include loss in mass due to cooking but exclude inedible portions such as bones and peels. Again, data of this nature for losses from farm to retail are not available.

Research is lacking in the United States, but anecdotal evidence suggests that drivers for household losses include:

Lack of awareness and undervaluing of foods. Cheap, available food has created behaviors that do not place high value on utilizing what is purchased. As a result, the issue of wasted food is simply not on the radar of many Americans, even those who consider themselves environment- or cost-conscious.

Confusion over label dates. Label dates on food are generally not regulated and do not indicate food safety. Multiple dates, inconsistent usage, and lack of education around date labels cause consumers to discard food prematurely. In the U.K., an estimated 20 percent of avoidable food waste in households is discarded because of date labeling confusion.⁷³

Spoilage. Food spoils in homes due to improper or suboptimal storage, poor visibility in refrigerators, partially used ingredients, and misjudged food needs.

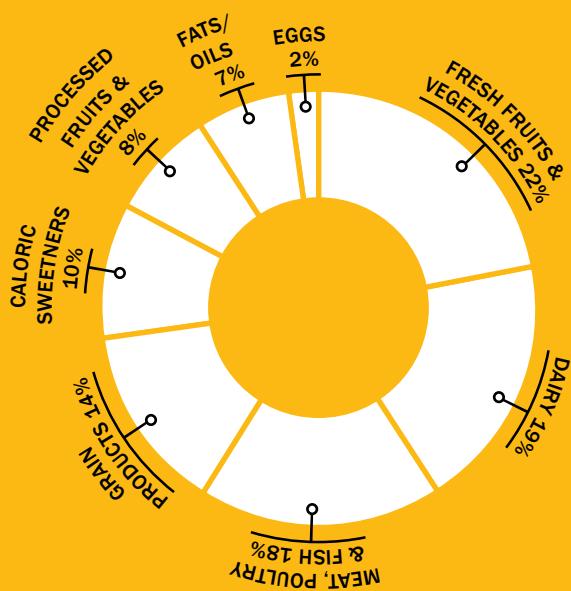
FOR THE AVERAGE U.S. HOUSEHOLD OF FOUR, FOOD WASTE TRANSLATES INTO AN ESTIMATED \$1,350 TO \$2,275 IN ANNUAL LOSSES.

Source: Bloom, *American Wasteland*, 187. Another report using updated USDA consumer loss numbers and 2011 prices estimates \$1,600 in annual losses per household of four: Clean Metrics, "The Climate Change and Economic Impacts of Food Waste in the United States," <http://www.cleanmetrics.com/pages/ClimateChangeImpactofUSFoodWaste.pdf>.



TOTAL FOOD LOSS FROM RETAIL, FOOD SERVICE AND HOUSEHOLDS

(BREAKDOWN AS A PERCENTAGE OF TOTAL FOOD LOSS)



Source: *Journal of Consumer Affairs*, Fall 2011: 492-515.



Reducing Expiration Date Confusion

"Use by" and "best by" dates, commonly found on both perishable and nonperishable products, are manufacturer suggestions for peak quality. They do not indicate food safety, as is commonly believed, nor are they regulated. The exception to this is infant formula, for which "use by" dates are federally regulated, and some other specific products in certain states.

This is generally not how consumers interpret these dates. Many people believe they indicate a product's safety and discard food as soon as it reaches its expiration date. Research on date labeling in the U.K. by the Waste & Resources Action Programme (WRAP) shows that 45 to 49 percent of consumers misunderstand the meaning of date labels, resulting in an enormous amount of prematurely discarded food. In fact, WRAP estimates that up to 20 percent of household food waste is linked to date labeling confusion.

This led the U.K. government to recently revise its guidance on date labeling such that now 1) "sell by" and "display until" labels should be removed to avoid confusion for shoppers, with different ways of tracking stock control explored by retailers; 2) "Best before" dates relate to food quality, including taste, texture, and appearance, but do not indicate that eating product past that date will be harmful; 3) "use by" dates relate to food safety; and 4) food may not be sold after the "use by" date, but retailers can, with the exception of eggs, sell products after the "best before" date, provided they are safe to eat.

Sources: WRAP, *Consumer Insight: Date Labels and Storage Guidance*, May, 2011. www.wrap.org.UK/downloads/Technical_report_dates_final_cf179742.11175.pdf.

Food Standards Agency, *Guidance to end confusing date labels*, Food Standards Agency, September 15, 2011, www.food.gov.UK/news/newsarchive/2011/sep/datelabels.

THE AVERAGE AMERICAN CONSUMER DISCARDS 10 TIMES AS MUCH AS THE AVERAGE SOUTHEAST ASIAN.

Source: Food and Agriculture Organization 2011:

A REPORT OUT OF THE U.K. ESTIMATES THAT IF FOOD SCRAPS WERE REMOVED FROM LANDFILLS THERE, THE LEVEL OF GREENHOUSE GAS ABATEMENT WOULD BE EQUIVALENT TO REMOVING ONE- FIFTH OF ALL THE CARS IN THE COUNTRY FROM THE ROAD.

Source: WRAP, "New Estimates for Household Food and Drink Waste in the U.K.," 2011, www.wrap.org.UK./downloads/New_estimates_for_household_food_and_drink_waste_in_the_U.K._FINAL_v2.110a9ba6.11460.pdf.

LOSSES DURING DISPOSAL

The decomposition of uneaten food accounts for 23 percent of all methane emissions in the United States.⁷⁷ Of all the food that is lost at different stages from farm to fork, only 3 percent is composted.⁷⁸ The vast majority ends up in landfills. In fact, food now represents the single largest component of municipal solid waste reaching landfills⁷⁹ where it gradually converts to methane, a greenhouse gas at least 25 times more powerful in global warming as carbon dioxide.

In the landfill, food scraps decompose and give off methane, a greenhouse gas at least 25 times more powerful in global warming as carbon dioxide. Due to their organic nature and high moisture content, food scraps decay more rapidly than other organics. Therefore, they produce a disproportionately large component of the methane that landfills produce in the first years, often before the landfills are capped. One expert estimated food scraps contribute 90 percent of landfill methane emissions during this time.⁷⁹ This makes them a significant portion of the 16 percent of total U.S. methane emissions that come from landfills.⁸⁰ A report out of the U.K. estimates that if food scraps were removed from landfills there, the level of greenhouse gas abatement would be equivalent to removing one-fifth of all the cars in the country from the road.⁸¹

Composting is an important way to manage this waste; it reduces methane emissions, recycles nutrients, and raises consciousness about the quantities of food being wasted. It also makes possible the capture of methane for energy generation via a process called anaerobic digestion. No matter how efficient we are with food, there will always be organic scraps needing disposal. For all these reasons, composting is an important complement to increasing food use efficiency. Education regarding food waste reduction alongside compost roll-out programs can help to address this. As composting is really a waste management issue, it is outside the scope of this paper.

Food Recovery

Food recovery is the collection of wholesome food for distribution to the poor and hungry. It includes gleaning from fields and collecting perishable, nonperishable, and prepared foods from various stages in the supply chain. Currently, only about 10 percent of available, edible wasted food is recovered each year in the United States, allowing room for significant improvement. Barriers to recovering this food are liability concerns, distribution and storage logistics, and funds needed to glean, collect, package, and distribute it.

The Bill Emerson Food Donation Act, signed into law by President Clinton in 1996, protects donors from food-safety liability when donating food to a nonprofit organization. However, awareness about this law and trust in the protections it offers remain low. Even if protected by law, some companies may fear negative publicity if donated food causes illness.

Many businesses cite transportation as the main barrier to donating food. Typically, food recovery organizations are responsible for collecting and transporting donations. Businesses need to trust that collections will be consistent and reliable in order to participate. Many food banks have had to significantly invest in transportation infrastructure to successfully transition to handling greater quantities of perishable food donations. Unfortunately, some food recovery organizations are often staffed by volunteers and do not have the resources necessary to provide this consistency.

In addition, food ready for donation does not always match the needs of food recovery organizations. A focus on increasing produce and protein items as well as cultural norms and lack of preparation knowledge can further reduce the usability of donations.

Another challenge is updating federal tax incentives for food donations. Currently, a temporary allowance for small companies to receive enhanced tax deductions has expired. Much of the excess nutritious food at food processors, in the fields, and at food manufacturing plants is not packaged at all since without tax changes it would cost companies more to do that than to landfill the food. This represents a significant part of the nutritious food going to waste each year.

Regardless of these significant challenges, food recovery efforts have seen promising growth. Farm to Family, the main agriculture rescue organization receiving donations from farms in California, grew tenfold from 2005 to 2010. Contributions have also expanded much-needed infrastructure for recovery, such as a recent donation by Walmart of 35 new refrigerated trucks to Feeding America, a national food recovery organization.

Sources: Bloom, *American Wasteland*, 179. Telephone interview with Sue Sigler, executive director, California Association of Food Banks, on February 1, 2012. California Association of Food Banks, http://www.cafoodbanks.org/Farm_to_Family_Program_History.html. "Donated Trucks Will Help Deliver 41 Additional Meals," Walmart Corporate, <http://walmartstores.com/CommunityGiving/9602.aspx>.

TOWARD MORE EFFICIENCIES IN THE FOOD SUPPLY SYSTEM

Increasing the efficiency of our food system will ultimately require a multifaceted suite of solutions involving changes in consumer behavior, supply chain operation, market incentives, and public awareness. Some of the solutions to reducing food waste may bring immediate cost savings to both businesses and consumers.

BUSINESSES SHOULD HELP REMOVE INEFFICIENCIES IN THE FOOD SUPPLY SYSTEM

Conduct regular food waste audits and set targets. What gets measured gets managed. Businesses of all sizes can begin increasing the efficiency of their operations by conducting a detailed audit of their food losses and setting reduction targets. A food waste audit will establish a useful baseline for evaluating goals and will also highlight opportunity areas for savings. While occasional auditing can be helpful, integrating audits into standard practice will make attention to waste a continued part of the operation. Engaging staff through contests or recognition can be an effective way to create a team effort around food waste reduction.

Promote cooperation. Recently the Grocery Manufacturers Association (GMA), Food Marketing Institute (FMI), and National Restaurant Association (NRA) jointly formed the Food Waste Opportunities and Challenges Initiative. The initiative focuses on increasing food donations and reducing food waste sent to landfills and could provide an excellent platform for waste prevention in general. Members of these associations can help by participating in the surveys and programs moving forward.

Disseminate and encourage adoption of best practices by businesses. Many food-saving measures are already being practiced around the country. A concerted effort to illuminate how these have been implemented and to encourage businesses to adopt them would make a significant and immediate dent in the amount of food wasted. The industry initiative discussed above could be an excellent platform for this information.

Encourage innovation in online solutions and new technologies. New technologies and online solutions continue to emerge. Given the potential value, there is great opportunity for businesses that create products aimed





GOVERNMENT SHOULD HELP REMOVE INEFFICIENCIES IN THE FOOD SUPPLY SYSTEM

Conduct a comprehensive study of food losses

throughout the U.S. food system. The adage “you manage what you measure” applies well in this case. Food loss has become such a huge problem partly because it is not being measured or studied, thus making it difficult to discuss or address. A comprehensive report on food losses throughout the U.S. food system is needed to characterize the problem, identify hot spots and opportunity areas, set baselines against which improvement can be measured, and provide more detailed and accurate data. A similar study, completed by the European Commission in 2010,⁸² was an important first step in establishing reduction goals.

Establish national goals. Reducing food loss in the United States should be a national priority, starting with the establishment of clear and specific food waste reduction targets. In January 2012, the European Parliament adopted a resolution to reduce food waste by 50 percent by 2020 and designated 2014 as the “European year against food waste.”⁸³ At that time, the Parliament issued this statement: “The most important problem in the future will be to tackle increased demand for food, as it will outstrip supply. We can no longer afford to stand idly by while perfectly edible food is being wasted. This is an ethical but also an economic and social problem, with huge implications for the environment.” The U.S. government, on the other hand, currently dedicates virtually no resources to addressing this problem. This is unacceptable, as this waste represents a vast amount of lost money and resources throughout the food system and will have increasing impacts as demand for food grows.

Take action at the state and local level. State and local governments are well equipped to lead the charge on reducing food waste. State targets for reduction of wasted food can set the tone for local governments to act, and state waste agencies can provide direction and infrastructure to enable food waste prevention programs. States can also create incentives, tax or otherwise, that encourage donations of edible food by businesses at all levels of the supply chain. For local governments, one key opportunity is to include a food waste prevention campaign as part of composting programs, particularly during program introduction. Local governments can also encourage local businesses to adopt better practices through their existing business networks. Counties, cities, and local school districts can consider how their own procurement policies could help to prevent food from being wasted. They can also look to address local barriers to food donations.

at reducing food losses and salvaging food for secondary markets. There are already smartphone applications that help consumers to know how long products have been in the refrigerator, plan appropriate portions, and create shopping lists. Technology such as LeanPath software weighs and tracks discarded food in restaurant kitchens. Websites such as Ample Harvest are springing up to help connect those with surplus food to those in need.

And there continue to emerge new ways to extend product life, reduce shrink from transport, and detect product state. Researchers have explored technology that would scan and list the contents of refrigerators. Specialized distribution pallets that protect and extend product life are being tested.

Address date labeling confusion. Dates on food products do not indicate food safety, yet many consumers believe that they do and discard food accordingly. Research on date labeling in the United Kingdom suggests that standardizing food date labeling and clarifying its meaning to the public could reduce household food losses by as much as 20 percent.⁸⁴ The European Commission concluded that “date labeling coherence” is one of the top three policy priorities for the European Union for reducing food waste.⁸⁵ Further research is necessary to determine the best approach for achieving more clarity on date labeling. One option would be to learn from the recent guidelines adopted by the United Kingdom and follow their lead if appropriate. Another would be to explain on packaging that “use by” dates indicate peak quality but not safety.

Support and enable food recovery. As stated above, only about 10 percent of surplus edible food is currently recovered in the United States.⁸⁶ Clearly, there is room for significant improvement. Barriers to recovering more food are liability concerns, distribution and storage logistics, and funding to support the collection and distribution of food. An active program involving industry and supported by the U.S. government could catalyze action, as was the case in the mid-1990s, when the USDA had a dedicated coordinator of food recovery and gleaning. Stronger tax incentives could also incentivize more recovery. An enhanced tax deduction for smaller businesses that donate food expired in December 2011. Unless Congress votes to extend this provision, only large businesses known as C corporations will be eligible for the enhanced deduction.⁸⁷ Another bill, H.R. 3729, could also go even further to incentivize donations by making the enhanced tax deduction for food donation permanent for smaller businesses, raising the cap for total deductions for food donations, and codifying other related aspects of the tax code. A permanent extension of the enhanced tax deduction to smaller businesses is critical in convincing them to establish a food donation program long term.

Improve public awareness. Love Food Hate Waste, a major public-awareness campaign launched in the United Kingdom, has been extremely successful. As mentioned above, avoidable household food waste has dropped 18 percent in the five years that the campaign has run though this could in part be due to increased food prices. Possibly due to this effort, a recent survey by the U.K.’s Food Standards Agency found that food waste was one of the top three food issues of concern to the public, ranking above food safety.⁸⁸ A large public campaign featuring widespread communications and celebrity spokespeople could be effective in putting food waste on the radar of American consumers. Educating consumers about how they can reduce food waste does not require asking them to make personal sacrifices, in contrast to much of the dietary advice they receive. A “value your food” message is a positive one, a natural extension of other “foodie” messaging. It allows for a fun campaign that offers tips and recipes while also drawing attention to the impact of food production on the environment.



CONSUMERS CAN ALSO HELP REMOVE INEFFICIENCIES IN THE FOOD SUPPLY SYSTEM

Consumers can make a big difference by educating friends, family, colleagues, and others about these issues. There are also many steps that can be taken in households to reduce waste, several of which are suggested below. A more complete list can be downloaded from the Food and Agriculture section of the NRDC website at www.nrdc.org/food.

Shop wisely. Planning meals, using shopping lists, buying from bulk bins, and avoiding impulse buys or marketing tricks that lead to overbuying can all help reduce the amount of food discarded at the household level. Though volume purchases and promotions may be less expensive per ounce, if part of the food goes bad before being eaten, it may actually be more expensive in the long run.

Understand expiration dates. “Sell by” and “use by” dates are not federally regulated and do not indicate safety, except on certain baby foods. Rather, they are manufacturer suggestions for peak quality. Many foods can be safely consumed after their “sell by” and “use by” dates.



STEPS TO PURSUE AT EACH STAGE IN THE FOOD SUPPLY SYSTEM

At Harvest

Revise quality and aesthetic standards. If produce buyers later in the supply chain were to relax quality standards related to appearance or created separate product lines to sell aesthetically imperfect produce, it might prove economically viable for farmers to harvest more off-grade items.

Expand alternative outlets and secondary markets for off-grade foods. There already exists an infrastructure of brokers, distributors, and wholesalers to sell off-grade products. However, because a significant volume of product does not make it into this stream, an evaluation of methods to facilitate growth of this distribution channel is warranted.

Practice farm-level food recovery. There is already a network of food recovery organizations eager to receive donations and even help harvest unsold crops. Food banks are especially interested in healthy and nutritious foods. Growers can help Organizations such as Feeding America, Food Donation Connection, and local food banks can help producers to donate their products with relatively little effort, feeding people and receiving tax benefits at the same time.

Enact regulatory measures that incentivize complete harvest. Often, whether or not to harvest is an economic decision driven by market conditions at the time of harvest. Building harvesting incentives into tax credits or other publicly funded farmer support programs could help tip the financial equation in favor of harvesting. In California, Assembly Bill 152 provides tax credit to farmers for the donation of crops to a state food-assistance program. These credits provide a larger incentive than deductions for charitable contributions, which can be applied to federal taxes but only up to a certain limit. Similar tax credits exist in Arizona, Colorado, North Carolina, and Oregon. A further analysis is warranted examining how tax breaks, other federal programs, and crop insurance are incentivizing or discouraging both product donation and overplanting.

Promote regional or local food distribution. Encouraging the growth of regional food systems can help alleviate some of the losses associated with fresh products. Shorter transport times and distances would likely lead to lower "shrink" (loss of product) during transport and could create a market for produce with a shorter shelf life at the time of harvest. More research on the extent of this opportunity would be useful.

At Processing

Focus on reengineering. Much of the losses at the processing level may be unavoidable, but a focus on redesigning products, reengineering manufacturing processes, and adopting new technologies with food utilization in mind could lead to gains in efficiency.

Meeting Global Food Demand

Worldwide, we produce 4,600 kilocalories per person per day, and yet only 2,000 to 2,800 kilocalories are available for consumption. In the United States alone, consumers waste 10 times more food per capita than those in Southeast Asia. Meanwhile, 925 million people suffer from chronic hunger. This challenge of food security will only increase. The United Nations Food and Agriculture Organization (FAO) forecasts that food production must increase by 70 percent by 2050 to feed an expected global population of 9.1 billion people with increasingly meat-dependent diets.

Much of the needed food production can be traced back to increased meat consumption, either the meat itself or the crops required to feed livestock. Animal products require 4 to 40 times the calories to produce than they provide in nutrition when eaten, mainly due to the crops they consume. If all of the crop production currently allocated to animal feed were directly consumed by humans, global food production would increase by some two billion tons and food calories would increase by 49 percent. This becomes more important when considering the projections that, barring any shift in diets, worldwide meat consumption could increase 40 percent by 2050 (from a 2000 baseline). Although not the focus of this paper, an important step in ensuring food security will be to move diets away from animal products, thus increasing the efficiency of our food system in terms of calories delivered.

To meet global food demand, the FAO estimates about 170 million more acres of farmland will be required along with an 80 percent increase in yields from existing croplands in developing countries.

These estimates, however, do not assume any reduction in food wastage rates. A recent report by the United Kingdom's Government Office for Science estimates that cutting in half the total amount of food losses—a realistic target, the authors contend—could contribute the equivalent of 25 percent of today's global food production to the total food supply. A separate McKinsey Consulting report projects that reducing food waste at the consumer level by 30 percent could save roughly 100 million acres of cropland by 2030. The European Parliament has taken this challenge seriously by recently adopting a resolution to reduce food waste by 50 percent by 2020, calling for "a coordinated strategy, combining E.U.-wide and national measures, to improve the efficiency of food supply and consumption chains sector by sector and to tackle food wastage as a matter of urgency."

Focusing on efficiency will reduce pressure to intensify production on existing cropland or convert natural land to agricultural use. It will help ensure that we use as much as possible of the food that we produce, a critical part of meeting global demand for food. McKinsey estimates the total benefit to society of reducing food waste to be \$252 billion globally in 2030. However, ensuring global food security is a complex task and will require more than just reducing food wastage, including addressing the issues of income distribution and dietary preferences.

Sources: J. Lundqvist, C. de Fraiture, and D. Molden, "Saving Water: From Field to Fork—Curbing Losses and Wastage in the Food Chain," Stockholm International Water Institute (SIWI) Policy Brief, 2008. Lundqvist et al. put the number at 2,000 kcal/capita/day using year 2000 numbers. An estimate of 2,797 kcal/capita/day is reported by the U.N. Food and Agriculture Organization (FAO) for year 2007 numbers. <http://faostat.fao.org/site/609/default.aspx#ancor>. U.N. FAO, "Global Food Losses and Food Waste," 2011, www.fao.org/ag/ags/division/publications/publication/en/?dyna_fef%5Buid%5D=74045. U.N. FAO, "Millennium Development Goal Progress," 2011, www.fao.org/economic/ess/ess-fs/rmdg/en/. U.N. FAO, "How to Feed the World in 2050," 2008, www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf. Foresight, United Kingdom Government Office for Science, "The Future of Food and Farming, Final Project Report," London, 2011. "Parliament Calls for Urgent Measures to Ban Food Waste in the E.U.," *European Parliament News*, January 19, 2012, www.europarl.europa.eu/news/en/pressroom/content/20120118IPR35648/html/Parliament-calls-for-urgent-measures-to-halve-food-wastage-in-the-E.U. R. Dobbs et al., "Resource Revolution: Meeting the World's Energy, Materials, Food, and Water Needs," McKinsey Global Institute, November 2011.

Pay further attention to potential secondary uses for trimmings/peels.

Trimming and peels contain nutrition and should be considered for their value. A concerted effort should be made for scraps and by-products to go to their highest use—as other food products, if possible, or as animal feed, compost, or energy feedstock.

In-store

Analyze needs at the item level. Analyzing sales by item can reveal low-performing stock-keeping units (SKUs) that are not likely to be missed by most consumers. Fewer SKUs also means higher turnover per SKU, reducing both shrinkage and inventory costs. In addition, this type of analysis can improve forecasting and inventory management, bringing significant savings. Trader Joe's, for instance, carries approximately 4,000 SKUs, far less than the 50,000 carried by an average grocery store,⁸⁹ likely leading to less product loss and other benefits.

Use discount shelves. Retailers who have tried offering near-expiration items at a discounted price report that it does not reduce sales but rather raises customer satisfaction.

Redesign product displays. Using platforms and other props can make produce bins appear fuller without causing as much produce to spoil.

Allow prepared foods to run out close to closing. This can also cut down on waste.

Donate more. Retailers should work with local agencies to address the logistical challenges related to food donations. Such donations bring positive community impact and also offer tax benefits in the form of enhanced tax deductions.

Beyond the Store

Increase flexibility in contract terms and grading standards. The implications of contract terms and grading standards on upstream waste warrant further research. Allowing for occasional flexibility in delivered volumes might have a significant impact on waste at the farm level by reducing the pressure on growers to overplant. Easing cosmetic standards could translate to more complete harvests, with fewer products left in the field or culled. In 2008 a U.K. commission conducted an investigation into grocery supply chains that resulted in an amended “Grocery Supply Code of Practice” detailing a framework for supplier contracts that addresses some aspects of shared risk across the supply chain.⁹⁰

Adjust promotions. Specials that encourage overbuying, thus passing waste off to the consumer, should be reconsidered. Grocers in the United Kingdom have been experimenting with alternative promotion schemes that could serve as models for U.S. retailers.

Educate consumers. The retail environment is an ideal setting in which to educate consumers on food preparation, storage, expiration dates, and safe food handling. Providing more education to customers also improves their shopping experience and helps gain their loyalty to the retail brand. U.K. grocers have taken to increasing consumer education through information on produce bags, in-store television displays, and online contests.

Use date codes. To reduce customer confusion regarding sell by dates, codes could be used for in-store inventory management, instead of dates.

In Restaurants and at Food Operators

Adapt menus. Limiting menu choices, using specials to flush inventory, planning for food repurposing, and avoiding or redesigning buffets are all best practices for menu planning to increase efficiency of food use. In addition, half-order options, reduced portion sizes with optional refills, or choices in side dishes can lead to less plate waste.

Improve planning and management training. Culinary schools, restaurant associations, and certification bodies can all do their part to teach and encourage efficient practices in menu planning, inventory planning, and accounting to better align sales predictions with purchases.

Audit waste and engage staff. Incorporating waste audits into kitchen practice has been shown to engage both staff and management in identifying opportunities to alter not only menus but also preparation habits, purchasing practices, and prepared quantities. While occasional auditing can be helpful, integrating daily auditing into standard kitchen practice means that attention to waste will be a continued part of the operation. Involving staff through contests or recognition can also be an effective way to reduce food waste.

Encourage guests to take food home. Restaurants should urge diners to take leftovers with them—using as little packaging as possible, and preferably a reusable or compostable type.

Learn about donation benefits. Laws exist to protect those donating food from liability and enhance tax deductions for donations. Understanding these can help illustrate the benefits of donating food.

Reassess school lunch scheduling. While many other factors contribute to school schedules, offering lunch later in the day, perhaps just after recess, and providing more time to eat could lead to students’ eating more of their meals.

APPENDIX: SUMMARY OF FOOD WASTE BY SUPPLY CHAIN STAGE

Drivers	Potential Remedies
Harvest	
<p>Weather/disease. Natural phenomena harm crops and lead to excess planting to hedge against this risk.</p> <p>Market conditions. A crop's price at time of harvest may not warrant the labor and transport costs required to bring the product to market.</p> <p>Buyer quality standards. Selective harvest for minimum quality standards and shelf life leads to crops' being left in the field.</p> <p>Labor shortages. Where harvest timing is critical, a labor shortage leads to lower harvest rate.</p> <p>Food safety scares. Public fear related to food safety for specific products can lead to huge losses.</p>	<p>Revision of quality standards to encompass wider array of appearances</p> <p>Expansion of secondary markets for items with cosmetic damage</p> <p>Farm-level food recovery via paid "concurrent picking"</p> <p>Regulatory measures that incentivize complete harvest</p> <p>Regional food networks, leading to less transport and likely less culling for short-lived and damaged products</p>
Processing	
<p>Trimming. This includes removal of both edible portions (peels, skin, fat) and inedible portions (bones, pits, etc.).</p> <p>Processing efficiency. While most operations are quite efficient, some steps may lose more food than necessary.</p>	<p>Reengineering production processes and product designs</p> <p>Secondary uses for trimmings and peels where not already being employed</p>
Distribution	
<p>Improper handling. Various kinds of mishandling, such as deliveries needing refrigeration that sit too long on the loading dock, can damage products.</p> <p>Inconsistent refrigeration. Truck breakdowns and other mishaps can lead to spoilage due to lack of refrigeration.</p> <p>Rejected shipments. By the time a shipment is rejected, its contents have a shorter shelf life and may be difficult to sell before spoiling.</p>	<p>Proper training for handling and storage</p> <p>Online solutions to facilitate sale or donation of rejected shipments</p>

Drivers	Potential Remedies
Retail: In-store	
<p>Food displays. Excessive products may be displayed in order to create the effect of abundance, which is believed to increase sales. There can also be overstocking, over-trimming, and improper stock rotation.</p> <p>Ready-made food. Increases in this perishable category lead to greater discards at end of day.</p> <p>Label dates. Products that pass their "sell by" dates are removed from shelves.</p> <p>Pack size too large. Inflexible pack sizes lead to stores' ordering more than they expect to sell.</p> <p>Discarded product. The passing of holidays, promotion expiration, a high failure rate for new food products, and damaged packaging all lead to discarded product.</p> <p>Low staffing. With tight staffing, there is less labor to prepare food on-site and therefore less flexibility in repurposing minimally damaged products.</p>	<p>Item-level analyses to identify opportunities to reduce SKUs or change ordering patterns</p> <p>Discount offerings for out-of-date promotional items or slightly damaged goods.</p> <p>Product display redesign using platforms and other props to make produce bins appear more full</p> <p>Increased donations</p> <p>Allowing prepared foods to run out near closing; more repurposing of foods.</p>
Retail: Beyond store	
<p>UPSTREAM</p> <p>Cosmetic standards. Aesthetic requirements imposed by the market lead to nonharvest and culling of edible produce upstream.</p> <p>Rejected shipments. By the time a shipment is rejected, its contents have a shorter shelf life and may be difficult to sell before spoiling.</p> <p>Contract terms. Rigid contract terms can cause growers to overplant to make sure contracts are fulfilled.</p> <p>DOWNSTREAM</p> <p>Impulse/bulk promotions. Marketing and bulk promotions can lead consumers to purchase unnecessary goods that ultimately are not eaten once in the home.</p>	<p>UPSTREAM</p> <p>Increased flexibility in contract terms and grading standards</p> <p>Experimental offerings of lower-cosmetic-grade produce to determine viability</p> <p>Realigned promotions that discount blemished or soon-to-expire goods, or offer half off instead of 2-for-1 deals, etc.</p> <p>DOWNSTREAM</p> <p>Consumer education on food quality and expiration ("sell by" dates, blemishes, and so on)</p> <p>Closed dating codes on product so customers are not confused by "sell by" dates.</p>

Drivers	Potential Remedies
Food service <p>Large and inflexible portions. Diners often do not eat everything on their plate due to quantity and dislike of side items.</p> <p>Expansive menu options. Extended menus complicate inventory management and require more ingredients to be kept on hand.</p> <p>Unexpected sales fluctuations. Bad weather and other unpredictable factors make inventory planning difficult.</p> <p>Rigid management. Managers of chain restaurants are often unable to adjust for local demand or creatively use inventory.</p> <p>Fast-food time limits. Items such as French fries, chicken nuggets, and burgers are discarded after a designated elapsed time after preparation.</p> <p>School lunch timing. Schools may not provide enough time for lunch, may schedule lunch too early in day, or may schedule it before recess so that kids are not hungry.</p>	<p>Limited menu choices, use of specials to flush inventory, planning for food repurposing</p> <p>Flexible portioning by allowing half-orders or by providing smaller portions with optional free refills, choice of side dishes</p> <p>Training and encouragement of better menu management through certifications, associations, and culinary schools</p> <p>Waste audits to understand patterns of excess</p> <p>Staff engagement through rewards or incentives to participate in waste reduction</p> <p>Encouragement for diners to take home leftovers with low-impact containers</p> <p>Education about liability protection for business managers and owners</p>
Households <p>Lack of awareness. Low prices discourage frugality, and little education has led to a lack of awareness about food waste among the majority of consumers.</p> <p>Confusion over date labels. Multiple dates, inconsistent usage, and lack of education around date labels cause consumers to discard food prematurely.</p> <p>Spoilage. Food spoils in homes due to improper or suboptimal storage, poor visibility in refrigerators, partially used ingredients, and misjudged food needs.</p> <p>Impulse and bulk purchases. Promotions encouraging purchases of unusual or bulk products result in consumers' buying foods outside their typical needs, and these foods can then get discarded.</p> <p>Poor planning. Consumers may overbuy because they fail to plan meals, fail to use a shopping list, inaccurately estimate what is needed for meal preparation, or decide on impromptu restaurant meals.</p> <p>Overpreparation. Preparing more food than needed can lead to waste unless leftovers are saved and consumed.</p>	<p>Wiser shopping, including meal planning and lists that are followed.</p> <p>Education on food quality and expiration ("sell by" dates, blemishes, etc.)</p> <p>Better use of freezing to preserve food before spoilage</p> <p>Preparation of smaller portions in homes where leftovers are not routinely consumed</p>

Endnotes

- 1 M. Webber, "How to Make the Food System More Energy Efficient," *Scientific American*, December 29, 2011
- 2 USDA Economic Research Service, "Major Uses of Land in the United States," Pub. 2002/EIB-14, 2002, <http://www.ers.usda.gov/publications/EIB14/eib14a.pdf>.
- 3 United States Department of Agriculture (USDA), Economic Research Service, Economic Bulletin No. (EIB-16), "Agricultural Resources and Environmental Indicators," Chapter 2.1, July 2006, <http://www.ers.usda.gov/publications/arei/eib16/>.
- 4 K.D. Hall, J. Guo, M. Dore, C.C. Chow, National Institute of Diabetes and Digestive and Kidney Diseases, "The Progressive Increase of Food Waste in America and Its Environmental Impact," *PLoS ONE* 4(11):e7940, 2009.
- 5 J. Buzby, and J. Hyman. "Total and per capita value of food loss in the United States", *Food Policy*, 37(2012):561-570.
- 6 Ibid.
- 7 K.D. Hall, J. Guo, M. Dore, C.C. Chow, National Institute of Diabetes and Digestive and Kidney Diseases, "The Progressive Increase of Food Waste in America and Its Environmental Impact," *PLoS ONE* 4(11):e7940, 2009.
- 8 U.S. EPA, "Inventory of U.S. Greenhouse Gas Emissions and Sinks:1990-2010," April 2012. <http://www.epa.gov/climatechange/ghgemiissions/usinventoryreport.html>.
- 9 In this paper, the term "food waste" is used to represent only the edible portion of food discards that may have been avoidable. "Food losses" is used to represent the combination of discards that are both avoidable and unavoidable. Where inedible portions are included in numbers, they are explicitly noted as such. "Food recovery" refers to collection of surplus food for distribution to people in need.
- 10 This calculation assumes 2,500 kcal/capita/day and an annual total of 150 trillion calories in losses, as reported in K.D. Hall, J. Guo, M. Dore, C.C. Chow, National Institute of Diabetes and Digestive and Kidney Diseases, "The Progressive Increase of Food Waste in America and Its Environmental Impact," *PLoS ONE* 4(11):e7940, 2009.
- 11 A. Coleman-Jensen, M. Nord, M. Andrews, and S. Carlson, United States Department of Agriculture, "Household Food Security in the United States in 2010," September 2011.
- 12 U.N. FAO, "Global Food Losses and Food Waste," 2011, www.fao.org/ag/ags/ags-division/publications/publication/en/?dyna_fef%5Buid%5D=74045.
- 13 K.D. Hall, J. Guo, M. Dore, C.C. Chow, National Institute of Diabetes and Digestive and Kidney Diseases, "The Progressive Increase of Food Waste in America and Its Environmental Impact," *PLoS ONE* 4(11):e7940, 2009.
- 14 Parliament Calls for Urgent Measures to Ban Food Waste in the E.U., "European Parliament News, January 19, 2012, www.europarl.europa.E.U./news/en/pressroom/content/20120118IPR35648/html/Parliament-calls-for-urgent-measures-to-halve-food-wastage-in-the-E.U.
- 15 WRAP, "New Estimates for Household Food and Drink Waste in the U.K.," 2011, www.wrap.org.U.K./downloads/New_estimates_for_household_food_and_drink_waste_in_the_U.K._FINAL_v2.110a9ba6.11460.pdf.
- 16 R. Dobbs et al., "Resource Revolution: Meeting the World's Energy, Materials, Food, and Water Needs," McKinsey Global Institute, November 2011.
- 17 WRAP, *Consumer Insight: Date Labels and Storage Guidance*, May, 2011. www.wrap.org.U.K./downloads/Technical_report_dates_final_cf179742.11175.pdf.
- 18 United States Department of Agriculture (USDA), Economic Research Service, Economic Bulletin No. (EIB-16), "Agricultural Resources and Environmental Indicators," Chapter 2.1, July 2006, <http://www.ers.usda.gov/publications/arei/eib16/>.
- 19 USDA Economic Research Service, "Major Uses of Land in the United States," Pub. 2002/EIB-14, 2002, <http://www.ers.usda.gov/publications/EIB14/eib14a.pdf>.
- 20 A. Flanders, "Economic Impact of Georgia Tomato Production: Value Losses Due to the U.S. Salmonella Outbreak," University of Georgia Center for Agribusiness and Economic Development, 2008.
- 21 J. McKissick and S. Kane, "An Evaluation of Direct and Indirect Economic Losses Incurred by Georgia Fruit and Vegetable Producers in Spring 2011- A Preliminary Data Analysis and Summary Working Paper," University of Georgia Center for Agribusiness and Economic Development, October 2011.
- 22 L. Kantor, K. Lipton, A. Manchester, and V. Oliveira, "Estimating and Addressing America's Food Losses," USDA Food Review. Jan.-Apr. 1997, pp. 2-12.
- 23 Bloom, *American Wasteland*, 112.
- 24 USDA National Agricultural Statistics Service, Acres Planted and Acres Harvested, 2006-2011. Calculated from database at http://www.nass.usda.gov/Statistics_by_Subject/index.php?sector=CROPS
- 25 USDA National Agricultural Statistics Service, 2011 Crop Production Annual Summaries (principal crops and vegetables), usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1047.
- 26 Estimate from Feeding America. Feeding America conducted analysis of seven key crops using USDA data and arrived at the six billion pound estimate. When all crops are considered, the number is likely much higher. Telephone interview with Devi Chari, Director of Produce Innovation, Feeding America, May 14, 2012.
- 27 Elizabeth Weise, "Digging the Baby Carrot" *USA Today*, August 11, 2004 at www.usatoday.com/life/lifestyle/2004-08-11-baby-carrot_x.htm.
- 28 "Farmers Markets and Local Food Marketing" USDA Agricultural Marketing Service, www.ams.usda.gov/AMSV1.0/ams.fetchTemplateData.do?template=TemplateS&navID=WholesaleandFarmersMarkets&leftNav=WholesaleandFarmersMarkets&page=WFMFarmersMarketGrowth&description=Farmers%20Market%20Growth&acct=frmrdirmkt.
- 29 Bloom, *American Wasteland*, 23.
- 30 Bloom, *American Wasteland*, 229.
- 31 California Association of Food Banks, Farm to Family Program video, www.cafoodbanks.org/Farm_to_Family_Videos.html.
- 32 Supermarket News, "SN's Top 50 Small Chains and Independents 2012" <http://supermarketnews.com/grocery-outlet-2012>
- 33 Grocery Outlet Company Overview <http://groceryoutlet.com/Default/Outlet/CompanyOverview.aspx>
- 34 "Farm to Family," California Association of Food Banks, www.cafoodbanks.org/Farm_to_Family_Program_History.html.
- 35 Telephone interview with Ron Clark, food sourcing and logistics manager, California Association of Food Banks, April 6, 2012.
- 36 WRAP, "Waste Arisings in the Supply of Food and Drink to U.K. Households," March, 2010, <http://www.wrap.org.uk/content/waste-arisings-supply-food-and-drink-uk-households>
- 37 K.T. Higgins, "Flash Dryers and Potato Waste," *Food Engineering*, 22 March, 2003, www.foodengineeringmag.com/articles/flash-dryers-and-potato-waste.
- 38 "Design Case Study: Heinz Single Service Limited Telford," IGD, www.igd.com/index.asp?id=1&fid=5&sid=43&tid=158&fid=127&id=2181.

- 39 Bob Branham, "The Impact of Food Waste," Taste of General Mills blog, November 8, 2011, www.blog.generalmills.com/2011/11/the-impact-of-food-waste/.
- 40 J.C. Buzby et al., "The Value of Retail- and Consumer-Level Fruit and Vegetable Losses in the United States," *The Journal of Consumer Affairs*, Fall (2011):492-515
- 41 J. Alvarez and R. Johnson, "Doug Rauch: Solving the American Food Paradox," *Harvard Business Review* N9-012-022, November 2011.
- 42 J.C. Buzby, H.F. Wells, B. Axtman, and J. Mickey, USDA, Economic Research Service, "Supermarket Loss Estimates for Fresh Fruit, Vegetables, Meat, Poultry, and Seafood and Their Use in the ERS Loss-Adjusted Food Availability Data," EIB-44, March 2009.
- 43 Bloom, *American Wasteland*, 175.
- 44 Timothy Jones, "Analyzing Retail Food Loss", *BioCycle* (December 2005).
- 45 Bloom, *American Wasteland*, 166.
- 46 "Food Marketing System in the U.S.: New Product Introductions," *USDA Economic Research Service*, www.ers.usda.gov/Briefing/FoodMarketingSystem/new_product.htm.
- 47 Telephone interview with Reymundo Saldana, produce manager, Berkeley Bowl Market, March 2, 2012.
- 48 Rebecca Smithers, "Tesco Trials New Packaging to Reduce Food Waste," *The Guardian*, February 7, 2012, www.guardian.co.U.K./environment/2012/feb/07/tesco-new-packaging-food-waste.
- 49 WRAP, "The Courtland Commitment Phase II Progress Report," December 2011, http://www.wrap.org.uk/sites/files/wrap/CC2_First%20Year%20Progress%20Report,%2005%20Dec%2011%20final.pdf
- 50 WRAP, "The Courtland Commitment Phase II Progress Report," December 2011, http://www.wrap.org.uk/sites/files/wrap/CC2_First%20Year%20Progress%20Report,%2005%20Dec%2011%20final.pdf
- 51 Rebecca Smithers, "Sainsbury's Changes Food Freezing Advice in Bid to Cut Food Waste," *The Guardian*, February 10, 2012, www.guardian.co.U.K./environment/2012/feb/10/sainsbury-food-freezing-advice-waste.
- 52 WRAP, Case Studies, "Courtland Commitment I" (2005-2010), August 19, 2010, <http://www.wrap.org.uk/sites/files/wrap/CC%20Case%20Studies%2C%2019%20Aug%202010%20final.pdf>; and WRAP, "The Courtland Commitment Phase II Progress Report," December 2011, http://www.wrap.org.uk/sites/files/wrap/CC2_First%20Year%20Progress%20Report,%2005%20Dec%2011%20final.pdf
- 53 WRAP, Case Studies, "Courtland Commitment I" (2005-2010), August 19, 2010, <http://www.wrap.org.uk/sites/files/wrap/CC%20Case%20Studies%2C%2019%20Aug%202010%20final.pdf>
- 54 Joe Thomas, "Tesco Launches 'Buy One Get One Free Later' for Perishables" *Marketing*, January 20, 2010, www.marketingmagazine.co.U.K./news/978644/Tesco-launches-Buy-One-One-Free-Later-perishables.
- 55 Beth Philips, "Sainsbury's Shoppers Are Urged to Give a Fair Share," *The Grocer*, July 8, 2011, www.thegrocer.co.U.K./companies/sainsburys-shoppers-are-urged-to-give-a-fair-share/219395.article.
- 56 J.C. Buzby et al., "The Value of Retail- and Consumer-Level Fruit and Vegetable Losses in the United States," *The Journal of Consumer Affairs*, Fall (2011):492-515.
- 57 "Short Guide to Food Waste Management Best Practices," LeanPath, 2008, www.leanpath.com/docs/Waste_Guide_o.pdf.
- 58 L. Kantor, K. Lipton, A. Manchester, and V. Oliveira, "Estimating and Addressing America's Food Losses," *USDA Food Review* January-April 1997, p. 2-12.
- 59 Bloom, *American Wasteland*, 125.
- 60 Bloom, *American Wasteland*, 143.
- 61 "Portion Distortion 2," National Heart, Lung, and Blood Institute, hp2010.nhlbihin.net/oei_ss/menu.htm#sl2.
- 62 L. Young, M. Nestle, "Expanding Portion Sizes in the U.S. Marketplace: Implications for U.S. Counseling," *Journal of the American Dietetic Association*, Vol. 13, No. 2, February 2003, portionteller.com/pdf/portsize.pdf.
- 63 Bloom, *American Wasteland*, 122.
- 64 "Campus Kitchens get Smart on Food Waste," StopWaste.org, January 3, 2012, www.stopwaste.org/home/index.asp?page=1229.
- 65 Kurt Ingram, "Emit Less—Go Trayless!" Sodexo USA, February 28, 2011, blogs.sodexousa.com/bettertomorrow/2011/02/28/emit-less-go-trayless.
- 66 "Wise Up on Waste Toolkit," Unilever Food Solutions, www.unileverfoodsolutions.co.uk/our-services/your-kitchen/waste_toolkit.
- 67 "Household Food and Drink Waste in the U.K.," WRAP, November, 2011, www.wrap.org.U.K./downloads/Household_Food_and_Drink_Waste_in_the_U.K._Nov_2011.3030d3f6.8048.pdf.
- 68 Food Product Dating, USDA Food Safety and Inspection Service, www.fsis.usda.gov/Factsheets/Food_Product_dating/index.asp.
- 69 Bloom, *American Wasteland*, 187. The author reports a 15 percent loss in homes, with potentially an additional 10 percent loss in liquid products.
- 70 Bloom, *American Wasteland*, 187
- 71 R. Dobbs et al., "Resource Revolution: Meeting the World's Energy, Materials, Food, and Water Needs," McKinsey Global Institute, November 2011.
- 72 WRAP, "New Estimates for Household Food and Drink Waste in the U.K.," 2011, www.wrap.org.U.K./downloads/New_estimates_for_household_food_and_drink_waste_in_the_U.K._FINAL_v2.110a9ba6.11460.pdf.
- 73 WRAP, "Consumer Insight: Date Labels and Storage Guidance," May 2011, www.wrap.org.U.K./downloads/Technical_report_dates_final_cf179742.11175.pdf.
- 74 B.Wansink, B. Koert, and V. Ittersum, "Portion Size Me: Downsizing Our Consumption Norms," *Journal of the American Dietetic Association*, July 2007, 107, No. 7, 1103-1106.
- 75 Wansink, Brian and Koert van Ittersum (2006), "The Visual Illusions of Food: Why Plates, Bowls and Spoons Can Bias Consumption Volume," *FASEB Journal*, 20:4 (Mar 6) A618-A618, Part 1
- 76 Bloom, *American Wasteland*, 188.
- 77 U.S. EPA, "Municipal Solid Waste Generation, Recycling and Disposal in the United States: Tables and Figures for 2010," www.epa.gov/osw/nonhaz/municipal/pubs/2010_MSW_Tables_and_Figures_508.pdf.
- 78: Ibid.
- 79: Personal communication with Sally Brown, Ph.D, University of Washington. January 17, 2013.
- 80: U.S. EPA, "Inventory of U.S. Greenhouse Gas Emissions and Sinks:1990-2010," April 2012. <http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html>.
- 81 WRAP, "New Estimates for Household Food and Drink Waste in the U.K.," 2011, www.wrap.org.U.K./downloads/New_estimates_for_household_food_and_drink_waste_in_the_U.K._FINAL_v2.110a9ba6.11460.pdf.
- 82 "Preparatory Study on Food Waste Across E.U. 27" European Commission, October 2010, ec.europa.E.U./environment/eussd/pdf/bio_foodwaste_report.pdf.

83 "Parliament Calls for Urgent Measures to Ban Food Waste in the E.U.," *European Parliament News*, January 19, 2012, www.europarl.europa.eu/news/en/pressroom/content/20120118IPR35648/html/Parliament-calls-for-urgent-measures-to-halve-food-wastage-in-the-E.U.

84 WRAP, *Consumer Insight: Date Labels and Storage Guidance*, May, 2011. www.wrap.org.uk/downloads/Technical_report_dates_final_cf179742.11175.pdf.

85 "Preparatory Study on Food Waste Across E.U. 27," European Commission, October 2010, ec.europa.eu/environment/eussd/pdf/bio_foodwaste_report.pdf.

86 Bloom, American Wasteland, 179.

87 Linda Busche, "Tax Changes Likely to Boost Food Donations," National Restaurant Association, January 18, 2012, www.restaurant.org/nra_news_blog/2012/01/tax-changes-likely-to-boost-food-donations.cfm.

88 Biannual Public Attitudes Tracker, Food Standards Agency Social Science Research Unit, November 2010, www.food.gov.uk/multimedia/pdfs/trackerNov10.pdf.

89 B. Kowitt, "Inside the Secret World of Trader Joe's" *CNN Money*, August 23, 2010, money.cnn.com/2010/08/20/news/companies/inside_trader_joes_full_version.fortune/index.htm.

90 United Kingdom Competition Commission, "CC Publishes Code of Practice Order", February 26, 2009, www.competition-commission.org.uk/assets/bispartners/competitioncommission/docs/pdf/non-inquiry/press_rel/2009/feb/pdf/08-09.