

Introduction

Understanding Food Loss and Waste Across the U.S. Supply Chain

Reduction, Recovery, Recycling

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民以食为天 (*min yi shi wei tian*) is a Chinese proverb, meaning “food is a basic necessity of man.” Taken in its historical context (over 2,000 years ago, in the Spring and Autumn period in China), the original phrase conveys a more profound meaning, which may be translated as “the King’s power to rule is founded upon his ability to feed the people”¹.¹ Regardless of its origin, human history attests time and again that lack of food (hunger) breeds discontentment which in turn brews unrest and social instability.

These perils are equally relevant today as the world faces the vital challenge of providing enough food to meet the basic necessities of 7.3 billion people. Despite tremendous growth in agricultural productivity, hunger and malnutrition are widespread, and 1 in 9 people go to bed hungry every night. The situation may further deteriorate in the coming decades as the world population continues to grow to a projected 9+ billion by 2050 and food demand increases to an estimated 50-100% above the current level of production. Compounding the challenge of food security are the unrelenting worldwide problems of dwindling resources and environmental degradation, coupled with the overarching trends of urbanization and globalization. These complex and profound issues facing mankind are the subject of wide-ranging debates and discussions.

Various strategies have emerged to address the pressing need to sustainably feed the world. Enhancing agricultural output to increase the food *supply* stands as the most appealing option for many, spurred by our confidence in the seemingly unlimited potential in human ingenuity with science and technology innovation. Strategies have also emerged focusing on curbing *demand*. Striving for a global population with a sustainable replacement rate is considered critical, particularly in regions where a high degree of food insecurity

¹ http://www.ofnumbers.com/2013/03/20/chapter-3-food-and-beverage/#identifier_0_22

co-exists with birth rates more than double the world average, such as in Sub-Saharan Africa. There are no simple solutions. We need the combination of all possible ways and means to tackle the problem.

Recently, there has been a *waste-less-to-feed-more* movement worldwide, largely kindled by the United Nations Food and Agriculture Organization report² that about 1/3 of food produced for human consumption is lost or wasted before reaching a human stomach, amounting to 1.3 billion tonnes globally on an annual basis. Halving the amount of food wastage would mean enough food to feed the world's 800 million hungry people. Furthermore, reducing food wastage would help conserve natural resources and lower the environmental footprint that is associated with our food system. Conceivably, reduction in food loss and waste represents a realistic opportunity of significant magnitude with multiple benefits and very few negatives or conflicts.

It was under this global backdrop that *The Last Food Mile Conference* was organized by a group of faculty at the University of Pennsylvania. Supported by a USDA grant and held on the Penn campus on December 8-9, 2014, the *Conference* convened more than two dozen distinguished speakers from industry, academia, NGOs, and governmental agencies to examine issues of food loss and waste across the U.S. supply chain. Panel presentations and discussions covered wide-ranging topics, e.g. the scale of the problem, food waste streams and measurements, consumer food behavior, ongoing food waste reduction, recovery, and recycling efforts, and lessons learned and barriers encountered. More than 200 participants demonstrated a great deal of enthusiasm and engaged in active discussions and networking.³

The vitality of the conference persuaded the organizing committee to leverage the growing interest in food loss and waste by putting together this book, the first to explore the scale of the problem involving wastage of food and resources across the U.S. supply chain, to examine ways to reduce what is squandered and, where possible, turn wholesome (otherwise wasted) food into nourishment for this country's growing poor and food insecure families. This book is based on presentations given at the *Conference*, augmented with additional information taking advantage of flexibility in print format. Further, the book's scope is expanded and the content enriched with a few new chapters that bring fresh perspectives to the field or present new data that have not been published previously. The end product is a collage of 19 chapters authored by

² <http://www.fao.org/docrep/014/mb060e/mb060e00.htm>

³ For Conference summary and survey results, visit: <http://repository.upenn.edu/thelastfoodmile/followup/>

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people of outstanding rank in the field and covering key issues with breadth and depth.

Brief descriptions of the chapters are provided below to serve as a guide.

Food loss and waste is a global phenomenon and its implications are far-reaching beyond wasted food per se. The UN FAO recently led a series of studies on the scale of the food waste problem and its environmental ramifications at the global level. **Chapter 1** summarily presents the findings and conclusions from these studies, providing a one-stop reference for a large amount of material and information to interested readers. **Chapter 2**, undertaking an approach to examining global food production at the most fundamental level, discusses the elemental necessities required for the production and provision of food, namely soil, water, nutrients, solar radiation, fossil fuels, plus marine production systems. Here, the reader will find a comprehensive analysis of the nature, state, capacity, and potential limitations of these basic necessities, focusing on the non-renewable resources.

The significance of the United States in the landscape of global food production, consumption, and wastage cannot be overstated. In terms of production, the U.S. produces more food than France, Germany, UK, Canada, Japan, and Australia combined. In terms of consumption, the U.S. is the third most populous country in the world (behind China and India) and ranks number one in per capita food availability. How much of that food is never eaten but lost and wasted at the national level, and at what segments of the supply chain? In what scale and magnitude are natural resources embedded in the wasted food? **Chapter 3** provides authoritative information detailing the weight, calorie, and dollar value of food lost and wasted at the retail and consumer levels of the U.S. food system, while **Chapter 4** presents freshly obtained data, derived from a set of official statistical databases, that quantify the acreage of land, quantity of irrigation water, and amounts of fertilizer nutrients embedded in the wasted food at the national level.

Is food-wasting behavior a new vice that happens to infect modern day consumers? **Chapter 5** examines the issue from a historical perspective, arguing that food waste is nothing new and that continued social changes, cultural mingling, and the mega-trends of urbanization and globalization form the undercurrent that shapes the way we handle food as a people or as individuals.

Certainly, consumers are at the crux of the food-waste matter. In the U.S. and other developed countries, food loss and waste at the consumer level is the single largest component of wastage along the supply chain. Several chapters

in this book are devoted to consumer food behavior – **Chapter 6** provides a glimpse of Americans’ awareness and attitudes regarding food waste, as derived from a nationally-representative survey; **Chapter 7** summarizes current understanding of consumer knowledge and factors affecting consumer food behavior, based on literature review and synthesis; **Chapter 8** provides an insightful and in-depth analysis of the cyclical nature involving consumers and retailers that leads to the wasteful culture and practice of discrediting food of “imperfect” appearances.

Many of us are appalled by scenes of food wastage occurring at buffet-style eateries. What constitutes the waste streams? How much can be attributed to individual behavior and how much occurs because of the system (i.e. the business-service model)? What proportion may be recovered to feed the hungry and how much is unfit for the most desirable use? **Chapter 9** provides quantitative information from a carefully-designed study to shed light on these questions. The authors describe a research project that identifies four waste streams at an all-you-can-eat dining hall and the relevant quantities and proportions based on 10-day sampling and measurements. Their data speaks volumes.

Across the kindergarten-to-high school system in the U.S., food programs are in place to ensure that all pupils have access to adequate and nutritious food. Students from low-income families are provided with meals, usually lunch and in some cases breakfast and dinner as well, at reduced or no cost to them. Not surprisingly, a large amount of the food is tossed into the trash bin. In **Chapter 10**, a group of 8th graders, guided by adult counselors through a participatory project, presents their findings on the types and quantities of food thrown away and the associated reasons. The problems seen in the eyes of these youngsters and expressed in their own voices are quite thought provoking.

Chapter 11 discusses key change aspects in reducing food waste by moving from a culture of abundance to a culture of responsibility.

Food losses occur every step of the way along the supply chain, at farms, processing sites and manufacturing plants, packaging and storage facilities, retail stores, foodservice sites, and homes. Opportunities exist at each step to reduce, recover, and recycle (the 3Rs) food waste. Indeed, such 3R efforts have been taking place all over the country in a variety of formats thanks to numerous organizations and individuals. **Chapter 12** showcases some of the measures taken by the *food industry* with four exemplary stories. **Chapter 13** highlights some *charity organizations’* food rescue efforts that are geared toward the noble purpose of hunger relief in America. At the end of the supply

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chain are millions of *households*; how to reduce food wastage at home is perhaps the greatest challenge. **Chapter 14** describes a pilot program led by the U.S. Environmental Protection Agency with case studies demonstrating 20-35% reduction in kitchen food discards among participating households. Food remnants, generated in millions of tons each year from the food handling and processing sector, are generally unfit for human consumption, but such “waste” can be recovered for beneficial use in *animal feeding*. **Chapter 15** details the types, sources, and magnitudes of such food material and their uses in the animal industry, and discusses relevant limitations and challenges. Finally, *composting* is the last resort in the 3R hierarchy. **Chapter 16** provides an authoritative overview of food waste composting in the U.S. with the most updated information available, while **Chapter 17** discusses lessons learned and barriers encountered on a small Caribbean island where composting food discards and other organic wastes is vital to the health of the people as well as its ecosystem.

What role has the U.S. government played in combating food loss and waste? What laws exist to provide guidance and protection regarding food donations to feed hungry people? **Chapter 18** describes various federal programs and policies related to food waste reduction, recovery, and recycling, and **Chapter 19** covers the legal aspects of food recovery and donation in detail with clear and concise interpretations plus practical guidance.

This book, with its coverage of diverse topics contributed by leading, multi-disciplinary experts, is meant as a **source book for many** – for educators teaching in or outside of classrooms, for sustainability officers looking for practical solutions, for consultants developing strategic and actionable measures, for advocates educating and engaging the public, for hunger relief agents searching for inspiration and creative ideas, for researchers endeavoring to gain insights from solid scientific information, for concerned citizens wanting to make a difference through everyday actions, and for policy makers devising programs and shaping policies that may affect our future.

The USDA and EPA recently (9/16/2015) announced the nation’s first-ever food waste reduction goal, calling for a 50% reduction by 2030.⁴ It is our hope that this book will help support the policy and advance solutions to the complex problems of food loss and waste and sustainably feeding the growing population in the U.S. and beyond.

⁴ <http://www.usda.gov/wps/portal/usda/usdahome?contentid=2015/09/0257.xml>