Title
Balancing On-Farm Food Safety and Environmental Protection: A Comparative Case Study of Leafy Greens Producers in the United States and the United Kingdom

Author
Driscoll, Laura Rebecca

Publication Date
2018

Peer reviewed|Thesis/dissertation

Balancing On-Farm Food Safety and Environmental Protection: A Comparative Case Study of Leafy Greens Producers in the United States and the United Kingdom

By

Laura R. Driscoll

A dissertation submitted in partial satisfaction of the

requirements for the degree of

Doctor of Philosophy

in

Environmental Science, Policy and Management

in the

Graduate Division

of the

University of California, Berkeley

Committee in charge:

Professor Katherine M. O'Neill, Chair
Professor Alastair Iles
Professor Christopher K. Ansell
Professor Kathryn T. DeMaster

Fall 2018

Abstract

Balancing On-Farm Food Safety and Environmental Protection:
A Comparative Case Study of Leafy Greens Producers
in the United States and the United Kingdom

by

Laura R. Driscoll

Doctor of Philosophy in Environmental Science, Policy and Management

University of California, Berkeley

Professor Katherine O'Neill, Chair

In the last decade, high-volume industrial production of fresh leafy greens including spinach and romaine lettuce has become increasingly linked to outbreaks of dangerous foodborne pathogens such as *E. coli* O157:H7. Current approaches to food safety risk management seek to prevent the introduction of pathogens at field level, through wildlife exclusion practices and the removal of habitat near farms, which can damage environmental conservation efforts. Farmers must balance multiple overlapping requirements coming from government regulation and privately-operated food safety standards, in which food safety concerns may be given priority over environmental sustainability.

Improving food safety in fresh leafy greens without compromising environmental health will require policy solutions that consider the structural roots of food safety problems, and how food safety regulation impacts farmers. This dissertation presents an international comparative policy case study of leafy greens production in the United States and the United Kingdom, in which I evaluate public and private risk management mechanisms that have combined to shape national approaches to food safety, in the context of current political and regulatory trends. Deepening traditional comparative politics literature, this study draws on a structural comparison of public and private standards and interviews with leafy greens producers in both nations to illuminate the social and environmental impacts of various regulatory mechanisms. I demonstrate that food safety standards containing a balance of process-oriented and prescriptive requirements, and a balance between food safety and environmental concerns, are correlated with more environmentally friendly agricultural practices and more favorable farmer perceptions of food safety regulation. From a perspective situated at the convergence of agri-food studies, regulatory practice, and comparative policy, I suggest regulatory changes and supply chain solutions for balancing food safety and environmental sustainability.

Table of Contents

List of Abbreviations

AHDB	Agriculture and Horticulture Development Board
BSE	Bovine Spongiform Encephalitis, or "mad cow disease"
BLSA	British Leafy Salads Association
BRC	British Retail Consortium
CA	California
CCOF	California Certified Organic Farmers
CDC	Centers for Disease Control and Prevention of the United States (within Department of Health and Human Services)
CDFA	California Department of Food and Agriculture
CJD	Creutzfeldt-Jakob Disease, a neurological condition in humans linked to exposure to Bovine Spongiform Encephalitis
DEFRA	UK Department for Environment, Food and Rural Affairs, which replaced the Ministry of Agriculture, Fisheries and Food in 2002
EU	The European Union
EC	The European Commission
E. coli	*Escherichia coli*, an infectious intestinal bacterium that can cause illness or death in humans (variant: *E. coli* O157:H7, a specific serotype of the bacterium linked to particularly severe human reactions)
EFSA	European Food Safety Authority
FDA	Food and Drug Administration of the United States (within Department of Health and Human Services)
FSA	Food Standards Agency of England, Wales and Northern Ireland
FSMA	Federal Food Safety Modernization Act, a 2011 amendment to the US Food Drugs and Cosmetics Act of 1938.
GAP	Good Agricultural Practices
GlobalG.A.P.	An international food safety certification body, formerly EurepG.A.P.
HACCP	Hazard Analysis Critical Control Points, a food safety risk management approach
HPSS	Harmonized Produce Safety Standard, one of the types of certification offered by GlobalG.A.P.
IFA	Integrated Farm Assurance, one of the types of certification offered by GlobalG.A.P.
IFS	International Featured Standards (operator of the IFS Food standard)
LGMA	California Leafy Green Products Handler Marketing Agreement, commonly referred to as the "Leafy Greens Marketing Agreement" of which versions exist for California and for Arizona
NFU	National Farmers' Union of England and Wales
NRCS	Natural Resources Conservation Service of the USDA
NRDC	Natural Resources Defense Council
UK	The United Kingdom of Great Britain and Northern Ireland
USDA	United States Department of Agriculture
WHO	World Health Organization of the United Nations Development Group

Acknowledgements

Throughout the process of preparing, researching, and writing this dissertation, I have benefited from financial and advisory assistance at many levels.

First and foremost, I must thank the California and UK lettuce farmers who welcomed me to their fields and offices during this research, and who shared their struggles in chasing the twin goals of food safety and agricultural sustainability. I am deeply grateful to these farmers, and to my interviewees in the produce industry and gin various government agencies, without whom I would not have a story to tell.

Additionally, my work could not have been completed without valuable financial support and academic guidance facilitated by the staff of UC Berkeley's department of Environmental Science, Policy and Management during many moments of administrative assistance. I was grateful to receive both a Summer Research Grant and a Berkeley Connect Fellowship from the department, which eased financial burdens and greatly facilitated my research progress. I also gratefully acknowledge UC Berkeley's European Union Center of Excellence, which provided me with important early funding through a Predissertation Fellowship granted during the initial phase of my UK fieldwork. I am also extremely grateful to the faculty and staff of the ERSC Social, Technological and Environmental Pathways to Sustainability (STEPS) Centre hosted by the Institute of Development Studies (IDS) and the Science Policy Research Unit (SPRU) at the University of Sussex. I am grateful to the STEPS centre for including me in their Summer School on Pathways to Sustainability, and for helping to shape my analytical approach during my second season of UK field research. My time at the University of Sussex and the academic connections it afforded me were invaluable for completing my UK fieldwork and my dissertation as a whole. Finally, I am grateful for the financial and intellectual support of the Berkeley Food Institute (BFI) and its staff, especially Ann Thrupp and Nina Ichikawa. My work as a Research Fellow for BFI was important for shaping my approach to policy research, and contributed valuable financial support during the later stages of my research.

For their roles in shaping the initial research approach and data analysis for the California farmer surveys considered in this dissertation and responding to peer review during the first publication effort associated with that research, I would like to thank Josh Rolph of the California Farm Bureau Federation, Sasha Gennet and Jennifer Biringer of The Nature Conservancy, Rich Casale and Karen Lowell of the Natural Resources Defense Council, and my UC Berkeley ESPM graduate student colleagues Patrick Baur and Daniel Karp for their tireless work assessing environmental impacts of food safety regulation in California.

Completing dissertation work takes strong academic guidance, as well as intellectual and emotional support during scholarly and professional development. I must thank the members of my qualifying exam committee and my dissertation committee for their constructive feedback, encouragement, and patience during my research and writing. I am especially grateful to my advisor Kate O'Neill for her years of valuable guidance along my path to the PhD, including timely letters of recommendation, course and funding suggestions, and her useful and encouraging comments during many rounds of chapter revisions. Kate's support and faith in my

abilities never wavered, and I have been thankful countless times for her genuine kindness and generosity as both a mentor and friend. I am similarly grateful to Alastair Iles for his high-quality editorial comments on my research plans and chapter drafts, and for years of personal concern and encouraging guidance on my broader professional development. I am also exceedingly grateful to Louise Fortmann (now emeritus) for her efforts as chair of my qualifying exam committee, for welcoming me into her lab early on in my doctoral studies, and for her unwavering support both within and outside of her lab meetings. I am likewise thankful to Kathy DeMaster and Chris Ansell for their engaged scholarly guidance during my qualifying exam, and for their early input on my research and their detailed editorial efforts during my final writing process. I am grateful also to Jennifer Sowerwine and Christy Getz for early comments on shaping my approach to California research. Finally, I must thank Erik Millstone of the Science Policy Research Unit at the University of Sussex (now emeritus) for his consultation on research approach and his help securing valuable interviews at industry and government levels, and Kathy Lewis and her lab at University of Hertfordshire for early commentary on private standards in UK agriculture.

For support and assistance with all aspects of graduate student life from course requirements to pedagogy styles to comfort in difficult times, I must thank many of my fellow students in the department of Environmental Science, Policy and Management and other departments across campus. My gratitude goes to the Fortmann Lab, O'Neill Lab, and I am especially grateful to Patrick Baur, Katy Seto, Jeremy Faludi, Noriko Kusumi, and Esther Choi for their support, consultation, kindness, and humor during our heaviest lifts.

I am deeply indebted to my family for emotional and financial support at all stages of my work from the earliest moments of my graduate study to the final submission of my dissertation. I am especially grateful to my mother Susan Learned-Driscoll for encouragement and invaluable early proofreading of chapter drafts, and to my sisters Stephanie and Liz for their constant reminders that I am equal to this challenge. It is your faith in my potential that makes it all worthwhile.

Lastly and most dearly, I am grateful to my husband Patrick for his faithful encouragement, support, and kindness during all stages of my graduate studies. His companionship and level-headed guidance were essential during the most difficult stretches, and my achievement here is due in large part to his unwavering support.

Chapter 1: Influences of 20th Century Structural, Technological, Organizational and Social Change on Food Safety Risk-Management in Fresh Leafy Greens

Introduction

In 2006, Bagged fresh spinach from the central coast region of California contaminated by Shiga toxin-producing *Escherichia coli* bacteria with the serotype O157:H7 caused 199 illnesses across 26 US states, and at least 3 deaths (CDC 2006). Due to typically long production chains, illnesses from the outbreak were first reported in Wisconsin but were eventually traced to bagged spinach produced in California. The investigation was complicated by factors including the highly concentrated California bagged salad industry, in which two processing firms gathering products from across the state of California to supply 90 percent of the nationwide salad retail market (Calvin 2007). Although the outbreak was eventually traced to one specific farm, that farm was itself operated by a production firm that had leased the land from another operator, an arrangement common in California agriculture. Ultimately, it took more than a month to find the location where contamination originated, and opinions still differ over whether the bacteria originated in runoff from a nearby livestock farm, or arrived via the movements of wildlife traversing the spinach fields (Calvin 2007, Stuart 2011). This outbreak and the complexities of tracing it to its source across such a complex supply chain revealed problems within the lettuce supply chain, emphasizing the unique public health challenges posed by a highly capitalized, corporate industrial production system for a packaged fresh food.

Recent outbreaks of the same nature highlight the persistence of these public health challenges within the United States produce industry over the last 12 years, and point to the urgent need for better regulatory and supply chain solutions for produce outbreaks. Between October 8th and 31st, 2018, at least 43 people in 12 US states and at least 18 people in Canada were sickened by the same strain of *E. coli* O157:H7 that they were exposed to by eating US romaine lettuce from the central coast growing region of California.[1] On November 20th 2018, the US Food and Drug Administration (FDA) and Centers for Disease Control and Prevention (CDC) issued a stark warning to consumers: do not sell or buy any romaine lettuce, and discard any romaine lettuce already purchased. US consumers seeing romaine removed from store shelves in November may have felt an uncomfortable sense of déjà-vu; only five months earlier, the same strain of *E. coli* had appeared in the same crop, eventually sickening 210 people across 36 states, and causing 5 deaths. Unfortunately, large-scale foodborne outbreaks of this nature are far from uncommon. Despite difficulties identifying the source of a foodborne illnesses, CDC estimates that 48 million people in the United States contract foodborne illnesses each year, costing the United States at least $6.9 billion annually (Scallan et al. 2011; Thomas 2014). Increasingly, illnesses are being attributed to fresh produce, including romaine lettuce and other fresh leafy vegetables referred to collectively in the United States as 'leafy greens.'

This continuing pattern of food safety scares raises a series of difficult questions: Why is this strain of *E. coli*, which comes primarily from the feces of animals raised as livestock, now showing up so commonly in leafy greens? What specific aspects of the agricultural production systems and food safety regulatory mechanisms are allowing these outbreaks to occur, and what

[1] Initially, CDC recommended that retailers sell no US romaine lettuce, and consumers purchase no romaine lettuce, regardless of type or place of origin within the United States. As more information emerged over the course of investigations, CDC revised their guidance to a recommendation that retailers and consumers avoid lettuce from California, specifically. For more information, consult https://www.cdc.gov/ecoli/2018/o157h7-11-18/index.html

can be done about them? Out of all the possible methods for controlling pathogens in fresh produce, which methods will deliver the best outcomes for public health, with the fewest social, environmental, and financial costs? These questions are rooted in problems of public health, economics, and biology, but the search for their solutions within the food system is deeply political (Nestle 2010; Thomas 2014). Any adjustment of the existing system will be in the service of some groups, and an operational challenge for others. Decisions about the way public health concerns ought to be managed demand a rationale for making them, an authority qualified and able to advance them, and a willingness on the part of industry to meet new metrics. Addressing risks effectively within a complex supply chain requires an understanding of the structural roots of food safety problems, and the articulation of public and private actor groups within that supply chain who share responsibility for ensuring food safety outcomes.

In this dissertation, I will explore these questions and challenges using an international comparative policy case study of two nations: The United States and the United Kingdom. Working at the convergence of agri-food studies, regulatory practice, and comparative policy, I will explore the systems of formal bureaucratic government regulation as well as non-governmental private sector risk management mechanisms that have, together, shaped approaches to food safety in leafy greens production in my international socio-political comparison. Scholarship in comparative politics often focuses narrowly on regulatory mechanisms and the authority structures that create and disseminate them. In my study, I will shed light on the social and environmental impacts of the regulatory mechanisms I examine, making them visible as indicators of regulatory performance. The goal of my comparison will be to reveal how different regulatory climates around food safety in leafy greens production may be contributing to differences in the use of environmental conservation practices by leafy greens farmers, and to differences in the social burden that food safety regulation places on farmers.

With farmer experience and environmental sustainability as topics of focus, I will explore the state and non-state regulatory approaches that each nation has deployed in pursuit of food safety as a public good, and the economic and political systems in which they function. I will examine risks currently facing producers and consumers of leafy greens, as well as the negative impacts that some risk management approaches present for the agricultural environment. I will compare and contrast the two nations' histories of state and non-state approaches to food safety risk management, where historical differences in production methods and regulatory settings are delivering divergent social and environmental outcomes. Guiding questions in my comparative study include: What rules govern production, at both the public and private levels? What norms underlie government regulation, private performance metrics, and the behavior of producers? What consequences exist for food safety, and for environmental sustainability? What regulatory mechanisms have the best potential for safeguarding both food safety and the environment?

The work I present in this dissertation stems from two years of interviews conducted with farmers of leafy greens in California and central England, sites chosen because they represent the center of leafy greens production in the US and UK grocery markets respectively. I will supplement my interview data with an examination of public and private food safety regulations currently active in the leafy greens industry of each nation, and ground my case studies in their socio-political context through archival research. Using these tools, I will compare how leafy greens farming is currently conducted in each location, according to what rules and guidance, with what norms of practice, and with which beliefs and perceptions on the part of farmers, retailers, and regulators.

National food systems and the structures put in place to regulate them are products of their global historical context. In the remainder of this chapter, I will begin setting the stage for exploring the guiding questions of my case by providing a historically-grounded review of current challenges in food regulation that have resulted from the last century of global agricultural history. To contextualize my later analysis of present-day production of leafy greens in two nations of the industrialized Global North, I will examine four ways the global food system transformed during the 20th century, shaping the challenges it faces today. I will then explain five problems that currently exist within the modern global food system, which are reflected in various ways in my comparison of national frameworks for food safety regulation in leafy greens production.

I. The Modern Food System in the 20th Century

The modern food system has undergone deep and lasting changes globally since the beginning of the 20th century. Never before in human history have changes to our global food supply happened so quickly, at so large a scale, and affecting so large a human population. How one looks at the changes underway during this period of time depends on discipline. Engineers remark on the changes in farm equipment and processing technologies, while economists will notice the biggest changes in flows of capital and global patterns of trade. Sociologists place greatest emphasis on changes in the character of agriculture, the who, how and where of food and fiber production and consumption, while ecologists note how changing human exploitation of natural resources has impacted biological systems. Together, these perspectives build a complex puzzle of largescale change.

The food system within which we now live has been shaped by a century of unprecedented changes in size, structure, character, organization, global interconnectivity, production practices, and information flows. These changes have each presented new problems and challenges, creating the need for innovative regulatory responses in our contemporary world. In this section, I describe four core types of change that have, in concert, shaped the modern food system: Structural change, Technological change, Organizational change, and Social change. Each of these four categories of change occurred in parallel, co-producing the global context of the modern food system, and presenting unique challenges for modern society.

Structural Change

Perhaps the largest single change in the modern food system during the 20th century has been that of size and scope. While historical population estimates are subject to some degree of uncertainty, best estimates place global population in the year 1900 at around 1.6 billion people, the most in human evolutionary history up to that point.[2] By the year 2000, that figure had increased to just over 6 billion, representing an enormous change in how human populations interact with the environment that provides their food (Tilman et al. 2002). At the time of writing, current estimates now place global population at 7.5 billion. Production of food in the global system has grown proportionally with increases in human population, although with regional variations in quality and quantity, and changes over time in which foodstuffs form the

[2] Population Reference Bureau. "In 2001, World Population Surpasses 7 Billion." http://www.prb.org/Publications/Articles/2011/world-population-7billion.aspx

bulk of human diets (WHO-FAO 2003; Vasileska and Rechkoska 2012). Reaching 1.6 billion took humanity hundreds of thousands of years, but adding the latest 1.5 billion took only seventeen years. Population growth rates are also far from uniform across different regions of the world. Per capita population growth has fallen precipitously in the western industrialized nations of the Global North, even as total global population has increased, and growth rates have remained high in many parts of the Global South.

Technological Change

The 20th century is also notable for its unprecedented pace of technological innovation, resulting in visible benefits to quality of life, along with increasing popular awareness of public hazards. This technological boom has had important consequences for the expectations that societies of the Global North have for the structures of regulation that protect them (Beck 1992; Wynne 2002), and the ways that risk is perceived and articulated (Jasanoff 1999). In the food system, technological advances were transformative at many levels. Producing enough food to feed so many more people with a declining percentage of the population working in agricultural production required matching changes in production technologies and the geographic distribution of populations. The impacts of two World Wars on the economies of the leading industrial nations left lasting impacts on industrial productive capacity, agricultural food webs, and social attitudes toward the environment (Fitzgerald 2003; Andrews 2006).

Industrial mechanization of farm work beginning in the 19th century facilitated the production of more food per farmer, a trend which greatly accelerated in the 20th century. The tractor was first invented and developed in the United States grain belt in the 1890s, revolutionizing farming and farming landscapes and permitting farming to take on a new, larger scale that facilitated the subsequent rise of industrial farming models. In 1909, two German chemists Fritz Haber and Carl Bosch developed the first laboratory process for creating artificial nitrogen fertilizer, an invention which would allow for greatly increased crop yields compared with traditional soil enrichment methods, although it was also crucial for the production of poison gases and explosives used in World War I.

In the immediate postwar period, technological innovations such as cardboard boxes, refrigeration, and plastic packaging played a role in the post-war economic boom experienced by the United states, spurring the birth of modern consumer culture around food and home goods (Mayo 1991, 1993; Andrews 2006). This new consumer culture was quickly adapted and exported to other industrialized nations including the United Kingdom (Shaw et al 2004).

Post-war technological changes ultimately transformed agriculture. Factory production models were applied to food production, enabled by the technological output of wartime industries (Fitzgerald 2003). The reorientation of wartime industries to produce industrial fertilizers in the post-war period facilitated a new frontier of scientific innovation in plant breeding. Beginning in 1945 on the shoulders of earlier work by other researchers, US agronomist Norman Borlaug led a humanitarian-minded program of conventional breeding to improve yields in staple crops such as wheat and rice, advancements enabled and supported by the new availability of fertilizers and agricultural chemicals. These genetic advances and the resulting “high-yielding varieties” and their chemical counterparts would ultimately be exported across many countries in the Global South, ushering in between 1950 and 1970 what came to be known as the Green Revolution. Much higher yields of wheat, rice and corn under certain conditions made possible by this work supported efforts toward food self-sufficiency in the

Global South countries of India, Pakistan, Mexico and Indonesia, enabling the global population gains made during this period, the majority of which occurred in the Global South. Green Revolution technologies also brought with them certain Western 20th century norms of production including agri-chemical toolkits and ideological approaches to human exploitation of the natural environment that would fundamentally restructure global agriculture in the Global South with mixed social and environmental impacts (Griffin 1979; Horlings and Marsden 2011; Clapp 2012; Shiva 2016).

Increased urban populations in the industrialized nations also required new technologies for transporting, storing, and selling food to urban consumers. Food came to be purchased through grocery retailers selling many types of agricultural products under one urban roof, a change possible only because of transportation innovations and the development of packaged, frozen and other durable shelf-stable foods (Friedmann 1992). This technological also permitted grocery retailers to increase their bargaining power within agricultural supply chains, intensifying price pressure on primary producers (Allain 2002; Clapp 2012).

Organizational Change

Alongside technological changes centered in the Global North, a concurrent restructuring of food provision systems took place in the Global South with the establishment of modern globalized patterns of agricultural trade. Global networks for trading agricultural commodities had existed for much of the previous thousand years of human history, but during the 20th century they changed in their specifics. Life was still primarily agrarian for most of the Global South at the beginning of the 20th century, but urban populations were beginning to increase, and the 20th century became a century of urban growth. Local organizational dynamics might have remained local, had not this also been a time of enormous change in how the global system was organized and interconnected by networks of trade and communication.

Technological innovation during 20th century brought unprecedented changes in the way money, goods and information flow from place to place (Goodman and Watts 1994; McMichael 2002). The 20th century's increasingly instantaneous communication and faster shipping reorganized global trade patterns, blurring borders and making it possible for corporate actors in the global food system to exert influence on primary producers around the globe through their global sourcing of agricultural products (Allain 2002; Clapp 2012; Otter 2015). A banana grown in Guatemala can be picked and then shipped to Europe and purchased in a European grocery store before it fully ripens. Meanwhile, the majority of the profits from that banana's sale will likely accrue to a multinational food corporation rather than to the farmer or even to the end retailer. Agricultural products—like bananas—that do not offer opportunities for capital consolidation because they cannot be easily grown in the Global North are typically imported from the Global South at extremely low prices that exploit power relationships and historical patterns of colonial control. These types of global trade often operate under extreme pressure to meet cosmetic standards and keep prices down, often leading to the erosion of environmental and labor standards in pursuit of lower costs (Allain 2002). Producer nations for whom this type of agricultural commodity export is a primary foreign exchange earner can become locked in to continuing to supply these commodities at low prices that do not allow them to achieve the economic diversification of more powerful nations (Wallerstein 1976; McMichael 2011). Moreover, producer nations may also end up shouldering disproportionate environmental and social burdens of production (Collins 2000). At the same time, corporate and political bodies in

the Global North have moved to solidify their economic power base by using biotechnology to develop domestically-produced substitutes for some previously imported high-value goods, exemplified by the development of high fructose corn syrup to supplant use of imported sugarcane (Busch 2010).

Harriet Friedmann and Philip McMichael have written extensively on what they term "food regimes", historical periods of relative stability in where specific configurations of global political power have allowed for capital accumulation from certain types of agriculture and trade in food. Under this framework, the first food regime was controlled by the colonial powers in Europe and characterized by stable global trade routes for tea and sugar, which were in turn transformed and supplanted by the second food regime controlled by the United States and centered on industrial agriculture and processed food (Friedmann and McMichael 1989). Now, the face of modern food is increasingly one with a brand name and a logo; it has been suggested that we may now be in the midst of a third food regime, often dubbed the Corporate Food Regime, organized around international trade institutions that make rules encouraging freer trade and by transnational agri-food corporations that operate beyond national borders and within a truly globalized network of production and trade (McMichael 2009; Campbell 2009; Holt Giménez and Shattuck 2011).

Social Change

During the 20th century, unprecedented population growth and technological advancement brought about massive changes of equal magnitude in the ways that food is grown, harvested, stored, transported and consumed. For sociologists and economists, the linchpin of social change during this period was a shift in the organization and valuation of labor. Social and economic theorists from the mid 19th century forward have characterized the past several centuries of human history as a time when the western world saw a significant restructuring of labor and capital, as Karl Marx described in his famous writings on capitalism in the context of the European industrial revolution. The plentiful 19th century urban labor market in Europe had been created by patterns of land ownership dating back to feudal times, in which the accumulation of land and capital by the wealthiest classes had resulted in the disenfranchisement of rural people from the means of primary agricultural production.

At the start of the 20th century more Global North citizens than ever before were earning their living as urban laborers rather than in farming. Across the nations of Europe, it is estimated that the percent of population working in agriculture declined from between 55 and 75% in the early 1700s, to between 15 and 40% by 1900 (Mazoyer and Roudart 2007).[3] In the United States, the share of population working in agriculture had already fallen by half between 1800 and 1900, to roughly 40%. Between 1900 and 2000, agrarian percentages across many nations of the the Global North then fell to their lowest level in recorded history, hovering between 2% and 5% of national population. In the words of rural sociologist Frederick Buttel, "agriculture has become a decreasing component of rural economies" (Buttel, *in* Goodman and Watts 1997, p. 346).

The massive social changes inherent in the military mobilizations of World War I and World War II also left their mark on the food system. Fertilizers and agro-chemicals produced and scaled for the war effort were instrumental in catapulting postwar agriculture into the Green

[3] Our World in Data. "Agricultural Employment – Our World in Data." https://ourworldindata.org/agricultural-employment/

Revolution (Smil 2002), and perceived post-war political risks from underfed global populations spurred those biotechnological innovations. Technological and organizational changes have made it commonplace for citizens of the Global North to eat meals composed of ingredients from around the world, and to visit grocery stores that carry thousands of foods with global pedigrees (Goodman, Watts and Watts 1997). As a society, residents of the industrialized western world now view the rest of the globe as the equivalent of the farm next door. These sorts of changes to our food are, in a way, changes to ourselves. In the words of agricultural sociologist Lawrence Busch, "there is no way to restructure nature according to our wants without simultaneously restructuring society. The plant breeder who develops a new wheat variety alters the behavior of the farmer who adopts, the baker who bakes, the miller who mills, perhaps even the consumer who eats" (Busch *in* Bonanno et al. eds. 1994, p.71).

II. Problems, Challenges and Critiques

The 20th century saw changes in nearly every aspect of the global food system: Who grows and who eats, what is consumed by whom, where food comes from, how food is obtained, and even what food fundamentally is. The global system has thus far been able to incorporate these changes, in various ways, without grinding to a halt. In this sense, the global food system is an enormous success. A staggering 7.5 billion human beings are variably nourished by this system each day, with an incredible diversity of local and regional food systems and crops, while achieving—in some circumstances—incredibly high yields per agricultural worker. Food is grown nearly everywhere on the planet that supports human life, and international agricultural markets form an important part of the economies of all nations of the world. All this has been achieved amidst a century of unprecedented change and shocks to global political systems. That the global food system works to the extent that it now does, is a testament to the power of human innovation and hard work at all levels of global society.

However, despite the great advances made in food production and in systems for delivering and monitoring food flows, there are many problems that now demand solutions through reform or replacement of the existing system. Core structures of the existing system such as established local capacities, long-standing economic power differences, corporate consolidation, and historically stable resource flows have created powerful lock-in effects that prevent—or at least hamper—the incremental development of alternatives, slowing solutions to the problems they create (IPES-Food 2016). Some of the trickiest current problems are—or may soon become—large enough to present the global food system with an existential threat. For example, of the 7.5 billion humans alive today, the Food and Agriculture Organization of the United Nations estimates that as many as 815 million go chronically hungry despite global availability of sufficient food to serve their needs.[4] Those who do get enough to eat face problems including rising rates of obesity, inadequate nutrition regardless of calorie intake, and growing concerns over food safety and food quality. These deep systemic problems are direct results of the very networks, technologies and efficiencies that the global food system has generated while restructuring to provide food to a rapidly growing and changing human population.

[4] For more information on hunger estimates and data gathering efforts, see http://www.fao.org/state-of-food-security-nutrition/en/

Despite the scale and complexity of many of the problems we now face, the existing framework of the global food system contains many structures, adaptations and efficiencies that were hard won, and which form a strong basis for reform of problems both large and small. The pro-reform toolkit includes a century or more of public regulation of health and safety challenges in the food system and lessons learned, as well as agricultural innovations, technological advancements, and structures of multilateral cooperation. Many of the processes and structures that have contributed to the creation of ongoing problems in the global food system may also be useful sources of change and improvement, under the right conditions. The groundwork is thus well laid for movements of reform that seek to adjust the course of the existing global system, if we can understand what constitutes 'the right conditions.' Timely course corrections now may help address problems in food production and provision before they grow larger and more difficult to solve.

In the sections that follow, I present five specific problems in the modern food system that affect food production and consumption, which are well demonstrated by the case of fresh leafy greens production. Each problem has its roots in the past century of food system change, and each threatens the ability of the food system to continue providing safe, healthy food to a growing and urbanizing global population. These problems include: Distancing of consumers from the source of their food, loss of state regulatory power, corporate concentration and consolidation, environmental sustainability concerns, and problems with ensuring safety and quality. In the sections that follow, I will explain how these problems manifest today, and use the example of leafy greens to offer thoughts on why improved, more effective regulation is vital to achieve positive outcomes.

The Growing Distance Between Us and Our Food

One difficulty inherent in the modern food system comes from how little the average person in the industrialized Global North currently knows about food production. We depend on our food no less than at any previous time, yet fewer of us than ever are involved in growing it. The result is a psychological barrier separating most of modern society in the Global North from the realities of food production (Princen 2002; Clapp 2012, 2014). This separation has important implications for how modern northern societies currently go about ensuring a safe and adequate food supply, and what changes may be warranted to avoid the trap of 'out of sight, out of mind'.

From the beginning of agriculture to the beginning of the colonial period, food carried an explicit localism. Limitations on transportation and storage meant that foodstuffs were produced geographically close to where they were consumed, although not necessarily always by the same people who would consume them. For the majority of people, farm work was a nearby and daily task, and farming landscapes were the landscapes of daily life.

In Europe, the colonial period saw this long-lasting pattern of local food production change to include imported staples such as sugar, grain, tea, rum, and spices from colonies established in different parts of the world (Mintz 1985). No longer was everything on an average family table produced within a geographic radius that could be travelled in a few days by horse and cart, but the bulk of the diet was still locally produced. As the industrial revolution began and urban populations swelled with the ranks of former farmers, Karl Marx described historical systems of class separation and land ownership in preindustrial Europe which had begun to disenfranchise this urban laborer class from their agricultural lands. He articulated the concept of "metabolic rift" to describe the growing psychological and geographic distance between the

urban proletariat and the land and knowledge from their farming past, which Marx called the means of production (Marx 1976). During the 20th Century in the industrialized Western nations, the geographic link to food changed again, in a fundamental way. Together with material innovations like cardboard boxes, refrigeration, plastic packaging and commercial vehicle travel, it became possible to transport food much longer distances before reaching the end consumer.

The growing and consumption of fresh leafy greens provides a prime example of the lengthening of supply chains and the impact of this type of distancing. During the latter half of the 20th century, consumers buying food in grocery stores and thus distanced from production came to expect staple fresh food items to be available year-round, rather than on a seasonal basis. To fill this demand, retailers began sourcing products from much farther away, and also exploring packaging to protect and preserve items during transit (Friedland 1997; Freidberg 2009). Salad greens and many other fresh produce items are now available year-round, sourced from hundreds or even thousands of miles away, obscuring seasonal variation. In California, salad growers often move their operations across state lines to Arizona and even to Mexico on a seasonal basis, shifting production seamlessly to ensure an unbroken supply despite the limits of time and space.

Innovations in processing and packaging of fresh products further divorced consumers from food production. Following on the heels of the season-less grocery store, were new varieties of food products that could be sold for higher prices because of value added through additional processing. Rather than buying the raw materials for home-prepared foods, mid-century consumers could buy pre-mixed, pre-assembled, packaged or frozen, finished food products (Goodman and Redclift 2002; Friedmann 1992). Rather than buying a head of lettuce and cleaning and preparing a salad at home, consumers of salad mixes can now purchase a pre-cut, pre-washed, pre-mixed salad containing multiple varieties of salad greens in a single plastic bag or clamshell. This new coupled social norm and technological innovation have restructured the growing environment from afar, bringing about increased mechanization of leafy greens harvesting, larger-scale farms, and central processing to wash and mix salads of different types. In the space of a century, consumers have gone from growing and harvesting their own food or purchasing from a neighbor, to buying finished prepared items that have traveled a considerable distance prior to sale.

How the growing landscape now looks and operates varies among the industrialized nations, but all have seen this increasing separation—both psychological and geographical—between the locus of production and the majority of the consumer population. Urban consumers purchasing food in grocery stores increasingly know little or nothing about the particulars of its production. Foods from frozen pizza to fresh salad greens have taken on a uniquely modern character of industrial standardization and separation from place, which in turn distances us as consumers from the realities of food production (Iles 2005). In a sense, this food is what has been called "food from nowhere" (McMichael 2005; Campbell 2009; Bové and Dufour 2001).

Almost since its entry into the market, movements have begun against this standardized food without a sense of place. Groups of thought and practice as disparate as the California organic movement, the Italian slow food movement, the eat-local phenomenon, low-carbon diets, geographically protected traditional denominations of origin like Champagne and Parma ham reflecting ideals of quality, and proponents of the French concept of *terroir* have all attempted in different ways to bring food back from nowhere, to celebrate that which makes it locally specific, non-industrial, non-standard, and anti-capitalist (Bové and Dufour 2001; Trubek 2008; DuPuis and Goodman 2005; Guthman 2004; Petrini 2003;). Julie Guthman has observed that

while eco-labels and place-based certifications putatively re-embed lost social values in the market economy and protect them from being further eroded by neoliberal market development, such forms of resistance also reinforce the power of market dynamics through their reaction to them, and allow further penetration of capitalism into new markets (Guthman 2007). Moreover, although these efforts continue to make important gains, they remain in their truest form at the periphery of the dominant global food system. The psychological and physical divide between mainstream food production and the food consumption still continues to grow. Food luminaries ranging from journalist and professor Michael Pollan to celebrity chef Jamie Oliver have noted that we as a society no longer seem to understand what "food" truly is. Food is increasingly a manufactured good about which we know progressively less and less as time goes on.

The less we know about the how our food comes to arrive on our tables—how it is farmed, harvested, processed and transported, by whom, under what conditions—the more disconnected we become from the politics associated with our food. A consumer may have opinions about how farm laborers should be treated, what amount of carbon emissions should be generated by a meal, or how fresh a salad should be, but if the farm landscape and its people and technologies are out of sight and out of mind, that consumer is unable to make a link between those values and the agricultural system. The farther away food production feels, the less empowered consumers and even regulators are to engage with food production and its challenges. Lack of attention at many levels threatens the ability of the food system to deliver to us the food we need and the deeper values that make up our society.

Corporate Concentration and Consolidation

'Food from nowhere' affords the consumer an unprecedented degree of choice, freed from many constraints. Modern grocery store shelves offer consumers high degrees of cosmetic quality, standardization, multi-seasonal availability, and low price (Clapp 2012; Nestle 2013). But these benefits come with a wide array of costs, the result of producing food within a corporate capitalist structure of distribution. The stable supply, large volume, and dependable quality that must be present to create food from nowhere, in turn require longer supply chains and more industrialized production to deliver them. To reduce competition, to accomplish effective transportation of fresh products across long distances and to insulate themselves from financial shocks, food companies have grown larger and more diversified. Corporate food giants like Pepsico, General Mills, Cargill, Coca-Cola, Unilever, ConAgra and Nestle grew to their present size primarily through mergers and acquisitions of smaller brands. A handful of major corporate food firms now represent hundreds of smaller brands that are still sold under their original brand names, hiding the consolidation of the market (Howard 2006, 2016). Some of these firms have also widened their influence into adjacent market spaces such as genetic engineering, energy, seed and pesticide manufacture, and agricultural securities, while corporations such as Monsanto (now owned by Bayer) and Syngenta originally based in those sectors have also begun to add food to their portfolios. During the 20th century, food producing corporations also began to actively influence both regulations and public opinion through their lobbying and advertising campaigns, focused on increasing sales and not necessarily on increasing human wellbeing (Nestle 2013).[5] The result is a cluster of agri-food conglomerates

[5] In the revised 2013 edition of her seminal 2002 book *Food Politics: How the Food Industry Influences Nutrition and Healt*h, Marion Nestle explores the impact food businesses have been able to have on American nutrition and

that wield immense financial and political control in the global marketplace (Fuchs, Kalfagianni and Arentsen 2009; Clapp and Fuchs 2009).

Soon after the American colonial period closed, market forces operating in the American free market for agricultural goods incentivized the consolidation of agri-food producers into corporate conglomerates, and spurred a pattern of vertical and horizontal integration of supply chains (Gereffi, Humphrey and Sturgeon 2005; Sexton et al 2007) and financialization of the agriculture industry (Clapp 2012, 2014). The result today is that the American food system is dominated by a highly vertically integrated, highly consolidated set of agricultural markets in which corporate food companies now control the entire life cycle of production of a plant or animal in the food system (Heffernan and Constance 1994; Boyd and Watts 1997; Heffernan 2000; Boyd 2001; Hendrickson and Heffernan 2007; Tallontire 2011). Farmers in this type of production are increasingly corporate employees rather than free operators, constrained by production contracts, and both legally and financially controlled by the vertically integrated corporations for whom they grow food products.

Fresh salad greens demonstrate this rise of corporate consolidation, vertical integration, and the shift to contract farming. As with many foods, lettuce production systems exist along a spectrum from small-scale farms to immense industrialized corporate farms. Salad mixes were initially developed in California as a luxury commodity for restaurants that made their name by offering small-scale organically-grown food and emphasizing a close connection between farm and table (Guthman 2004; Stuart 2011). This packaging innovation was then copied as part of the portfolio of large corporate farms serving audiences with less concern over organic methods or farm-to-table cuisine, and the production systems behind this new commodity began to industrialize. Scholars have described the resulting bifurcated market, in which some small alternative producers still deliver fresh salads directly from farm to table, but the bulk of the market is dominated by large corporate farms run under contract, and that now operate under increasingly industrial and conventional supply chain models (Buck, Getz and Guthman 1997; Guthman 2014; Constance, Choi and Lyke-Ho-Gland 2008).

Rural sociologist Thomas Lyson describes the impact of these changes thus: "The development of supply chains means that on-farm decisions will no longer be made to benefit the long-term sustainability of the farm, the good of the community, or the health of the natural resources that sustain the farm" (Lyson, Stevenson and Welsh 2008, p.9). In such a system, the profits of agriculture are owned by the corporate conglomerate, not the farmer, and farm management decisions are also made by the corporate conglomerate, not the farmer. Distancing of human consumers from our food is thus taken to a mind-boggling extreme: Even the dwindling percentage of the population who wake up each morning on farms or whose livelihood comes directly from growing food, are not those who are in control of the way farming takes place.

At the same time, the psychological and geographical distancing of consumers results in a packaged food purchasing landscape where consumers cannot tell which products come from which of the large firms, or how those products and firms may reflect their values. In both fresh

---

health outcomes. Nestle examines the implications of the food industry's application of standard capitalist business methods dedicated to increasing sales, in the context of a product that is foundational to life and that no consumer can choose to go without. She traces how processes of corporate concentration and consolidation have increased the leverage that food companies can wield over public opinion, and the highly politicized nature of food industry lobbying efforts to change how research is carried out, how health priorities are decided, how science is used and how regulations are enacted.

and packaged foods, corporate consolidation and control of all levels of food and agriculture presents growing regulatory challenges for ensuring that food delivers on desired outcomes such as healthy environments, fair labor practices, and safe food.

Transformation of State Regulatory Power

The 20th century's population explosion, increasing urbanism, and new technologies for agriculture, food manufacture and food marketing gave rise to corporate food culture in the Global North. Grocery retailers and food brands consolidated, vying for control of emerging consumer markets. Capitalist industrial development over the following half century then allowed mega-corporations like Cargill, Nestle, and Unilever to amass unprecedented financial and political resources. Vertical integration makes these corporations some of the largest agricultural producers worldwide, managing multinational supply chains and posting yearly profits larger than many smaller countries' GDPs. These goliath corporate entities also wield considerable political power, through their size and financial importance, as well as through lobbying and direct political involvement. As the power held by these large corporations grew toward the end of the 20th century, scholars from many disciplines began pointing to a decrease in the power and influence held by nation-states (Friedmann and McMichael 1989, Bonanno et al. eds. 1994, Buttel, *in* Goodman, Watts and Watts 1997). In this globally linked world where movements of capital, goods and information now happen faster and at a scale never before seen, transnational corporate interests have gained economic and political clout in a way that crossed and almost erases borders, allowing them to escape or influence regulation of their activities.

Scholars have also noted that "globalization is developing in the context of a new international division of labor" (Bonanno et al., in Bonanno et al. eds. 1994., p.1) as a result of the dynamics of agrarian change and the rise of capitalist farming that have occurred in the industrialized world. Different areas of the world have come to specialize in—or be trapped within—different types of goods or services within the new global market, with differential degrees of political and societal bargaining power, much of which is now exerted within supply chains by means of private standards (Gibbon 2003; Gereffi, Humphrey and Sturgeon 2005; Ponte and Gibbon 2005; Gibbon, Bair and Ponte 2008; Fuchs, Kalfagianni and Arentsen 2009). It has even been suggested that the rise of transnational corporations may make the concept of the nation-state economically irrelevant (Bonnano et al. 1994). Using their concept of food regimes, Friedmann and McMichael posit that transnational corporations are the owners of geopolitical power now in the emerging present-day Corporate Food Regime in the same way that national governments held this geopolitical power in food regimes prior to 1970 (Friedmann and McMichael 1989; Holt Giménez and Shattuck 2011).

These trends have resulted in a weakening of public regulatory power in favor of an increasingly diffuse array of non-state actors exerting power over food and agriculture. When foods are produced and consumed in locations so far apart that they fall under different cultures, languages, political divisions, and social norms, little can be relied upon without being codified into standards that follow supply chains rather than borders (Henson and Reardon 2005; Bain 2010). A corporation that sources a food crop from a country that has fewer or less effective environmental and labor regulations may operate there in a way that their home country would not allow (Friedberg 2004). Both governments and consumers of goods in the many countries where this product eventually ends up for sale are then left unable to influence or fully regulate the activities of the transnational corporation in its broader supply chain. There are no formal

public governmental entities in this interstitial space, necessitating alternative forms of non-state governance to achieve a degree of regulatory oversight where traditional state regulation cannot penetrate (OECD 2014).

In addition to—and sometimes in place of—traditional state-led public regulation, what has begun to take shape in the modern marketplace is a devolution of regulatory power from the state to an array of non-state actors. This development is not inherently problematic, and may in many cases reflects attempts to make regulation more flexible, more responsive, and less costly to pursue. However, when regulation by state regulatory authorities is replaced by (or added to) quasi-governmental regulation designed and promulgated by authorities that are not publicly accountable, and for whom there are no established codes of conduct, important questions surround the resulting regulation. Private corporations, activist NGOs, and independent certification bodies have spearheaded the emergence of an array of privately-held production and quality standards, designed to provide assurances where public regulation does not suffice or does not exist (Konefal, Mascarenhas and Hatanaka 2005; Hatanaka and Busch 2008, Hammoudi, Hoffman and Surry 2009; Bain 2010; Hobbs 2010). Thus, the new landscape is marked by a network of standards and certifications maintained by private entities, some separate from industry, some industry-led or industry-influenced. Examples include certifications managed by non-profit groups like the Forest Stewardship Council, industry-led governance bodies like the Roundtable on Sustainable Palm Oil, and advocacy-based campaigns to inform the consumer public through "naming and shaming" corporations like popular campaigns to hold Nike or Apple accountable to consumers for their environmentally and socially questionable overseas activities (O'Rourke 2005).

The global rise of transnational corporations and the rise of private standards and certifications in the global marketplace coincided with a shift in how states exerted power over food and agriculture. Prior to this shift, states had sole power to control food and agriculture production within their borders. But since the late 1980s and 1990s, this power has become constrained, and shared with private industry. Transnational trade has made it harder to regulate the activities of food and agriculture because products cross borders and regulatory systems between production and sale, and neoliberal reforms in many global markets have led to public regulatory rollbacks. Against this backdrop, markets have developed and firms have sought to differentiate their products in ways that do not rely exclusively on state regulation, perhaps reflecting a new emerging economic order (Bonanno et al. eds. 1994; Busch and Bain 2004; Konefal, Mascarenhas and Hatanaka 2005; Gereffi, Humphrey and Sturgeon 2005; Gereffi and Lee 2009; Bain 2010). Capitalist market development under this framework can focus on product differentiation through "a turn to quality", in which products are marketed based on qualities such as environmentally friendly production practices, high food safety assurances, or other attributes verified by non-state certifiers (Murdoch, Marsden and Banks 2000).

The result of these changes has been described as a shift from government to governance (Peine and McMichael 2005, Hatanaka and Busch 2008), in which states retain a degree of basic rulemaking authority and supervisory control, but private systems of certification hold much of the responsibility for defining controls and ensuring compliance. While this arrangement reduces the costliness of regulation from the perspective of states, it is uncertain whether governance accomplished with the assistance of these private actors can reliably deliver better outcomes, and if this governance system can be considered adequate from the perspectives of conflict of interest and robust accountability (Busch and Bain 2004; Konefal, Mascarenhas and Hatanaka 2005).

Fresh lettuces and salad greens provide a useful window into the regulatory challenges inherent in devolving regulatory authority from governments to non-state actors. The longer supply chains of industrial leafy greens production require larger, more complex networks of quality management, whether or not products cross borders between production and sale. In these long supply chains, quality problems such as contamination by pathogens have immediate and far-reaching effects on the consumer populace, demanding control and solutions. In one way, devolving regulatory authority to lettuce producers or other private entities can expedite the process of responding to such problems, but it can also result in solutions that are incomplete and leave both governments and the public without recourse to push for better outcomes. The specific nature of public and private controls in the governance landscape for food safety in leafy greens will be detailed extensively in Chapter Two.

Environmental Sustainability Concerns

The many changes and reorganizations of environments and human populations that have given rise to the modern food system have also presented questions for the long-term sustainability of modern agricultural patterns. Can we expect that agriculture and food consumption can continue the way they are now, without eroding the basis of global production? Industrial agriculture in its modern sense is associated with a long list of environmental harms, including pollution of air and waterways, depletion of soil nutrients and harm to soil biota, buildup of toxic compounds in growing environment from the use of agrochemicals, and increased emissions from and dependency on environmentally damaging inputs such as fossil fuels and industrial chemicals (Kremen and Miles 2012; Horrigan, Lawrence and Walker 2002; Tilman et al. 2002, Diaz and Rosenberg 2008). Although negative environmental impacts are well documented, less is known about the capacity of the natural environment to withstand negative impacts. Where the rate of damage outstrips the ability of the natural environment to recover, modern agriculture faces a bleak future.

Since the 1987 report of the United Nations World Commission on Environment and Development (the Brundtland Commission) introduced the idea of 'sustainable development' to differentiate it from unsustainable business-as-usual development, sustainability has been popularly discussed and employed as a concept at every level of politics and daily life. Like any concept that has simultaneously become a rallying cry for scientists, activists, policy makers and the public, there is little real consensus about how the term should be used from one forum to the next, and what actions should be predicated upon it. What should be sustained, by whom and for whom, over what period of time, how, and why? The range of sustainability framings found in popular and scientific literature reflect three basic categories: the pure ecological stability of environmental systems, intergenerational equity, and the ideal of economic efficiency (Pannell and Schilizzi 1999). Power and visibility add an additional dimension, as sustainability is more often the rallying cry of those at the edges of political participation, than of those with greatest political power (Redclift 1997). Sustainability goals are also closely linked to issues of economic and environmental governance and the generation-bridging institutions through which governance is accomplished (Redclift 1997).

In practice, working definitions of sustainability in agriculture often combine one or more of the above categories into a blended socio-economic-environmental-equity sense of stability over time. For example, sustainability may be framed as "the need to ensure a better quality of life for all, now and into the future, in a just and equitable manner, whilst living within the limits

of supporting ecosystems" (Agyeman, Bullard and Evans 2003, 5). Food movements have picked up and combined elements of these framings as calls to action, in the California organic agriculture movement, the move to local food diets, low-carbon diets, and many others.

The implications of environmental impacts and sustainability concerns emerge in especially sharp relief in the production of fresh leafy greens. The transition of many leafy greens farms from smaller-scale hand-harvested farms to larger, more industrialized operations run by corporate conglomerates has had consequences for environmental management. For growers experiencing pressure to produce food under specific safety conditions and below certain thresholds of cost, ecological health has, by necessity, become de-emphasized in the face of economic challenges (Stuart 2011). Systems thinking that links food production methods to broader health costs and environmental damage is an important tool that is still lacking in food policy circles (IPES-Food 2017). Combined with growing separation between consumers and food, increasing corporate power, and retractions of public regulatory power, high profile food safety failures have had important consequences for environmental sustainability in leafy greens production systems, which I will explore in detail in the course of my comparative case study.

Health and Safety Challenges

The new economics of corporate control of agriculture, the balance of public and private regulatory power, and distancing consumption from production are all beginning to present new risks to health and safety. Health risks from food can come in many forms, including the presence of pathogens that can cause foodborne illness. Foodborne illness is estimated to cost the world economy $14 billion annually (IPES-Food 2017). While staggering, no number can fully convey the degree of human impact, because many cases of foodborne illness are never reported. While the potential for food to make us sick is not unique to modern times, current patterns of food transport and storage have created the potential for far greater impacts than previously recorded. Food safety risks are now able to go unnoticed at field level in part because of larger farm size and more highly mechanized production. Contaminated foodstuff can then travel farther and faster through extended supply chains, creating outbreaks that affect a much larger number of people than ever before (Worosz, Knight and Harris 2008; Stuart and Worosz 2012). A paradox appears to be developing: The more our food system succeeds at providing more food to more people across larger distances, the more it includes the possibility of mistakes with ever greater reach.

The fresh leafy greens industry in the United States has seen several recent widespread health and safety problems emerging from industrial agricultural production. As mentioned at the start of this chapter, the parallel outbreaks in November and April of 2010 of *E. coli* O157:H7 in romaine lettuce have called attention to persistent systemic problems in leafy greens production. These outbreaks make an eerily familiar echo of the 2006 *E. coli* outbreak in California spinach, indicating that the production and supply chain problems underlying the original outbreak are still in need of solutions.

Review of food safety outbreaks has indicated that fresh produce causes the largest portion of all foodborne illnesses in the United States (Painter at al. 2013). Pathogens can contaminate leafy greens via contaminated water or crop inputs, unclean processing equipment, or via contact with workers who are ill or otherwise carrying pathogens (Suslow et al. 2003; Lynch et al 2009; Gil et al 2015). Fresh agricultural products like leafy greens can spoil quickly once harvested, and must be transported and stored under carefully controlled refrigeration and

time horizons to reduce the risk of illness (FDA 2010). However, research in the United States indicates that actual storage and display temperatures are frequently sub-optimal for product lifespan and foodborne illness risk (Brown et al. 2015). While proper refrigeration significantly retards the growth and proliferation of foodborne pathogens during storage, pathogens can survive and continue to grow slowly at temperatures just above freezing (Suslow et al. 2003; Gil et al. 2015).

Structural factors in the leafy greens supply chain also increase risk. Leafy greens from many different sources are often washed and processed at a few central locations, which can spread food safety risks, and greatly complicate the work of identifying the source of a problem. (Stuart 2011; Calvin 2017; Gil et al 2015). Packing into plastic bags can improve some aspects of food quality and safety during storage by protecting delicate greens from damage and additional bacterial exposure, but can also provide a breeding ground for any pre-existing contamination (Suslow et al. 2003). Bags of salad greens can wait 15-17 days between production and sale, allowing ample time for problems to develop before purchase (Stuart 2011), let alone during subsequent home storage by consumers.

Scholars of the food system have noted that current food-safety governance has emerged within a production system that is already primed to create these sorts of problems because of its long supply chains and industrial, centralized structure (DeLind and Howard 2008), and that that structure itself is rarely examined as a contributing factor or a candidate for change (Busch and Bain 2004; Stuart 2011; McMahon 2013). The devolved nature of food regulation also plays a role in amplifying risks. The Economic Research Service of the United States Department of Agriculture admitted after the 2006 *E. coli* outbreak from bagged spinach that USDA kept no formal statistics on how many growers of fresh leafy greens followed which specific practices to reduce contamination, and that regulation of those practices was handled by third party auditors and private safety standards rather than by direct regulatory intervention by branches of the federal or state governments (Calvin 2007).

In leafy greens as well as other industrial food products, the same system that ensures unprecedented quantities of food across ever longer distances also presents the possibility of increasingly hard-to-solve problems for public health (Nestle 2010). New forms of regulation and supply chain oversight are needed to ensure that public health problems are adequately managed, alongside goals of environmental health and sustainability, economic stability, and social equity.

III. Conclusion: Opportunities for Better Food Regulation

The structural, technological, organizational and social changes that the 20th century has wrought on the global food system have created a host of growing difficulties in the provision of modern food. Using leafy greens production in the United States and United Kingdom as a window, we see a food system that has formed cracks as it grew and changed, cracks which threaten its future stability. Governments and private actors have responded to challenges within the food system through diverse systems of regulation aimed at correcting market failures, but continuing difficulties such as food safety scares and environmental degradation indicate that current modes of regulation are insufficient to provide optimal outcomes.

Today's leafy greens consumers are increasingly distanced both physically and psychologically from the field-level production of their salad products, with little actionable knowledge of potential health risks or environmental impacts. Many farmers within the

increasingly corporate and industrial leafy greens system are losing managerial control over the lands they work, even as food safety requirements increase. Industrial production methods are creating mounting threats to environmental sustainability of production systems, while fresh-food supply chains continue to experience public health failures. Holistic systems-based responses are needed to solve these problems, but the durability of existing production methods and regulatory frameworks makes transformative solutions increasingly hard to find or deploy. Private regulation has risen to the fore as a way of protecting retail reputations and delivering new consumer guarantees in a fast-moving market, but questions remain. What kinds of food safety controls are likely to deliver the best outcomes for public health, without overburdening farmers or threatening environmental sustainability?

In the chapters that follow, I will explore these issues through the comparative case of domestic leafy greens production systems in United States and United Kingdom. Both nations are experiencing a trend toward increasingly intensive and capitalized produce agriculture, along with a rise in the prominence of private regulation of food safety by food retailers and independent standard-setting bodies. Both nations are also grappling with changes to the structure of government and the mandates of public food safety regulatory bodies, including new federal food safety regulations in the United States and the exit of the UK from the European Union. The challenge of how to ensure microbiologically safe, environmentally-sensitive agricultural systems is also a growing concern in both nations. However, the US production system appears to be struggling more regularly with pathogen outbreaks from leafy greens, and regulation of food safety in leafy greens is having unintended ecological consequences that are not echoed to the same degree in the UK system. These differences provide an opportunity to compare and contrast leafy greens production and the regulation of food safety in each location, in search of factors affecting the social and environmental outcome of various public and private food safety controls. Through my research, I will show that regulatory and non-governmental responses to food safety challenges in the United Kingdom are leading to greater farmer satisfaction with food safety regulation and more environmentally sustainable production practices, providing clues for the creation of improved regulatory systems for food safety in leafy greens.

In the following chapters, I will present my comparative case and its results. In Chapter Two, I will explain the basis of my US-UK comparison, presenting a detailed account of the existing regulatory framework governing leafy greens production in the United States and United Kingdom. I will ground my case study comparison in a comparative historical-political examination of food safety concerns and present the research framing that underpins my international comparison. In Chapter Three, I will present the results of my comparative research with US and UK lettuce farmers, retailers and regulators, in which I evaluate the structure of public regulatory controls, farmer opinions of food safety regulation, and the impact of public and private food safety standards on farmers' land management decisions. In Chapter Four, I will explore underlying socio-cultural dimensions of difference within food safety discourse, including structural differences in how responsibility is assigned for food safety violations, regional differences in the discourse of food safety, divergent background framings of the growing environment, and different degrees of overlap between utilitarian agricultural use and preservationist conservation. I will end my comparative case by presenting a summary of my observations from this comparison, and recommendations for the future of transatlantic food safety governance.

Chapter 2: Approaches to Regulation of Food Safety Risk in Leafy Greens

Situating My Comparative Case

In response to the broad social and environmental changes brought by industrial activity in the 20th century, the industrialized world witnessed a change in public perception of human health, the environment, and the proper role of government in ensuring public safety. Beginning for the most part in the United States and spreading to Europe and the Global South, these changes have been described by legal scholars as a series of gradual shifts in the functioning and accountability of government over time, contributing to the emergence of the modern regulatory state (Sunstein 1993; Levi-Faur 2011). The concept of the rise of the modern regulatory state describes the growth of administrative structures leading to increasing expression of government authority through formal and informal rule-making by governments and their institutions, accompanied by systems of monitoring and enforcement (Levi-Faur 2011). The early founding structures and commitments of European and American nation states were transformed during the 20th century by progressive reforms and bureaucratization, war mobilization, the rights revolution of the 1960s and 1970s, deregulation efforts during the 1980s, and the rise of corporate power from the 1980s onward (Majone 1997; Sheingate 2003; Holt-Giménez and Shattuck 2011). The regulatory language, structures and norms of practice that first gained prominence during this period of social and environmental awakening formed the basis for modern regulation of the food system.

Modern regulatory states achieve policy goals through government actions that rely primarily on top-down processes of rule-making and enforcement. Regulatory rule-making involves defining goals to be achieved, such as the reduction of harmful pollutants in air or water, and to define the criteria and standards by which progress toward goals will be measured. Compliance with regulation can then be assessed through the designation of enforcement mechanisms to ensure uptake of regulatory targets (Rosenbaum 2017). Regulation of this sort can enable a central government to achieve certain outcomes, but the durable structures of precedent in rulemaking may also constrain the use of executive power, limiting its usefulness as risk landscapes change over time.[1] Additionally, some forms of regulation in a particular policy space may be more effective than others in terms of desired policy outcomes and broader attitudes toward regulation, engendering a wide variety of responses from those subject to regulation.

It is thus important to understand the relationships between regulatory approaches and the downstream economic and social effects that regulation creates within supply chains. The nature of regulatory requirements and how they are communicated can vary greatly from one government to another. Examining these differences allows scholars of regulation to discern

[1] For example, in her 2014 book *In Food We Trust: The politics of Purity in American Food Regulation,* Courtney Thomas points out that the US legal framework around food safety was initially founded to counter the threat of food adulteration by harmful non-food additives such as sawdust and lead, but the most salient food threats today are much more frequently associated with pathogens or products of food technology (GMOs, pesticides). The legal framework of the United States, founded as it was on adulteration, is not inherently set up to handle these new types of threats without significant amendments. In this case, historical patterns of food regulation act as both an enabler and a limiter of government action. In this uncertain space where methods for controlling risk are needed but public regulation may not be sufficient, similar systems of control exercised by private actors may function in a similar regulatory way to ensure outcomes.

differences in "regulatory style" which can be analyzed as indicators of national priorities, and as ways to explain the actions taken by various actors within both the public and private sectors (Vogel 1986). Ultimately the regulatory styles used to achieve policy outcomes will have impacts on the general norms of practice within industries subject to regulation, and the individual experiences of those complying with regulation. Regulatory style will also have consequences for the distribution of power among industry players, willingness of stakeholder parties to continue to submit to regulation, and broader societal good such as the environmental sustainability of agricultural production within a particular governance regime.

For scholars of politics and policy, using a comparative approach that considers two or more different policy environments can be a powerful tool for seeing and analyzing policy mechanisms and their outcomes (Landman 2002; Lichbach and Zuckerman 2009; Dodds 2018). Comparisons can reveal hidden details about the cases compared, and yield lessons that may be applicable in other contexts, identifiable through description, classification, hypothesis-testing and prediction (Landman 2002). The core benefit of comparison is its ability to revealing ways in which aspects of policy that appear inevitable when viewed within their national context are in fact socially or culturally contingent when compared against other national contexts (Dodds 2018). By revealing that policy systems are culturally embedded, comparative policy work enables us to critically analyze the features of one policy system against another. This lens in turn allows us to benchmark policy systems against one another to show where the tools and outcomes of policy are equivalent, and where they are divergent. Where they are divergent, this style of analysis makes it possible to question the status quo. Many comparative policy scholars have chosen to compare countries, or groups of countries that share specific characteristics (Castles 1998; Dodds 2018), and a great many comparisons have analyzed the English-speaking industrial powers as a cohesive group (Vogel 1986; Castles 1998; Hobbs. et al 2002: Gunningham, Kagan and Thornton 2003; Iles 2007; Vogel 2012). For some purposes, it can also be useful to compare subnational units, for example in cases where using a national unit would introduce so much variation from one region to another that it would be impossible to see and analyze differences at smaller scales (Landman 2002; Lichbach and Zuckerman 2009; Dodds 2018).

In my analysis, I will examine the United States and United Kingdom as two nations from the industrialized, English-speaking world, comparing them on the basis of their policy similarity to identify possible sources for differences observed in policy outcomes. However, for the United States, I will center my analysis around a subnational unit: the state of California. Although this is somewhat unusual in the comparative politics literature, and may appear to be an inherently apples-and-oranges comparison, there are several reasons why I have chosen to situate my analysis in this unusual footing. First, the state of California is equivalent to a nation by measures including its population, area, and economy. Second, I hoped with this comparison to explore and benefit from past scholarly work examining areas of comparative policy difference such as use of the precautionary principle in public policy, and differences between adversarial direct regulation exemplified by certain periods of policy development in the United States and more cooperative models common in some European countries. Third, and most importantly, my comparative case study will be grounded in the production of fresh leafy greens, a sensitive agricultural crop grown in very specific climatic zones. In the United States, California supplies between 70% and 75% of US domestic nationwide leafy greens supply on an

annual basis (Geisseler and Horwath 2016; USDA NASS 2017), making its output clearly equivalent to a national unit.[2]

My analysis will differ from the majority of comparative politics literature in one additional way. While most comparative politics research centers only on comparative policy contexts and the forms of regulation they embody, my analysis will add an element that is seldom considered. My study will combine analysis of policy instruments at state, hybrid and non-state levels, with primary social science research conducted with farmers of leafy greens, providing real world information on the impacts that regulation in each national context is having on individual farmers and their environmental choices. In this way, I will deliver an interdisciplinary look at comparative policy in its human dimensions.

In the remainder of this chapter, I will outline my comparative case by describing several forms of regulation currently active within the food system, as background for my investigation of the environmental consequences of public and private food safety regulation in fresh leafy greens. I will begin by examining three basic types of regulation that underlie current food safety governance regimes: State regulation, Co-regulation and Non-state regulation. I will explain the actors involved in each approach, how power is shared by actors, and the strengths and compliance challenges inherent in each approach. As a foundation for my international comparative case study of private regulation as it applies to leafy greens producers, I will trace the roots of current food safety regulation in the United Kingdom and in the United States and explain the role of food safety risk management in shaping farmers' environmental practices. Lastly, I will present and explain the components of my comparative case study, and the guiding questions it aims to answer.

I. Regulatory Risk Management in the Food System

Regulatory efforts in the modern food system exist along a spectrum from state-led regulation, through cooperative public-private regulation, to alternative forms of control in which standard setting and enforcement rely upon non-state entities. Table 2.1 compares and categorizes the most prominent regulatory forms that have been employed in the modern food system, arranging them according to the goals, methods, and structural characteristics of each approach. Although real-world regulatory efforts often reflect a blend of more than one style of regulation, it is nevertheless useful to examine archetypal forms to understand the multifaceted background of blended approaches and how their strategies borrow from these distinct types.

[2] During the months of the year when California is the primary producer of leafy greens (roughly April to October), California supplies nearly all of nationwide domestic leafy greens supply. The annual percentage is estimated at 70-75% because winter production moves to Arizona for the months between November and March.

Table 2.1. Forms of Regulation in the Food System, Compared

Type	Approach		What is Regulated	Locus of Control	Power Distribution	Tenor	Strategies
State Regulation	Direct Regulation ("Command and Control")		Outcome	Regulators	Concentrated	Adversarial	Audits, Sanctions
Co-Regulation	Modified Command and Control	Risk-based Regulation	Outcome	Regulators	Concentrated	Cooperative	Risk assessment, Audits, Sanctions
		Responsive Regulation	Outcome	Regulators, and Regulated Firms	Bimodal	Cooperative	Consultation, Audits, Sanctions
	Process-Oriented	Enforced Self-Regulation	Either or Both	Regulators, and Regulated Firms	Bimodal	Neutral	Audits, Sanctions
		Management-Based Regulation	Process	Regulators, and Regulated Firms	Bimodal	Neutral	Audits, Sanctions
		Systems-based Regulation	Process	Regulators, and Regulated Firms	Bimodal	Neutral	Audits, Sanctions
		Meta-Regulation	Process	Regulators, and Regulated Firms	Bimodal	Neutral	Audits, Sanctions
		Principles-Based Regulation	Outcome	Regulators, and Regulated Firms	Bimodal	Neutral	Audits, Sanctions
	Incentive-Based	Market-Based Instruments	Outcome	Regulators, or Association of Firms	Concentrated	Neutral	Financial Savings, Financial Penalties
Non-State Regulation	Voluntary and Information-Based	Information-Based Regulation	Outcome	Regulators, Firms, Private Entities, Consumers	Decentralized	Neutral to Adversarial	Public Labelling
		Private Regulation	Either or Both	Private Entities, Firms	Concentrated	Neutral to Adversarial	Loss of Contract, Public Labelling
		Self-Regulation	Either or Both	Firms, or Association of Firms	Concentrated	[Any]	[Any]

State Regulation

Traditional state-led regulation as seen over the majority of the last century places control over rule-making, standard-setting and enforcement in the hands of public regulators and their regulatory scientists. Government regulators define regulatory targets, which industry actors must comply, what compliance looks like, how it shall be measured, and what consequences will accrue for noncompliance. This form of regulation is referred to as direct regulation, with the most extreme forms dubbed “Command-and-Control”. Firms operating under this form of regulation are ostensibly held separate from regulators, and do not participate directly in setting standards or crafting legislation. This style of regulation is often characterized as adversarial, punitive and legalistic; fear of sanctions forms a key motivating force (Karp & Gaulding 1995). Outcomes are ensured through top-down administrative control, which typically stipulates both the desired outcome and how it must be achieved (Claeys 2004).

Direct regulation came to prominence in the second half of the 20th century, paralleling the rise of modern regulatory states. In the United States, direct regulation evolved out of the Progressive Era's focus on scientific rationality and direct provision of social and economic support through a bureaucratic central government. Direct regulations such as the Clean Air Act of 1963 and the Clean Water Act of 1972 applied a centrally controlled rule-making and enforcement process to the management of environmental problems linked to the activities of the manufacturing and chemical industries. Around the time of its establishment in the United States, this style of regulation became the dominant form of regulation across the nations of the Global North.

Since the 1980s, this approach has struggled to maintain primacy in light of politically-motivated deregulation efforts and increasing recognition of the international collective nature of many modern regulatory challenges. For example, many environmental and social problems—especially those in the modern, globalized food system—follow supply chains and human migration routes rather than national borders, outstripping the capacity and jurisdictional boundaries of traditional public regulation (Karp and Gaulding 1995; O'Neill 2017). Additional weaknesses of direct regulation include the lengthy process of gathering data, setting standards and crafting appropriate legislation, and the high financial and administrative costs of ensuring compliance once targets are set. Additionally, firms under this form of regulation may circumvent their exclusion from the regulatory table, through legally sanctioned lobbying and revolving door hiring, or via extra-legal activities such as concealed financial and political influence, any of which may allow them to "capture" regulators and weaken the regulatory process (Stigler 1971; Laffont and Tirole 1991). Under the best of circumstances, it is difficult for state regulators to know everything that can and must be known for effective top-down management of a large and diverse array of threats, resulting in the potential for regulation of this sort to be incomplete or inadequate (Karp & Gaulding 1995; Malloy 2010). Additionally, putting all the regulatory eggs in one basket by concentrating power into the hands of state regulators leaves command-and-control approaches subject to political regime changes, weak institutions, bureaucratic sluggishness, regulatory capture, and budget fluctuations, any of which may hamper regulatory outcomes (Karp & Gaulding 1995).

Co-Regulation

To adapt direct regulation to new policy arenas and make regulation less costly and time-consuming to administer, regulatory variations have appeared that seek to ensure the same outcomes with more efficient use of resources. Modified direct regulation strategies such as Risk-based Regulation and Responsive Regulation retain the basic administrative structures of direct regulation under command-and-control frameworks, while modifying interactions with non-state actors in order to create a less burdensome, more effective and more cooperative regulatory process (Hampton 2005; Rouvière and Caswell 2012; Garcia Martinez et al. 2013). In Risk-based Regulation, risk assessments direct inspections and enforcement toward those firms most likely to fail, while low-risk firms enjoy lighter regulation, motivating firms to build a record of compliance (Hampton 2005). Similarly, Responsive Regulation seeks to understand and resolve barriers to compliance, avoiding the use of enforcement resources to clear up cases of ignorance and misunderstanding, so that they may be used instead only for more serious cases of noncompliance (Ayres and Braithwaite 1992).

Process-oriented approaches such as Enforced self-regulation, Management-Based Regulation, Systems-based regulation, Meta-regulation and Principles-Based Regulation aim to control *how* firms act, rather than directly mandating end results. These styles seek to improve on traditional direct regulation by allowing those closest to the problem to design the solutions (Coglianese and Lazer 2003), requiring only that solutions be developed internally and put into place. One possible drawback of this approach is that the outcome itself is left uncertain even when regulations function optimally; the possibility remains that firms may be in total compliance with the procedural requirements of this type of regulation, without actually achieving the desired policy outcomes.

Since the 1990s, many governments have also undertaken efforts to broaden regulatory participation to include a wider array of views and interests (Rothstein 2004). These efforts have been made with the goals of heightening public awareness of regulatory issues and improving the quality of regulation for normative (Munton 2003), epistemic (Funtowicz and Ravetz 1996), and instrumental (Bloomfield et al. 2001) reasons. It is unclear however, whether the goals of broadened participation have been, or can be, achieved in practice (Rothstein 2004). However, it can be hard to strike a balance between democratic goals and policy goals, and broadening participation is often expensive. Scholars have also have argued that the success or failure of participative policy projects can hinge on "institutional fit" between the policy process and the beliefs and norms embodied within participation (Irwin 2006; Wesselink et al 2011; Rothstein 2013; Fisher et al. 2013). Nevertheless, co-management may offer the best chance of managing complex social and environmental problems within multi-level governance systems (Cash et al. 2006).

Although these variations of direct regulation offer improved solutions and more efficient use of regulatory resources, new challenges emerge. Research suggests that risk-based approaches may still suffer from many of the problems of direct regulation because the top-down regulatory style is still not necessarily fully responsive to the needs of industry (Ayres and Braithwaite 1992). Some scholars also question whether these modified approaches truly deliver on the initial promise of regulation by ensuring desired outcomes, or whether they actually result in diluted, less effective regulation (Tombs and Whyte 2012; Grabosky 2013).

Non-state Regulation

Regulation achieved by non-state entities can take a wide variety of forms, including Information-based Regulation, Private Regulation and Self-Regulation. These forms differ from command-and-control in that rule-making power and enforcement authority are held not by state regulators, but by non-state actors (Porter and Ronit 2006). Self-regulation describes a process where public regulators grant firms the power to define their own regulatory targets and the authority to police their own activities, either individually or through industry associations. In the food system, these approaches borrow from recent developments in environmental governance that seek to address perceived failures and inefficiencies of state-led regulation by shifting regulatory power to markets and market actors (O'Neill 2017). Enforcement authority in non-state regulation derives from supply chain relationships and from economic concerns, rather than from government. Information-based Regulation seeks to increase the public availability of information about firms' performance to encourage compliance. In Private Regulation, private actors assume the roles traditionally played by public regulators, by defining targets and directing inspections and enforcement. Private standards typically function alongside and in

addition to public regulation but may also act to supplant public regulation where public enforcement is lacking, public standards are insufficient, or where no public response yet exists.

One of the most notable benefits of non-state approaches is that they can move more quickly than traditional public regulatory processes, producing timely technical decisions which might have taken longer to emerge from a more accountable, representative public regulatory process involving chambers of government and bureaucratic agencies. This nimbleness can be beneficial when responding to new and emerging threats such as the environmental hazards of new and as-yet-unregulated technologies, or newly recognized public health threats which do not yet have established regulatory benchmarks but for which human suffering might be averted by swift action before such regulation is produced. Although self-regulation and private regulation may seem like the fox guarding the henhouse, competition among rival firms can encourage stronger self-regulation as firms watchdog each other independent of public regulatory enforcement, avoiding a race to the bottom. Private efforts can also act to improve and deepen the public regulation landscape (Locke, Rissing and Pal 2012). In some cases, private regulation that is viewed as successful or politically expedient may even become hardened into law, generating new public regulation where none previously existed (Sabel and Zeitlin 2012).

However, private regulation's nimbleness and relative lack of bureaucracy can also be an Achilles heel. Whereas governments are accountable to their citizens if their regulatory standards are found to be faulty, no such accountability is necessarily built into privately controlled regulation. The market primarily exerts influence over such standards, and the market can become a vehicle with no driver at the wheel. Private strategies thus reflect the character of their creators; they are as lax or as rigorous, as representative or as mysterious, as complete or as cursory, as the firms and public regulatory efforts that pursue them (Gunningham, Kagan and Thornton 2003). If industry associations successfully create ineffective mandatory standards or if firms choose to sign on to those voluntary standards which ask the least of them, the market may experience a downward convergence onto the least effective standards (Overdevest and Zeitlin 2012). Self-regulation and private regulation may also be pursued by firms that specifically wish to avoid or to weaken public regulation. Poorly designed or bad faith private regulatory efforts can provide equally poor outcomes.

Comparative Trends in Politics of Risk Regulation for Environment and Food

The United States and the United Kingdom have very different agricultural histories, as might be expected due to dissimilar geographies and historical settlement patterns. The history of UK agriculture precedes modern civilization, evolving from a background of early subsistence activities and feudal peasant agriculture. Enclosures of public lands in the early stages of the industrial revolution disenfranchised Britain's rural agricultural populace, while the role of capitalist production-oriented agriculture expanded to feed growing urban workforces (Samuels 1981; Federici 2004; McMichael 2005). The current UK agricultural system combines elements of the social and landscape heritage of Britain's long history of rural family farming with the modern style of capitalist production, within the trade relationships and political linkages of the European Union (Eurostat 2018). Landholdings still often follow historical patterns of family ownership and traditions of land management, even while growing commodity crops meant for international markets (DEFRA 2016, 2017a, 2017b). As a consequence of agricultural intensification driven in part by the supply chain activities of powerful food retailers, UK

farming has recently seen an increasing reliance on migrant labor beginning since the 1990s (Frances, Barrientos and Rogaly 2005; Rogaly 2008).

In the US, agricultural histories differ sharply along regional lines, based on timing and character of early post-colonial settlement. California's agricultural history shares little with that of the UK. California's relatively recent and highly capitalist agricultural industry did not develop from a history of small-scale, independent family farms, nor from feudal landholdings. California's native inhabitants did not farm the land, and at no point in subsequent settler history was California host to a small-scale agrarian populace[3]. Instead, from its establishment around the time of the Gold Rush in the mid 1800s, California agriculture has always been intensive, large scale, market-oriented, and dependent on hired labor primarily supplied by migrant and ethnic minority communities, often under extremely exploitative circumstances (McWilliams 2000; Freidberg 2009; Guthman 2014).

Despite the divergent starting points of their agricultural histories, the UK and US both experienced an increase in the public visibility of environmental and public health problems in the late 1800s and early 1900s. A new era of progressive policies followed, aimed at reforming core industrial activities and solving collective action problems in the large-scale production of public goods such as clean water and clean air (Vogel 1986). In response to a wide array of factors including political regime changes, shifting public opinion, and the rising power of global agribusiness, the approach of the two states has shifted considerably over time.

Early in the period of heightened environmental regulation that began among most developed nations in the 1960s and 1970s, the United States was recognized as a progressive leader. The earliest US risk regulation in the realms of environment and food during this time took a precautionary stance that prioritized the public interest and sought to place limits on the activities of industry through ambitious and comprehensive formal regulation on topics including water quality, air quality, product safety, vehicle emissions, and chemical safety. In contrast, although UK regulation had established regulatory bodies dedicated to environmental problems in the mid 1800s, UK environmental regulation during this period was, during this early period, less ambitious than environmental regulation in the US. UK regulatory efforts moved slowly and incrementally, developing multi-sectoral scientific consensus before the drafting of legislation, and relying on trust between industry and regulators rather than enforcement and sanctions.[4]

Beginning in the 1980s, a wave of neoliberal reforms and deregulation during the Reagan administration changed the tenor of US environmental and public health policy. US risk regulation became more conservative and less precautionary in its approach and more protective of industry, as environmental and public health regulation came to be seen as a tax on industrial economic growth, and US regulators eschewed precautionary policy in food safety partly out of concern that a precautionary stance might present a non-tariff barrier to trade (Henson and Caswell 1999). US environmental law originally referenced precautionary reasoning in decisions around early environmental reforms (Wiener and Rogers 2002) but Congress and the White House later declared it improper to create policy based on uncertain risks, favoring scientific risk assessment in place of precaution (Vogel 1986, 2012). On this basis, the US adopted ambitious

[3] For a detailed history of the impacts of 20th century capitalism on the development of California agriculture, see Guthman 2004, 2014. For a similarly detailed exploration of the exploitative labor relations, urban/rural separation, and factory-like production norms that have long characterized California farming, see McWilliams 1939, 2000.
[4] For more detail on how these dynamics have impacted the use of science in regulation and the impact these differences of approach have made on the attitude of business interests toward environmental regulation, see Vogel 1986.

scientific standards developed without formal industry input, requiring mandatory use of the most effective technologies. While some degree of collaboration and flexibility entered the system through the implementation efforts of local regulatory authorities, the basic architecture of the system was built to rein in the activities of industry through the use of stringent direct regulation. Around the same time, the character of UK regulatory efforts in the environmental and public health arena, following the approach taken by the European Commission (European Commission 2000), retained their focus on trust and consensus, and became increasingly motivated by the precautionary principle. The British style emphasized the evolution of smaller, incremental targets, developed with the cooperation of industry through collaborative site visits and inspections, in a legislative process out of view of the public eye. These targets typically included deep collaborative participation by industry groups and less focus on adherence to rigid standards, allowing a greater emphasis on informal and voluntary participation (Vogel 1986; Hawkins and Hutter 1993; Ansell and Vogel 2006).

By the late 1980s, progress made by the two states on a host of environmental and public health issues showed similar levels of improvement, despite the fact that the two states had approached these regulatory challenges through very different means. The key difference in transatlantic environmental and public health regulation that emerged by the turn of the century was in the attitude of industry toward environmental regulation. In the US, environmental regulation became a highly politically polarizing issue seen by industry as a hindrance to economic growth, while in the UK environmental regulation never became as contentious a political topic, and the relationship of business to government remained focused on compromise and conciliation.

Emerging Focus on Food Safety

In both the US and UK prior to the 1980s, risk management in food and agriculture centered primarily on economic concerns such as commodity production and price supports. Food safety surveillance had existed in both nations since the late 1800s for products such as milk and meat, but food safety was not a leading regulatory focus (Cooter and Fulton 2001; Henson and Hooker 2001). Growing awareness of the risk of pathogens in the food supply began to put food safety at the top of the regulatory agenda following the emergence of a new range of public health concerns which focused attention on food production practices and revealed the inadequacy of existing regulatory controls to deal with pathogen threats (Thomas 2014).

In the UK, high profile food safety concerns and a new focus on food safety began with the emergence of Bovine Spongiform Encephalopathy (BSE) or “mad cow” disease in British cattle from 1986 onward. The BSE crisis, along with and later scares such as the appearance of foot and mouth disease in cattle and sheep, and the contamination of Belgian animal feed with dioxin in 1999 (van Larebeke et al 2001) drew attention to production practices in livestock supply chains and to pathogenic food safety as a large-scale societal risk embedded in the industrial food system. The epidemiological identification of BSE and the subsequent confirmation of its link to new variant Creutzfeldt-Jakob Disease (vCJD) in humans sparked a massive controversy within British and European food production and regulation, shining a light on government mismanagement of the crisis and the role of food safety in international trade. These concerns left deep scars in the UK regulatory framework for food safety, eroding public perceptions of the authority of scientific experts and members of government to provide guidance in the face of salient public safety threats (Jasanoff 1997). Ultimately, this breakdown

of public regulation led to the eventual creation of the European Food Safety Authority as an oversight body and a reorganization of European and UK food safety controls to focus on "farm to fork" management of agricultural safety and quality (Ratzan 1998, Wiener and Rogers 2002, Barling 2004; Busch and Bain 2004, Ansell and Vogel 2006, Paul 2012). These combined issues in modern animal husbandry called into question the basic safety of intensive agricultural production systems, and the British government's handling of the BSE crisis ultimately shook consumer confidence in the fundamental ability of public food regulation to adequately protect consumers from harm (Ratzan 1998; Vogel 2012).

This constellation of food safety failures prompted the UK government to adopt its seminal 1990 Food Safety Act. In reaction to BSE and other scandals, and as part of an attempt to incorporate EU language and priorities at the regulatory level (Barling 2004), the Act placed a high value on achieving traceability in food supply chains. Importantly, the 1990 Food Safety law also established a new "due diligence defence" for assigning criminal responsibility in cases of food safety violations, an element that has played a strong role in driving much of the UK retail industry's focus on food assurance schemes and production standards (Kirk-Wilson 2002). The language of the defense states that a food provider is responsible for any food safety risk that they could "reasonably" have been expected to know about or have acted to solve. Food providers must demonstrate due diligence or face criminal consequences.

During the same period, the United States government responded to domestic and international foodborne illness outbreaks by formally adopting a new food safety management protocol first developed by NASA to ensure the safety of food sent into space for American astronauts, and later broadened to minimize risk in a range of product supply chains (Freidberg 2009; Nestle 2010; Thomas 2014). Known as Hazard Analysis and Critical Control Points (HACCP), this protocol directs producers to make themselves aware of all potential sources of risk in their operations and place controls at specific steps to neutralize each hazard. Beginning in the early 1990s, HACCP-style risk management controls were formalized and US legislation began to mandate their use. Over the next decade HACCP models were adopted across global supply chains and incorporated into EU food law as part of the multinational response to BSE (van der Meulen 2013). In 1997, the Codex Alimentarius Commission, a joint body of the UN Food and Agriculture Organization and the World Health Organization, adopted HACCP into its international collection of food production standards for the protection of consumer health and the regulation of international food trade (CAC 1997; WHO 1998). Given heightened awareness of risks throughout the food supply chain, food safety risk management across the industrialized nations has moved from testing the safety of final products on the retail shelf or the consumer's table to monitoring the riskiness of field level agricultural production methods (Henson and Humphrey 2009).

Even in this heightened climate of food safety attention, some threats evaded early notice. The high-profile food safety failures of the 1980s had come primarily from the meat and poultry industries, focusing early regulatory responses on both sides of the Atlantic on livestock supply chains. Although botulism and other foodborne illness outbreaks had been seen in canned and preserved vegetable products in the US and elsewhere, outbreaks of animal origin gained more visibility during this time of increased focus on food safety. As a result, vegetable food safety threats largely escaped public attention and regulatory pressure through the late 1990s even as global consciousness of food safety gained momentum. The US Food and Drug Administration's first public acknowledgement of food safety risks in fresh produce came in 1998 with the FDA "Guide to Minimizing Microbial Food Safety Hazards for Fresh Fruit and Vegetables" and the

first EU Regulation establishing general food hygiene law was created in 2002 (European Commission 2002).

Shifting Authority in Food Safety Regulation

In the search for improved food safety assurances in global agricultural value chains, a new balance of power began to develop between regulators and the food retail industry that would transform the food regulatory landscape. Public regulatory responses from due diligence clauses to HACCP requirements represent examples of regulation at a distance, extending traditional public regulation to the realm of enforced self-regulation by private firms (Antle 1999; Coglianese and Lazer 2003; Hutter and Amodu 2008). This change in the landscape of food regulation reflected the rising power and centrality of non-state governance mechanisms, creating new architectures of authority in global agri-food chains.

Lacking confidence after food scares, consumers sought new ways of ensuring product quality (Murdoch et al 2000; Murdoch and Miele 2004; Goodman, Harvey et al. 2010; Hoffman 2010; DuPuis and Goodman 2012). Food retailers responded to this "turn" to quality by introducing an array of non-governmental safety and quality assurance schemes designed to exceed the requirements of public regulation in an effort to win back consumer trust (Fearne 1998; Fearne and Garcia Martinez 2005; Fulponi 2006). Quality assurance standards soon appeared across the developed nations focusing on topics such as enhanced animal welfare, fair labor practices, food safety, and environmental protection (Antle 1999; Murdoch et al. 2000; Hatanaka, Bain and Busch 2005; Ponte and Gibbon 2005; Goodman, DuPuis and Goodman 2012; von Schlippenbach and Teichmann 2012).

Private or non-governmental food standards can be divided into three categories based on formation and participation (Henson and Humphrey 2009; Rossignoli and Moruzzo 2014; Freidberg 2017). Individual firm standards are those created by a single private food corporation and intended to apply only to that firm's products and suppliers, e.g. Tesco's own-brand 'Nurture' program (originally 'Nature's Choice') founded in 1992 and required for suppliers of Tesco's UK retail stores. Collective national standards represent standards developed jointly by multiple private food corporations which are designed to apply across multiple firms or industry sectors, as when the British Retail Consortium formed and created its Food Technical Standard in 1998. Lastly, collective international standards are those formed by geographically diverse coalitions of food firms and designed to apply at an international level to facilitate the movement of foods through global supply chains that cross between many national regulatory settings. The International Featured Standards (IFS) – Food (originally International Food Standard) created in 2003 by a coalition of Dutch, French and Italian Retailers is an example of one such international standard currently followed by agricultural producers in many countries worldwide.

Whether individual or collective, national or international, these and other retailer-driven private standards have restructured power relationships within agricultural supply chains in the name of achieving heightened food safety and quality.[5] Officially, private standards such as these

[5] For the purposes of my analysis, I will focus on the impacts that public and private quality standards have on domestic agricultural producers within a national fresh goods market. For an examination of how private standards affect international supply chain relationships and primary agricultural producers in the Global South who supply retailers in industrialized nations, see: Collins 2000; Jaffee and Henson 2004; Freidberg 2004; Henson and Humphrey 2009; Gereffi and Lee 2009; Rossignoli and Moruzzo 2014. For discussion of how quality standards have affected international trade oversight at the multilateral level, see Jill Hobbs 2010.

depend on voluntary market relationships and do not have the authority to mandate adoption or participation. However, research has shown that voluntary private standards of this sort can become *de facto* mandatory if they become widely adopted in the market and companies require compliance from producers (Henson and Northen 1998; Henson and Reardon 2005; Fulponi 2006; Henson 2008; Nadvi 2008; Fuchs, Kalfagianni and Arentsen 2009; Hobbs 2010; Davey and Richards 2013; Rossignoli and Moruzzo 2014; Friedberg 2017). Such standards may then be used by both public and private actors as a recognized governance mechanism, comparable in power to public regulation (Hatanaka and Busch 2008).

The ascendance of non-governmental food standards has increased retailers' control over all stages of food production. By ostensibly guaranteeing the consumer public a higher level of safety or quality than that presumed to be delivered by the background public regulatory process, private food standards assert the authority of food retailers as a legitimate rule-making force within broader food governance. Food retailers in both the UK and US markets now hold a position of regulatory authority and legitimacy within agri-food supply chains (Havinga 2006; Fuchs and Kalfagianni 2010). By becoming the architects of the leading food regulations affecting both their own commercial activities and the growing practices of their producer suppliers, retailers have effectively made themselves the gatekeepers of food safety (Friedberg 2004; Hatanaka, Bain and Busch 2005; Hatanaka and Busch 2008; Goodman, DuPuis and Goodman 2012). With industry in control of defining, measuring, and managing food safety risks, government regulators in many parts of the industrialized world have focused more on the administrative task of evaluating industry's efforts (Nestle 2010; Stuart 2010).

Benefits and Hazards of Private Food Safety Governance

Regulation of the food system achieved via non-state actors has shown certain benefits over pure public regulation, along with notable drawbacks. Private regulation can address market failures that might otherwise go unregulated by public entities, providing solutions to collective action problems that might persist in food supply chains without intervention (Cafaggi and Renda 2012). Examples include the establishment of privately-operated organic food certifications in the 1970s in the United States and Europe[6] designed to solve ecological externalities in conventional food production, and fairtrade certifications born in the late 1980s[7] and early 1990s with the aim of correcting exploitative labor conditions in developing countries exporting commodities for international trade (e.g. coffee). By offering solutions for these and other market failures, private standards and other forms of self-regulation can enhance the efficiency of supply chain management, reduce transaction costs, standardize industry responses to problems, and reduce liability for both retailers and producers (Hobbs 2010). Instead of competing solely on factors like price or convenience, private quality standards can allow desired public goods such as improved food safety, animal welfare, labor standards, or environmental sustainability to be measured and managed directly within the supply chain, making them into attributes that can fuel retail competition as part of brand and product differentiation.

[6] Early examples include the organic certification program operated by the German collective Bioland beginning in 1971 and certification offered by the non-profit organization California Certified Organic Farmers beginning in 1973.

[7] The Dutch non-profit Solidaridad together with the Oaxacan coffee farmers' group UCIRI are credited with establishing the first fair trade certification standard in 1988 for international coffee exports, which later grew to encompass other crops and its own independent standard setting body in the 1990s.

Private regulation can also be especially helpful for addressing problems that involve transnational trade and globalized supply chains of the sort now commonplace in food production, because they can be much more easily enforced across an extended supply chain. Private regulation can hold to account industry actors who operate across and between outside national boundaries, and might otherwise escape or supersede traditional state regulation (van Schooten and Verschuuren 2008). Furthermore, in part because private standards can become effectively mandatory for the producers they apply to because they control market access (Freidberg 2017), they can be powerful vehicles for advancing a desired outcome quickly through a supply chain that crosses through multiple public jurisdictions (Lewis et al. 2010; Hobbs 2010).

However, research suggests that private food standards do not necessarily provide equivalent results compared with traditional public regulation. Examinations of quality assurance schemes in UK agriculture have concluded that private food governance is unlikely to provide the outcomes sought by either consumers or governments (Fuchs, Kalfagianni and Arentsen 2009), and that many private standards are critically flawed because guiding objectives fail to include adequately broad coverage of environmental threats and because definitions of key metrics and indicators are not clear enough to be well assessed and enforced (Morris 2000). Similarly, a recent UK study of private and hybrid environmental standards found that few standards exist which genuinely have the potential to achieve public environmental outcomes (Lewis et al. 2010). Because goals such as food safety assurance and environmental protection are inherently linked to profit motives, food retailers often create proprietary quality standards as part of corporate branding efforts, wielding them more as tools of market competition rather than as tools of public good (Hatanaka, Bain and Busch 2005; Fulponi 2006; Lewis et al. 2010). Even when private standards are built by broad coalitions of stakeholders or include independent third-party accreditation and auditing mechanisms to increase consumer trust in objectivity, retailers often implement their own proprietary standards as an additional step even after collective standards are put in place (Von Schlippenbach and Teichmann 2012). In this marketing space, proprietary private safety and quality standards represent a black-box style of food regulation where decisions are not necessarily openly accountable to the public or subject to robust monitoring and enforcement (Ponte and Gibbon 2005). Research suggests that food safety and quality controls under these circumstances may function to promote corporate profit and industry dominance rather than to achieve public regulatory goals (Morris 2000; Hatanaka, Bain and Busch 2005; Konefal, Mascarenhas and Hatanaka 2005; Loconto and Busch 2010; Lewis et al. 2010).

In light of the drawbacks of pure non-state regulation and the costs and compliance challenges of pure state regulation, co-regulatory approaches have become common in food safety. Co-regulation in the food system purports to decrease both the high administrative costs of achieving compliance, and the adversarial climate that coercive regulatory tactics can create (Fearne and Garcia Martinez 2005), and combinations of public and private regulation can achieve better outcomes than either strategy can deliver alone (Morris 2000). However, scholars have observed that co-regulation of food supply chains may work most effectively when the motives of the public and private parties involved are aligned, a situation that is far from common in food regulation (Garcia Martinez et al 2013).

Research suggests that for optimal outcomes in the food system, public standards may need to be strengthened in conjunction with the implementation of robust private standards (Morris 2000; Henson and Reardon 2005). Evidence from outside the food system suggests that

non-governmental regulatory efforts achieve their best outcomes when the background public regulatory controls also strengthen over time; comparative research among US, Canadian and Australian paper mills revealed that adoption of environmentally friendly methods and technologies was greatest when both private and public standards regimes improved concurrently, raising the bar for all players and creating an overall climate of improved consciousness and responsibility (Gunningham, Kagan and Thornton 2003). If private regulation instead substitutes for strengthening public approaches, or if too much responsibility is ultimately placed in the hands of non-governmental actors, broader societal benefits may fail to materialize.

Finding the ideal balance between private and public regulation has become a pressing transatlantic concern in food regulation. In ideal terms, co-regulatory approaches and hybrid private and public regulatory regimes created by overlapping standards could be well poised to deliver desired public health outcomes in a complex and dynamic regulatory space, but many questions remain unanswered. The complex interactions of actors at multiple layers of food safety regulation are still incompletely understood (Havinga and Verbruggen 2017). A profusion of overlapping public and private rules in co-regulatory models can lead to confusion, audit fatigue, and increased expenses for primary agricultural producers, with the end result that some regulatory goals may slide off the table as producers become overburdened with too many standards and rules (cite). Research has suggested that the presence of overlapping standards controlling the same activities in often complementary but sometimes contradictory ways may constitute a separate and important shaping factor influencing the development of regulatory regimes equal to state regulation in its impact on producers (Berman et al. 2013). Efforts to harmonize public and private food safety requirements have begun within both national and international markets in an attempt to reduce the strain on producers but have so far been hampered by the parallel role that private food regulations play as tools of competitive advantage in food retail markets (Henson and Humphrey 2009). Additional efforts at harmonization of private and public regulation are necessary to achieve regulatory goals without undue impact on producers (Mei Soon and Baines 2013; Berman et al. 2013), and to account for unintended consequences and regulatory priorities that have been underrepresented in food standards to date.

II. The Comparative Case of Food Safety Risk Management in US and UK Leafy Greens

As food safety risk management rose to prominence in the 1990s and early 2000s, regulation at both public and private levels sought to improve food safety controls on fresh products such as leafy greens. Private retailer safety standards proliferated, in hopes of reassuring consumers and solidifying low-risk production practices within an industrial production system with vertically integrated supply chains under strong corporate control. But although pathogen presence is a prerequisite in foodborne illness transmission, the organization of the food production system may be ultimately responsible for whether and how pathogens pose a risk to consumers; in this sense, outbreaks may be best characterized as "food-system borne disease rather than food-borne disease" (McMahon 2013 p. 408). Critics of the dominant food safety risk management framework point out that current private standards and policy solutions tend to address food safety risks without engaging with the larger economic and biological causes, essentially treating the symptoms without addressing the underlying disease: Field-level safety practices aim to control risk using technological methods such as sanitization of harvested products or modification of the growing environment to remove the natural. These

steps do not address the role of large-scale centralized industrial agriculture in creating food safety risks (DeLind and Howard 2008; Stuart 2011; McMahon 2013).

Sources of Risk in the Lettuce Supply Chain

Compared to many other agricultural products destined for grocery markets, lettuces and other leafy greens are considered particularly high-risk food items. Leafy greens are at higher risk than many other crops in part because they grow so close to the ground, which increases the chances of exposure to pathogens via contact with soil, pest animals (Langholz and Jay-Russell 2013; Gennet et al. 2013; Jay-Russell and Doyle eds. 2016), agricultural chemical residues, runoff (Suslow 2003; Suslow et al 2003; Selma et al. 2010), and internal contamination by irrigation water (Tyrrel, Knox and Weatherhead 2006; Cooley et al. 2007; Lynch et al. 2009; Gil et al. 2015). In addition, the cool, humid growing conditions that lettuce crops require for optimal growth are the very same conditions that favor pathogen persistence (Takeuchi and Frank 2000; Takeuchi et al. 2000). With their large, flat surfaces and a high ratio of surface area to volume, leafy greens maximize the potential for pathogens to persist on their edible surfaces. Leafy greens are also often harvested and processed by machines, and subject to additional processing steps such as cutting, rinsing and bagging (Gil et al. 2015), all of which can spread and magnify contamination during harvesting. Finally, crops such as lettuce are most commonly eaten raw rather than cooked, avoiding the kill-step which otherwise helps minimize or eliminate pathogen transmission from many other foods. This maximizes the chance that any pathogens present on fresh lettuces can survive to pose a health risk to the consumer.

Despite the many challenges of growing and bringing to market such a sensitive and risk-prone crop, production and consumption of leafy greens in both the United States and United Kingdom has risen since the 1970s due to the purchasing decisions of increasingly health-conscious consumers (Lin et al. 2016; Roberts et al. 2018)[8]. Increases in lettuce production and consumption have come hand in hand with an increase in the risk of foodborne illness, as lettuce supply chains have lengthened, including more processing steps in order to provide steady year-round supply to urban and peri-urban grocery retailers. Beginning in the United States in the 1980s and later expanding to other developed nations, leafy greens began to be sold in bagged, ready-to-serve salad mixes marketed as a convenience item aimed at busy grocery shoppers seeking healthy options that do not require additional preparation (Stuart 2011; Rekhy and McConchie 2014). These salad mixes are now one of the highest value fresh produce items in the US and UK grocery market (Agricultural Marketing Resource Center), positioned as they are at the intersection of increased consumption of healthy foods, and convenience-oriented grocery purchasing (Sagoo et al 2003; Tyrrel, Knox and Weatherhead 2006; Quested 2010; Koukkidis 2016). But bagged, pre-mixed salads may also present particularly high risks for consumers. More processing steps and longer supply chains increase the amount of time that pathogens can multiply between harvest and consumption. Bagged salads can be kept under refrigeration to travel farther and longer than whole heads of lettuce, while permitting pathogens to continue to incubate during transit and storage, especially where salad leaves are damaged (Koukkidis et al.

[8] Although the USDA's Economic Research Service estimates that total US per capita consumption of vegetables has declined slightly since the late 1990s, much of that decline is driven by lower consumption of potatoes and potato products. Leafy greens are one crop that is measured to have increased during this period of otherwise modest decreases in consumption (USDA ERS 2016). Similarly, UK consumption of fruits and vegetables has decreased slightly since 2006, but lettuces remain one of the strongest product categories (Public Health England 2018).

2016). Evidence suggests that illnesses associated with leafy greens are more closely linked to consumption of ready-to-eat bagged salads, than to consumption of unprocessed lettuces that are sold by the head (CAFF 2008; DeLind and Howard 2008; Little and Gillespie 2008; Stuart 2011; Vestrheim et al 2013), making pathogen control especially important for packaged ready-to-eat leafy greens (Sagoo et al 2003).

Risk Responses Within the Lettuce Supply Chain

Within the industrial fresh produce supply, efforts to control food safety risks have also revealed potential negative environmental impacts stemming from food safety attention. Attention—and potential changes—to multi-level food safety regulation in the US and UK leafy greens markets have typically followed outbreaks and public failures, of which there have been more incidents and higher profile difficulties in the US market. The 2006 outbreak of E. coli 0157:H7 from California spinach sickened more than 200 people and killed 3 (CDC 2006). A lengthy investigation concluded that the contamination had originated in domestic cattle and feral pigs living adjacent to spinach fields in the central coast of California and may have entered fields through a combination of the movements of irrigation water, wind, and wild animals (Calvin 2007; Stuart 2009). This outbreak brought industry-wide attention to foodborne pathogens in US fresh leafy greens, creating lasting changes to the way lettuce production in the United States interacts with natural landscapes. To decrease food safety risks, farmers were instructed to minimize animal presence on and near agricultural operations by removing non-crop vegetation that may offer habitat for animal activities, and by employing wildlife traps, poisons, increased predation, and other deterrents. In California's ecologically sensitive central coast growing region, these recommendations have created ongoing conflict between food safety goals and long-standing environmental efforts to improve water quality by promoting the maintenance of vegetated buffers and filter strips, and the use of conservation practices designed to allow agriculture to better coexist with local wildlife (Stuart, Shennan and Brown 2006, Beretti and Stuart 2008, Stuart 2011, Karp et al 2015, Baur et al 2016). Framing the natural environment purely as a source of foodborne illness risk ignores indications that wetlands and non-crop vegetation at field margins provide an important filtering effect that contributes to pathogen reduction in cultivated fields (Stuart, Shennan and Brown 2006; Karp et al 2015), outweighing potential risks from increased wildlife penetration.

In both the US and UK, food producers and retailers must today balance their differential responsibility to the environment and to the safety of consumers, but they are currently finding different ways forward. Evidence suggests that UK retailers have stronger accountability systems and may be better able to see and manage environmental challenges within their supply chains due to early and comprehensive action on supply chain sustainability, while US retailers have taken sustainability steps only in response to specific consumer pressures, and have typically tended to be aware of sustainability through the lens of corporate cost reduction rather than generalized environmental improvement (Iles 2007). Retailers chart their course in this space via a complex system of socially-mediated decision making affected by norms of corporate behavior, the nature of the public regulatory framework in which corporations operate, the scientific and economic information they gather, and the marketing relationship they seek to cultivate with their customers. This multifaceted way of approaching decisions that must be made vis-à-vis environmental conduct in this high-risk food safety space constitutes each retailer's "license to operate" (Gunningham, Kagan and Thornton 2003) which shapes responses

to environmental and public health concerns. As primary producers, leafy greens farmers must navigate their way between the requirements imposed by food safety standards from retailers and government, and the capabilities and vulnerabilities of their productive lands. Farmers may be simultaneously bound by multiple private standards and government requirements, while also seeking to balance the needs of environmental stewardship. Overlapping state, hybrid and non-state controls active in produce food safety in the United States and United Kingdom include the following:

Table 2.2 Food regulatory controls affecting fresh produce, US (CA) and UK

	UK	US (CA)
State	• Food Safety Act 1990 (and Amendment Regulations 2004) • No. Regulation (EC) 178/2002 (EU General Food Law)	• FDA Food, Drug and Cosmetics Act (1938) • Food Safety Modernization Act (2011) • USDA Harmonized GAP (2015, 2018)
Hybrid	• Red Tractor Assured Fresh Produce Standard	• CA Leafy Greens Marketing Agreement
	• British Retail Consortium (BRC) Global Food Standard	
Non-State	• Tesco NURTURE Standard • Marks & Spencer "Field to Fork" Standard • LEAF Marque Standard • Internal Retail and Food Service Risk Assessments	• International Featured Standards (IFS) Food • Safe Quality Food (SQF) • Food Safety System Certification (FSSC) 22000 • Internal Retail and Food Service Risk Assessments
	• GlobalG.A.P. Integrated Farm Assurance (UK) / GlobalG.A.P. Fresh Produce Standard (USA)	

Examples of State Regulation of Food Safety, US and UK

The 2011 Food Safety Modernization Act enacted by the United States is an example of "Command-and-control" regulation in the food system. The law lays out standards for acceptable procedures in controlling food safety risks, with specific allowed thresholds and permitted actions such as timing windows for the application of certain crop amendments prior to harvest. Assessments are slated to be carried out through state and federal inspection mechanisms including announced and unannounced audits of farm facilities and food processing facilities.[9] Failures to comply with either established pathogen limits or codes of practice are met with fines and other punitive measures. Leafy greens handlers at all levels of the United States produce supply chain are required to follow HACCP guidelines, and maintenance of food safety is emphasized at field level. National food safety guidelines frame the natural growing environment of leafy greens crops primarily as a source of risk, recommending caution wherever agricultural lands abut natural areas, and prescribing a program of control and deterrence vis-a-vis wildlife.

The United Kingdom's due diligence framework also incorporates HACCP guidelines, and similarly treats food safety in fresh produce as a risk best managed at field-level. National audits and inspections within the UK agricultural system are carried out by local city and regional governments and their contractors, who in turn are overseen by the Food Standards

[9] Due to the complexities of planning enforcement, difficulties in defining some elements of the enforcement criteria such as the definition of a "farm", and in recognition of the cost barrier this new regulation of food safety will present to smaller operators and those using alternative production methods that may require more verification by food safety auditors, enforcement of some FSMA provisions has been delayed into 2019. Details of enforcement are still being decided at the time of writing.

Agency. Stakeholder experts at the level of the European Commission have identified bacterial pathogens as the top food safety risk, and field-level good agricultural practices (G.A.P.) as the most important way of controlling pathogens. However, produce safety alerts are seldom issued for bacterial pathogens, and tend to be employed much more readily for flagging excessive pesticide residues, indicating both a wider set of public health priorities and perhaps also a greater degree of importance placed by regulators on protecting retailer reputations from the negative consumer backlash of publicized outbreaks (Van Boxstael et al 2013). The United Kingdom also uses a risk-based policy framework for food safety required by EU regulations, including the risk-based regulation strategy of requiring pre-regulatory assessments to prioritize food producers for public regulatory inspections. This represent a hybrid approach.

Examples of Hybrid Food Safety Controls, US and UK

Hybrid controls may develop as non-state mechanisms that are subsequently adopted by state regulatory authorities, or as the result of direct efforts to involve private actors in formation of cooperative regulatory mechanisms. Agricultural firms and local leafy greens growers in California responded to the 2006 food safety failure in spinach by developing the California Leafy Green Products Handler Marketing Agreement, LGMA, a private, voluntary field-level production standard for controlling food safety risks in leafy greens, with assistance from the United States FDA (Calvin 2007). The LGMA standard was created in 2007 as a way to get more rigorous safety standards in place for the next growing season after the 2006 outbreak rather than waiting for a longer public rule-making process (Food Safety News 2008). LGMA is overseen by a board of directors formed of leafy greens industry members, appointed and overseen by the California Department of Food and Agriculture. The LGMA standard was not created through a government rule-making process or by state regulators, but requires that compliance with the standard be verified by state and federal audits and inspections under the terms of a federal marketing agreement.[10]

In the United Kingdom, several pre-regulatory assessments are currently included by public regulators as part of risk-based regulatory frameworks for food safety. These include Red Tractor Assured Produce Scheme, and the BRC Global Food Standard. These pre-regulatory assessments are the product of an industry-level trade union (the National Farmers' Union) and an industry association (The British Retail Consortium) respectively, but both are incorporated into the public regulatory process as part of pragmatic risk-based regulation on the part of the United Kingdom's public regulatory approach, and a desire on the part of UK retailers to demonstrate due diligence as required under the 1990 Food Safety Act (Kirk-Wilson 2002).

Examples of Non-state Food Safety Regulation, US and UK

Retailers of fresh leafy greens in both the United States and United Kingdom have responded to outbreaks and public concern with an assortment of non-state regulatory methods to

[10] In the words of the US National Agricultural Law Center, marketing agreements and orders "are designed to stabilize market conditions for certain agricultural commodities by regulating the handling of those commodities in interstate or foreign commerce." Marketing agreements and orders must compel producers and distributors to take one of six specific actions. In the case of the California LGMA, the action that is being invoked is that of mandatory government-controlled audits and inspections. http://nationalaglawcenter.org/overview/marketingorders/ and 7 U.S.C. § 608c(6).

protect the safety of retail foods, while reassuring consumers and protecting brand reputations. Examples include a variety of retailer-branded food safety standards targeting field-level risk reduction through specific agricultural practices related to hygiene and use of safe farm inputs, including Tesco's NURTURE standard and the parallel US and European standards managed by the private group GlobalG.A.P. These standards are typically similar to state regulatory controls for food safety, but attempt to exceed the terms of local law by adding additional levels of specificity and broadening the scope of food safety regulation to include additional values such as environmental improvement and labor protections.

III. Comparative Case Study Objectives

In the chapters that follow, I will examine in detail the overlapping layers of regulatory responses to food safety risk management affecting leafy greens affecting leafy greens production in the United States and United Kingdom, identifying the social and landscape effects they have had for lettuce producers. I will examine what types of regulation are present, what forms they take, what regulatory styles they represent, and how they are perceived by farmers of leafy greens. I will also examine the field-level practices farmers have instituted to respond to food safety requirements, and assess the environmental impact of such practices. Throughout my analysis, I will explore how the differential value placed on direct care of environmental health evidenced by different types of food safety standards reflects food corporations' environmental "license to operate", and the tenor of the surrounding public regulatory style.

Chapter 3: Impacts of Regulatory Style on Farmer Experience and Farming Practices

Introduction

This chapter presents the results of my comparative exploration of state and non-state regulation of food safety risks in leafy greens production in the United Kingdom and the United States, and an examination of the social and environmental impacts of those food safety controls. In this analysis, I will consider differential models of food safety assurance and actual measures of farmers' practices as a means of tracing the landscape impacts of varying approaches to food safety management.

I will begin by providing background information on the structure of the lettuce industry in each nation and similarities and transnational differences between supply chains, methods of production, and incidence of foodborne illness. I will then present the public and private food safety controls included in my analysis, my hypotheses and methods, and the limitations of my study. I will report the results of my comparative surveys and interviews with leafy greens farmers, regulators, retailers and researchers across the US and UK, identifying to the extent that I can the impact that differing state regulatory styles and non-state food safety controls may be having on field-level food safety practices. I will organize my results into insights at policy level, focusing on my study of state regulatory frameworks and legal instruments, and at industry level, using data gathered during my comparison of standards via their audit checklists.

I. Comparing US and UK Lettuce Production

For this analysis, I will consider the production of fresh leafy greens for domestic consumption in the United States, and United Kingdom. Comparative agricultural statistics are provided in Table 3.1 below. The relative locations of main lettuce cultivation areas in each region are detailed in Figures 3.1 and 3.2.

Figure 3.1: Major Lettuce Producing Areas of California
California (dark gray)

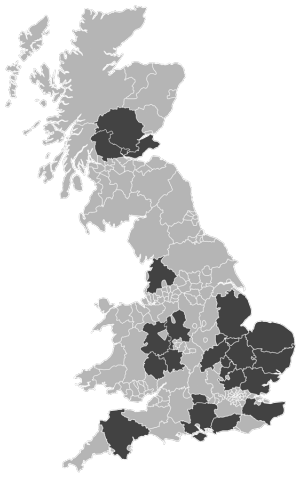

Figure 3.2: Major Lettuce Producing Areas of the contiguous United Kingdom (dark gray)

Table 3.1: Agricultural Comparison: United Kingdom and California

Lettuce Industry	CA	UK
Value of domestic fresh vegetable sector:	8.85 billion USD [3]	2.12 billion USD (2016) [2]
Value of domestic lettuce sector:	1.96 billion USD [3]	203 million USD [2]
Quantity of lettuce for sale in-state/in-country:	3.36 billion kg (2016) [1]	135.5 million kg [4]
Area in leafy greens production:	210,700 acres (2016) [1]	15,877 total acres [4]
General Agriculture	**CA**	**UK**
Land mass:	163,696 square miles	94,058 square miles
Land in agriculture:	25.5 million acres [3]	45.6 million acres (2014)
Value of agriculture industry	47 billion USD [3]	34 billion USD (2014) [6]
Number of farms:	77500 [3]	218,000 (2016) [2]
Average farm size:	329 acres [3]	210 acres (2016) [2]
Structure of industry (farm size):	65% under 49 acres [7] 14% 50-139 acres 7% 140-259 acres 15% 260 or more acres (2012)	37.7% under 49.4 acres 21.1% 49.4-123 acres 17.2% 123-247 acres 23.9% over 247 acres [2]
Average age of farmers:	58 years old (2012) [7]	59 years (2013) [5]

All data are from 2015 unless noted. Only finalized figures have been used.

1 United States Department of Agriculture 2016 State Agriculture Overview

2 Agriculture in the United Kingdom 2016

3 California Deprtment of Food and Agriculture 2015-2016 Agricultural Statistics Review

4 Department of Agriculture, Food & Rural Affairs Horticulture Statistics Dataset 2016

5 European Union Farm Structure Survey 2013

6 Department of Agriculture, Food & Rural Affairs British Food and Farming at a Glance 2016

7 United States Department of Agriculture 2012 Census of Agriculture

In the United States, 99% of lettuce consumed is grown domestically, and California produces roughly 75% of the nation's supply of leafy greens.[1] California's agricultural industry is one of the most valuable in the world, at US $8.85 billion in 2015, of which 1.96 billion is attributed to lettuce and other leafy greens (CDFA 2017). Leafy greens are typically grown along California's central coast where mild weather permits their cultivation during most of the year. During winter months, the neighboring state of Arizona produces much of the nation's supply, often through the same management companies and contractual grower networks that source from California during the rest of the year. When landholdings are held by one corporation in both areas, upper level staff and harvest crews move to Arizona for the winter articulation of the supply chain, in order to continue producing without weather-related interruptions. As with much of California agriculture, California's leafy greens farmers for the most part tend to operate either relatively small farms, or very large farms, with fewer farms operating at middle scales (Guthman 2014). This is in part due to the legacy of California's historical agricultural development, in which agriculture was from its inception focused on large-scale for-profit production. Many smaller farms exist today in part because of the alternative agriculture movement that has been active in California since the 1970s, but the central coast area is known as "the nation's salad bowl" because of the very large corporately-owned farms that dominate the agricultural market of the state and operate on an industrial scale using hired labor (McWilliams 2000; Freidberg 2009; Guthman 2014). Lettuces are most often harvested by machine, and harvested products typically go from the farm to a processing center where they are washed,

[1] US leafy greens production is highly seasonal. Together with Arizona, which produces leafy greens during the coldest 3-4 months of the year, California produces upwards of 98% of the United States' domestic supply of fresh leafy greens (Geisseler and Horwath 2016).

together with other similar products, and then enter the retail supply chain or the wholesale market for shipment out of state.

The UK lettuce industry is considerably smaller than the California lettuce industry, affecting many aspects of the supply chain that will be considered in the remainder of this chapter and Chapter 4. Lettuce cultivation in the United Kingdom also works slightly differently, and some of these differences will be explored in greater detail in my Industry Level results later in this chapter and explained in Figures 3.4 and 3.5. The UK fresh vegetable industry was estimated at a value of $2.12 billion in 2016 (DEFRA 2017), of which 203 million comes from the cultivation of lettuces and other leafy greens. In the UK, climate allows leafy greens to be produced across much of the area of England and Scotland throughout the warmer months of the year, while wintertime leafy greens supply most often comes from Spain, Italy and the Netherlands. Compared to California, farm sizes are distributed more equally between size categories, with an emphasis on smaller farms. Some UK leafy greens farmers have responded to economic pressures of market competition by banding together into grower associations, in which family-owned and -operated farms continue to produce goods but do so in mutual association in order to benefit from centralized marketing efforts and collective economic of scale.

Comparative Sources and Rates of Foodborne Illness

Data for foodborne illness always contain some degree of uncertainty due to the post-hoc nature of outbreak data collection. Many incidents of intestinal disease go unreported. For those that are reported, it is not always possible for monitoring authorities to be entirely certain which pathogen was responsible, whether it came from food or another source, and which food vehicle among many was ultimately at fault. Reports are sometimes missing data, and personal information from infected individuals can contain omissions, mistakes, or recall bias. When food vectors can be identified and a pathogen confirmed, there is often still some degree of uncertainty over whether the pathogen originated on the food itself or was introduced from elsewhere via contact with other people or surfaces during handling and preparation. In some cases, more than one pathogen is implicated, or more than one food type is the likely source. Estimates of overall disease burden contain additional uncertainty because they must be extrapolated from observed reports of illness by adjusting for expected reporting rates. While individual point estimates contain these and other known and expected sources of uncertainty, it is possible to examine overall aggregate trends.

In 2014, the UK's Food Standards Agency (FSA) released the results of an in-depth national study of the domestic burden of infectious intestinal disease (Tam et al. 2014). From roughly 500,000 cases of food-related intestinal disease observed over a one-year period from mid-2011 to 2012, the researchers identified the share of disease burden belonging to 19 pathogens, across 12 food commodity vectors. This FSA-funded study represents the best effort so far to reduce uncertainties using information from a meta-analysis of other disease source identification studies from nations broadly comparable to the UK in terms of general population health and public health monitoring systems, mathematical modelling, and expert consultation. According to these health statistics, the food class responsible for the biggest proportion of foodborne illness in the UK is poultry, at over 50% of illnesses. Red meats and produce are next most associated with illness, at much lower rates. The pathogens responsible for most hospitalizations and visits to physicians are *Campylobacter, Salmonella,* and *E.coli* (Tam et al.

2014). Previous large-scale analysis of public health data and research had placed the UK incidence of foodborne intestinal disease at nearly 2.5 million cases annually in 1992 and just over 1 million cases annually in 2000, showing an overall trend of improvement in public health outcomes (Adak et al. 2002) which this latest study continues.

In the US, it is estimated that risks from produce have been rising over the last several decades, increasing from 1% during the 1970s to as much as 12% during the 1990s (Lynch et al 2009). A largescale study of foodborne pathogenic illness from 1998 to 2008 found that 46% of foodborne illness during this time period was attributable to produce and especially to leafy vegetables, followed at 22% by red meat and poultry (Painter et al 2013). These increases most likely represent a combination of factors including but perhaps not limited to increased produce consumption, more prevalent aggregation and processing steps, and changes in pathogen presence around livestock operations that may contaminate nearby produce (Karp et al. 2015). The most recent national US public health records maintained by the Center for Disease Control (CDC) still implicate plant foods in 9.4 million reported cases of intestinal illness yearly, from which extrapolative estimates place the total actual number of foodborne illnesses at 47.8 million cases per year (Scallan et al. 2011). Norovirus is credited with causing the largest number of illnesses and deaths in the US each year, while *Salmonella*, *Campylobacter*, *Toxoplasma* and *Listeria* are responsible for the largest numbers of hospitalizations and deaths. The United States Food and Drug Administration (FDA) undertook an analysis of CDC outbreak data from 1996 to 2010, yielding 131 outbreaks from fresh produce in which it appeared likely that contamination had specifically occurred during growing, harvesting, manufacturing, processing, packing, holding and transportation of foods (FDA 2014). This research drove the establishment in 2011 of new national legislation instituting stronger preventive controls for food safety during primary production.

Comparison suggests that population-adjusted foodborne illness rates as of 2000 were as much as 11 times higher in the US compared to the UK, although data interpretation uncertainties were noted from the difficulty of source identification, and national differences in reporting rates and disease severity may reduce the gap in overall foodborne illness burden (Adak et al. 2002). Notably, the food sources associated with illness in the UK are meats and poultry, while in the US plant foods are the highest source of risk, especially leafy vegetables.

Research Priorities in Comparing the US and UK Food Safety Regulatory Landscape

Research has offered somewhat mixed results so far as to whether standards instituted by private commercial entities can in fact create real change in the behaviors of their agricultural product suppliers. A study of food safety standards in UK, Canada and Australia concluded that the initial reasons for adoption of food safety standards—whether crisis-driven in response to outbreaks of pathogenic disease as in UK, or prevention-driven as tools for avoiding trade disputes as in Canada and Australia—significantly shaped the type of private and/or public solutions sought (Hobbs et al. 2002). A recent study of sustainable practices among produce and flower suppliers in South Africa concluded that one specific company-led eco-standard successfully created measurable improvements in environmental practice among suppliers (Thorlakson et al. 2018). More such evaluations are needed, tracing the impacts of standards at state and private level, and their potential to drive change in social and ecological outcomes.

Additionally, the challenge presented by overlapping and sometimes conflicting sets of requirements at state and private level has been noted by many scholars (Henson and Caswell

1999; Fulponi 2006; Henson and Humphrey 2009, 2010; Berman et al. 2013; Mei Soon and Baines 2013; Karp et al. 2015; Baur et al. 2016), yet efforts to harmonize this landscape of standards have not made significant progress. The presence of multiple private standards in one marketplace may act to fragment regulation of markets and further undermine harmonization efforts by creating additional parallel sets of prescriptive expectations (Henson and Humphrey 2009). In the early 2000s, the Global Food Safety Initiative (GFSI) benchmarking scheme sought to advance harmonization efforts by determining equivalency between standards and allowing existing diverse standards to be accepted as common currency in global marketplaces (GFSI 2011). Few studies have yet addressed the cumulative impact on farmers of following many overlapping food safety requirements from both state and non-state level, and the impact of benchmarking efforts (Berman et al. 2013; Mei Soon and Baines 2013). Research is needed to explore relationships between private standards, the perceived pressures and constraints they generate for farmers, and resulting changes in land management decisions (Karp et al. 2015; Baur et al. 2016). I sought to illuminate this area of research and international environmental governance scholarship through my comparative case.

At the conclusion of the previous chapter, I explored the network of state, non-state and hybrid food safety controls currently active for fresh produce grown in California and the United Kingdom. Table 2.2 provided a complete overview of food safety standards active in US and UK lettuce production. For my comparative study I will examine a subset of these standards, as listed in Table 3.2 below. Some standards imposed by retail or food service buyers of leafy greens products take the form of internal risk assessments that are used by the retailer or food service outlet as a barrier to entry for riskier suppliers, but which do not constitute full standalone produce production standards that seek to shape farmers' practices. Such standards often require that prospective suppliers obtain produce safety certification from one or more external private standards operating at the national or international level before seeking to become a supplier. In order to contribute to scholarly efforts to analyze private standards separately from these sorts of risk assessments, instruments such as these were not considered in my analysis. My analysis rests instead on an examination of the full standalone standards most often referenced by these risk assessment tools as pre-requisites for initiating a supplier relationship. Additionally, two of the standalone standards were excluded from the analysis: Marks & Spencer's 'Field to Fork' was excluded entirely because an audit checklist could not be obtained for review, and GlobalG.A.P. was excluded from analyses of farmer opinions and practices because only four farmers in my survey results for either nation claimed to carry this certification.[2]

[2] There may be many reasons for this result. Firstly, GlobalG.A.P. is most useful to farmers who wish to sell their products on international markets. Because I was interviewing farmers who sold to domestic retailers and processors, and my research did not investigate transborder trade, GlobalG.A.P. did not appear to have penetrated these private standard ecosystems to the same degree as it has affected international produce networks. Additionally, farmers in my surveys gave a range of responses when asked to provide the names of food safety certifications they carry, and their responses revealed that certain certifications were considered more important, rigorous, or worthy of mention than others. The decision-making process involved in how these responses were given was not a core focus of my research, so I cannot comment as to how those decisions were made or why. However, I was aware that in some cases, certifications that were considered analogous or assumed were not readily mentioned, and I sought from the beginning of my research to standardize reporting of certifications as much as possible to avoid such omissions. Nevertheless, the chance remains that some farmers may not have given a complete list of certifications they hold, despite my specific requests.

Table 3.2 Sampled State, Hybrid and Non-State Produce Safety Controls		
	US (CA)	**UK**
State	•Federal Food, Drug and Cosmetics Act (1938) (FD&C Act) •Food Safety Modernization Act (2011) (FSMA) •USDA Harmonized GAP standard (2015, 2018)	•Food Safety Act 1990 (and Amendment Regulations 2004) •Regulation (EC) No. 178/2002 (EU General Food Law) •Regulation (EC) No. 852/2004 (Hygiene of Foodstuffs)
Hybrid	•CA Leafy Greens Marketing Agreement (2013, 2015, 2018)	•Red Tractor Assured Fresh Produce Standard (2014) •BRC Global Food Standard issue 7 (2014)
Non-State	•GlobalGAP Fresh Produce Standard v.5, v5.1 (2015, 2017)	•Tesco NURTURE 10 (2010) •LEAF Marque v.13 (2015) •GlobalGAP Fresh Produce Standard v.5, v5.1 (2015, 2017)

Table 3.2: Comparison of State, Hybrid and Non-State produce safety controls examined in this study

Research Questions for My Comparative Case

When embarking on this research, I was motivated by a number of questions including, but not limited to: What social effects does lettuce production under the current regulatory framework have on US and UK lettuce producers, and how do those effects differ between the two nations? What can the differential value placed on direct care of environmental health evidenced by different types of food safety standards tell us about food corporations' environmental "license to operate" in each location? How are overlapping regulatory approaches to food safety perceived similarly or differently by US and UK lettuce farmers? What field-level practices have farmers instituted to respond to food safety requirements, and what form do those requirements take? When private standards are more prescriptive than locally applicable public law and policy, how does this impact producers?

Hypotheses

Policy Level (State)

H1. State food safety controls in the UK will show greater use of process-oriented requirements than those in the US, owing to the cooperative style of regulation common in the EU and its member nations and the command and control style of regulation common in the US.

H2. Food safety management will show a more holistic environmental flavor under EU oversight in the UK than in the US regulatory context, because of transatlantic differences in application of the precautionary principle and the incorporation of environmental conservation goals at higher levels in the EU than the US.

H3. When compared to the regulatory example of California, the UK's "due diligence" framework will show evidence of incentivizing more broadly-conceptualized food safety controls that incorporate a broader understanding of potential sources of risk, as shown by specifics in the laws.

Industry Level (Non-state)

H4. Non-state food safety controls operating in the UK will also view food safety more broadly and show greater use of process-oriented requirements than non-state standards operating in the US.

H5. A greater focus on prescriptive rules as a regulatory style in produce standards will be associated with more negative farmer opinions of the certification process, and lesser confidence in the safety of produce.

H6. Farmers certified to standards with more environmental clauses and/or more process-based clauses will be more likely to engage in environmentally-friendly land management approaches, while remaining more satisfied with the food safety regulatory process and its effectiveness than their counterparts operating under standards with more prescriptive clauses and/or more clauses devoted to a singular goal of food safety.

Methods

The results presented here represent a combination of personal interviews and archival research, conducted during field research between 2014 and 2017 in multiple locations across California, and the United Kingdom. I report here the results of two different survey efforts. The first survey, piloted and released in 2014 to members of the California Farm Bureau Federation, yielded data for forty-nine California lettuce growers as part of a larger survey effort covering 965 California growers of a range of crops[3]. This survey was designed to update prior scholarship examining food safety measures among California farms since 2007. For the purposes of my research, I conducted five additional in-depth interviews with California farmers, two with regulators, and three with academic researchers to contextualize the results of that broader survey and inform my analyses of the responses of lettuce farmers who took part. The second survey reported here includes data from twenty-one in-depth interviews I conducted with UK farmers of leafy greens, designed to mirror the structure and topics of the survey delivered to California farmers. Further information is provided by nine additional in-depth interviews with representatives of major UK grocery retailers, academic researchers, farmers' trade associations, and food safety regulatory personnel, conducted in the United Kingdom between Summer 2014 and Spring 2016. In-depth interviews during both research efforts followed a semi-structured format tailored to each interviewee's unique position of knowledge within the food system, focused on elucidating the mechanisms behind how decisions are made at both the regulator and food retail industry level, what food safety and environmental pressures farmers experience, and in what ways differential value is placed upon food safety goals and environmental outcomes.

Both farmer surveys contained approximately 30 questions, ranging from farm area and crops grown, to perceptions of the food safety regulatory framework, to field level management practices in place for food safety or for the promotion of environmental protection. Full interview questionnaires for my California and UK survey efforts can be found in Appendices I and II, respectively. To understand the social impact of overlapping state and non-state food

[3] Full results of the 2014 survey of California produce growers were analyzed and published independently (Baur et al. 2015) and do not appear in this volume. For the purposes of this dissertation, I present here the analyses that I accomplished independently using a subset of those data, along with supplemental California farmer interviews that I completed subsequently and which were not affiliated with the 2014 survey.

safety controls, respondents were asked to specify what, if any, food safety certifications they currently held, and how they felt about the certification process and the public regulatory landscape around food safety. Farmers were additionally asked to assess which actors in the lettuce supply chain held the most power in setting field-level farmer practices, and in shaping the overall food safety regulatory landscape. Field level production practices were analyzed quantitatively, by assigning each farmer scores for food safety and environmental conservation. Interviews conducted in person followed the general structure and questions of the survey questionnaires, while also incorporating additional questions and further exploration of survey topics led organically by interviewees' interests and expertise.

To supplement data from interviews and survey results, I also present insights from an analysis of regulatory styles found in state and non-state food safety controls. To compare methods of state regulation of food safety across the United States and United Kingdom, I evaluate the most relevant food safety laws in each nation for their regulatory style and topics of primary focus. To illuminate the landscape of non-state food safety standards, I present a comparative analysis of the structure and written requirements of eleven produce safety standards operating across the UK and California. Each standard was evaluated through its certification audit checklists, by assessing each audit clause or certification criterion within the standard for its topic focus (environment, food safety, or both) and its regulatory style (prescriptive or process-based), enabling a quantitative comparison between standards. To compare the regulatory landscape emerging from the overlap of these state and non-state controls, I compare the approaches of both private and public food safety controls by organizing them into four categories based on focus and style. The results of these comparisons are presented graphically in the sections that follow.

Limitations

Because the two farmer surveys summarized in this dissertation were conducted during separate field seasons and survey efforts, the total number of respondents for each survey is not equivalent. Twenty-one UK leafy greens farmers were surveyed, compared to 49 US farmers. These differences reflect differences in response rate, as well as limitations due to amount of time in each location and different recruitment methods. In addition, because participation in data collection was entirely voluntary on the part of farmers, not all survey respondents chose to answer all questions on the survey, with the end result that the number of responses analyzed from each respondent group varies slightly from question to question on both surveys.

Survey questions themselves also differed in some respects between my US and UK surveys. The survey instrument used for UK farms used slightly different language from that used in California, an intentional step designed to adjust for local differences in terminology related to various practices, as well as different local concerns, local policy bodies, and local supply chain structures. As a result, some information is reported for only one study population, and any comparisons of non-parallel data types will be clearly noted. Additionally, all reasonable efforts were made to ask questions in locally appropriate language and terminology for each study population, resulting in slight variations in wording between the two surveys. Rather than increasing differences between the surveys, these adjustments were intended to reduce variation resulting from differences in language, and to ensure that variation observed was a faithful representation of actual practice and actual perceptions of governance institutions.

This study focused on evaluating public and private standards and their impacts on farmer practice and farmer decision-making as a result of produce standards and regulations. Because my focus was on *farmer experience, and farmer decisions in the realm of environmental conservation*—the ultimate outcome of multiple overlapping governance forces as seen by farmers rather than by regulators—I did not specifically investigate details of how the pre-regulatory risk assessment scheme Red Tractor Assured Produce and the industry-led harmonization effort by the British Retail Consortium (BRC) may influence the form that public regulation takes in the UK, or the articulation of public and private regulatory processes. Rather, I have evaluated those two standards at face value as component standards within the regulatory landscape, because that is how farmers experience them. For similar reasons, I have compared the explicitly pro-environmental Linking Environment And Farming (LEAF Marque) standard alongside other non-state food safety controls with fewer explicit references to environmental conservation because farmers indicated that they regard LEAF as a safety standard comparable to any other I examined. My analysis acknowledges and aims to engage these differences as a meaningful indication of how environmental conservation is valued by a range of food safety controls active simultaneously in the lettuce production market.

II. Results at Policy Level

Influence of Regulatory Style on Food Safety Governance

As a starting point for my comparison, I examined the state regulatory frameworks in place for produce food safety in the United Kingdom and United States. At the time of this research, the UK was a member of the European Union, meaning that national food safety regulation in the UK is shaped by EU requirements, and vice versa, in a shared governance arrangement that incorporates a multi-level strategic bargaining process and two-way transfer of priorities (Barling 2004; van der Meulen 2013). The top levels of EU food safety regulation take two different forms: regulations and directives. Regulations apply to member states directly, without any need for member states to create local interpretations. Directives, conversely, are general guidelines which member states must adapt to local contexts and implementation systems. Food safety goals are articulated here as broad principles which are meant to guide member states' actions as they construct action plans specific to their industries and local administrative authority structures. Action plans must fit within the broad principles set forth by European Food Safety Authority (EFSA), but must put them into practice by providing enforceable local regulatory specifics.

Beginning at the highest levels of state regulation applicable for leafy greens production in the United Kingdom at the time of this research, European food safety rules are presented in Reg EC No 178/2002. This regulation standardizes food safety goals and definitions for EU member states and forms the backbone of the European food safety system. The regulation does not specifically address food safety concerns in individual foodstuffs or their respective supply chains, but rather focuses on establishing basic terminology and expectations, along with the procedure to be followed in cases where problems are known or suspected. The regulation's stated goals of "a high level of protection of human life and health and the protection of consumers' interests, including fair practices in food trade, taking account of, where appropriate, the protection of animal health and welfare, plant health and the environment" (EC No 178/2002, L31/8) makes explicit mention of a range of parallel goals that must be considered as part of

food safety, including environmental health. Use of the precautionary principle is explicitly defined as a guideline for maintaining the safety of the food supply, along with risk analysis. Food businesses such as producers, processors, and manufacturers and retailers of food items are stated as the ideal controllers of food safety because of their proximate knowledge of any risks and appropriate solutions. Traceability is also elaborated as an important prerequisite of ensuring safe food. Article 18 of the regulation reads "The traceability of food, feed, food-producing animals, and any other substance intended to be, or expected to be, incorporated into a food or feed shall be established at all stages of production, processing and distribution." (EC No 178/2002, L31/7)

UK food safety regulation within this European framework is layered beneath EU controls and is predicated on the UK's 1990 Food Safety Act. The law makes no mention of produce or specific pathogens, following instead the general style of EC regulation in setting goals, definitions and procedures to be followed in the event of a problem. Section 7 of the act names as an offense "rendering food injurious to health" (UK Food Safety Act 1990).[4] In cases where food has been sold that is injurious to health, the state can prosecute the provider of that food item (the end producer or retailer) under the law. Several defenses are listed which can absolve a food business of criminal responsibility, most notably the defense of due diligence, defined as "a defence for the person charged to prove that he took all reasonable precautions and exercised all due diligence to avoid the commission of the offence by himself or by a person under his control" (UK Food Safety Act 1990 Part II section 21). A subsequent law, the Food Standards Act 1999, established the UK Food Standards Agency (FSA) and outlined its role as the controller of food safety within the United Kingdom.

Pursuant to these two acts, the FSA has released numerous factsheets and guidance documents interpreting the 1990 Food Safety Act for owners of food businesses. In a 2009 guide for food businesses, FSA presents examples of situations and actions that the 1990 Food Safety Act would apply to, and explains that the concept of due diligence is designed to protect both consumers and businesses. In their words, the due diligence defense is "designed to balance the protection of the consumer against defective food with the right of traders not to be convicted of an offence they have taken all reasonable care to avoid committing" (FSA 2009, p.14). The FSA factsheet *Monitoring microbial food safety of fresh produce* released in 2010 contains basic information on the names and risk factors for certain food pathogens with guidance for produce farmers in avoiding or reducing the potential for pathogen transmission through food products. The document emphasizes that there are "no statutory criteria for indicator bacteria on unprocessed fresh produce" (Monaghan and Hutchison 2010, p.11) and thus no specific microbiological targets that are required by law for fresh produce. Readers are directed instead to an EU statute that contains comparable guidance for irrigation water as a general reference point. Key practices recommended for maintaining microbial safety in produce include the use of potable water for irrigation, regular testing of water sources, avoiding the application of raw un-composted manure on crops that are typically eaten uncooked, and minimizing the degree of contact between irrigation water and the edible portion of crops.

[4] Demeritt et al. 2015 have pointed out that unlike other types of public injury avoidance in the UK (e.g. occupational injury), UK food safety regulation has been focused on total avoidance of failures, rather than avoidance only to an optimum level beyond which reduction would be too costly to implement. The influence of EU regulatory norms in this space has been to intensify the older, less risk-based focus of food safety regulation by upholding 19th century target-based commitments such as ensuring that food is "safe" in an absolute way, and not "injurious to health."

In comparison, in the United States, government food safety is managed through a similarly multi-level array of federal, state and local bodies, with requirements that become more specific and enforcement-oriented at local levels. At the federal level, the US Food and Drug Administration (FDA) establishes rules and sets general regulations that apply to all producers in all US states. In California, the California Department of Public Health (CDPH) and California Department of Food and Agriculture (CDFA) undertake guidance, inspection and enforcement of these federal rules at the state and local level.

The US regulatory framework for food safety in fresh produce begins with the 1938 Federal Food Drug and Cosmetics Act (FD&C Act), which established the United States Food and Drug Administration as the controller of food and drug safety at the federal level. The FD&C Act and its amendments prohibit "the introduction or delivery for introduction into interstate commerce of any food, drug, device, tobacco product, or cosmetic that is adulterated or misbranded" (FD&C Act §331), in which adulteration may include the presence in food of "any poisonous or deleterious substance which may render it injurious to health" (FD&C Act §342). In 2011, a significant change to the FD&C Act came in the form of the Food Safety Modernization Act, Pub. L. 111-353 (FSMA). FSMA amended the FD&C Act to expand the power of FDA to regulate *how* foods including fresh produce are grown, harvested and processed. FSMA's Section 105: Standards for Produce Safety called for the creation of a rule providing sufficient flexibility to be applicable to various types of entities engaged in the production and harvesting of fruits and vegetables that are raw agricultural commodities" (FSMA §105).

In 2015, pursuant to the Food Safety Modernization Act of 2011 (PL 111-353), FDA released the final version of its *Standards for the Growing, Harvesting, Packing, and Holding of Produce for Human Consumption* (hereafter referred to as the Produce Rule). The rule represented the first time that federal regulations had included a field-level safety standard for fresh produce, marking an extremely hands-on and top-down form way of controlling how food is grown. In response to FDA analysis of CDC data indicating that many food safety problems enter the supply chain during primary production and early handling and storage of fresh produce items (FDA 2014) the Produce Rule was designed by FDA to refocus food safety mitigation efforts on prevention rather than reaction, through the establishment of science-based minimum standards for produce safety. Key practices required by the Produce Rule include testing requirements for irrigation water, recordkeeping requirements, standards for the timing of compost application, worker health and hygiene requirements, equipment and facilities requirements, and specific limits for *E.coli* levels in irrigation water with zero detectable *E.coli* in water that washes or contacts edible portions of crops (FDA 2015). At the state level, CDFA has released guidance documents and electronic resources which interpret relevant FSMA subsections, providing guidance through a range of public-facing programs which aim to "educate then regulate" (CDFA Produce Safety Program) toward full compliance with the law. Enforcement of federal statutes is accomplished through partnerships between state and federal agencies.

Structurally, these two approaches to regulating food safety through state regulation are broadly similar. Both UK law and US law include regulatory goals at multiple levels, with the highest level setting out general objectives and definitions in the pursuit of safe food, and lower levels providing specifics and interpretation of statutes for on-the-ground implementation and enforcement. Both approaches also contain similar language setting out the targets of food safety regulation in absolute terms such as "safe food," which explicitly seek to avoid threats, rather

than reducing them to an acceptable level.[5] However, the UK's legal framework under EU law contains an explicit focus on use of the precautionary principle in regulation, and specific requirements relating to traceability, both of which are not emphasized to any comparable degree by US laws. Differences also exist in overall style of the regulations. The EU level contributes a strong emphasis on cooperative process and stakeholder education, and stresses the importance of food businesses as the actor group closest to the problem of food safety and therefore best situated to solve it. The regulatory model evidenced by the UK's due diligence framework acts to protect food businesses from threats beyond the realm of reasonable caution. In this sense, the UK is relying on a liability framework for risk management in fresh food products, something that sets UK food safety management apart from US food safety management through direct regulatory standards.

FSA operates through an arm's length relationship with food businesses, in which it is tasked with regulating their actions through audits and inspections but does not have the power to directly enforce or prosecute. Rather, FSA oversees the activity of local city and district governments (councils) who act as food safety enforcement bodies. These Local Authorities (LAs) employ auditors and inspectors who visit food producers to ensure that production standards are being met and hygiene requirements are being followed by food businesses. The central FSA as a result tends to communicate in the form of guidance, with control of deployment devolved entirely to the local level. This arm's length arrangement can make it challenging for FSA to direct activities at local level, but it also allows for general principles to be more effectively tailored to local or regional concerns. In comparison, the US model contains similar efforts toward cooperative education-based regulation, but at a lower level. Collaborative efforts to educate at the state level are still backgrounded by the context of inspection and punitive sanctions from federal level.

Influence of Regulatory Style on Breadth of Food Safety Approaches

From my research, The UK "due diligence" defense framework embedded in the UK's 1990 Food Law appears to structure responses to food safety concerns differently than the US focus on regulatory mechanisms for holding producers accountable. Based on my data, the effect of this provision has been to motivate a deep and broad care for food safety risks, first at the level of the largest retail corporations, and then downward along the supply chain. It is *deep* because suppliers and retailers know that they are legally responsible for being circumspect in their attention to risks, and *broad* because attention is focused on a broad suite of potential sources of risk, rather than zeroing in on only one source (e.g. pathogens). This breadth was evident in my interviews when suppliers and retailers spoke of risks from pesticides in the same breath as they mentioned risks coming from pathogenic agents in food. Food safety risk in the UK is thought of as coming from a wide variety of sources. In addition, many UK interviewees at both policy and industry level commented to me that food safety and environmental health are seen as linked concepts, in that a healthy environment is perceived as generating safer food.

[5] Scholars have echoed this point for many years as Spencer Henson and Julie Caswell did when they noted that public regulation is often through target-based standards that make pronouncements, for example declaring that food must be "safe" and providing a definition of safety, rather than a rationale for deciding what degree of safety is safe enough to be worth the financial and bureaucratic costs of regulation (Henson and Caswell 1999).

> "Safety and the health of the growing environment… at a basic level, it's really the same thing, wouldn't you say? Impossible to have one without the other. They're two sides of a coin and I think the guidance we create for industry reflects that." – UK regulator

> "Food safety and the environment cannot be separated. They go hand in hand." – UK researcher

> "Our site has to meet a basic government-defined level of cleanliness and food safety, but beyond that it's about what the retailers demand. There are quite a few rules around things like pesticide use, for example. The max residue limits are set by a combination of EU law and UK law and we're held to account for those along with microbiological threats." – UK farmer

> The approach we've taken is that clearly there are things farmers can do to control pathogens. But there are many other kinds of risk beyond pathogens, like worker health and safety, or environmental management, or even animal welfare. The reality is that what you might do to address those things usually has a positive impact also for reducing pathogens, so it reduces risks across the board." – UK Trade Association representative

Conversely, US suppliers and retailers have a much narrower focus on pathogens, because that is where the majority of popular and regulatory pressure falls. Potential risks that are not spelled out as a requirement are not given attention, in the interest of satisfying existing regulatory requirements with the most efficient use of resources. In the absence of a "due diligence"-style legal mandate that incentivizes breadth, food producers under the enforcement model of the US have incentives to devote attention to only the requirements they have been specifically directed to meet. This style can be both narrower, and more rigid and prescriptive. Respondents I spoke with who had experience in both CA and the UK explained the differences like this:

> "In California, the way that auditing is done against the standards out there, it's quite focused on yes/no questions. Do you have this, do you not. Are you doing this, are you not. It's always been very check-box. Whereas in a due diligence defense system, it's very much 'ok you don't have it, but what do you have instead?' And if you can demonstrate that you've got this under control and it meets my requirements, you could still pass." – Private Standard Representative (active in both CA and UK)

> "I was at the conference in the states recently and people were talking about spraying malathion. Here in England we haven't been able to use that for years because of the enormous public health risk. And they were talking about spraying every 5 days… There's no way we'd be able to do that here. Maybe twice a season, and never malathion. From the American perspective, the acute health issue of pathogens is more important in the minds of the regulators than the chronic human and environmental impact of things like malathion." – UK regulator

In comparison, California farmers shared experiences of narrow checklists with very little flexibility:

> "We have a checklist and we can look at all these laws and regulations and try to put it into place exactly word for word but that's not realistic. For example, with FSMA, they're trying to blanket the whole produce dept. And, well, what works for citrus doesn't necessarily work for greens. But the audit can be the same on paper." – CA farmer

> **"**To some extent it depends on the auditor. A few that have been doing this for many years will look at something and say ok I see where you're going with this but you might want to combine these two logs or whatever, even though they aren't supposed to give recommendations per se. Most other auditors come in with a list of boxes to check off, and if you're not doing something, it's very black and white. A lot of times there's just not much we can do that's realistic. That's what we're up against." – CA farmer

The kind of public criminal codes and legal mechanisms underpinning the due diligence approach do exist in US law, and they may be experiencing a resurgence in active enforcement which is beginning to shift thinking among industry leaders. However, due to differences in legal structures, criminal justice systems, and underlying societal attitudes, the nascent criminal liability approach may be taking a much more punitive form in the US than it currently takes in the UK. In 2015 five employees from the Peanut Corporation of America were sentenced to federal prison terms (including one executive sentenced to 28 years in federal prison) for their roles in distributing salmonella-contaminated peanut butter products to institutional buyers across the United States in 2008-2009, causing nine deaths and 714 illnesses across 46 US States. This case is an example of a recent application in US law of the Park Doctrine (the Responsible Corporate Officer Doctrine, named after a corporate executive charged with a criminal infraction due to his position as the operator of unsanitary storage warehouses in a 1975 case) in US law, whereby an individual in a position of responsibility within a corporate entity can be held personally criminally liable for harms caused by that corporation's activities, even if it cannot be proven that the individual in question acted personally or knowingly as part of the wrongdoing. Although the executives sentenced in the case of the Peanut Corporation of America had knowingly sold contaminated products, the statute invoked in their trial could equally be used to convict an executive who should have known, but did not. This difference in the protections afforded to food producers signals a harsher and punitive framework, with fewer protections in place to allow retailers any measure of security should food safety violations happen despite rigorous controls.

Influence of Regulatory Style on Farmer Opinions of Food Safety Governance

The more protective nature of food safety regulation in the UK may partly explain why UK farmers I interviewed reported being more satisfied overall with the food safety governance landscape they experienced and having a more comfortable relationship with food safety auditors and with the audit process as a whole (Figure 3.3). They also reported a greater belief in the ability of safety standards to improve the safety of their produce. By contrast, US farmers reported less satisfaction overall with both private standards and the broader regulatory process, and reported mixed feelings about whether the food safety standards they follow are actually improving the safety of their products.

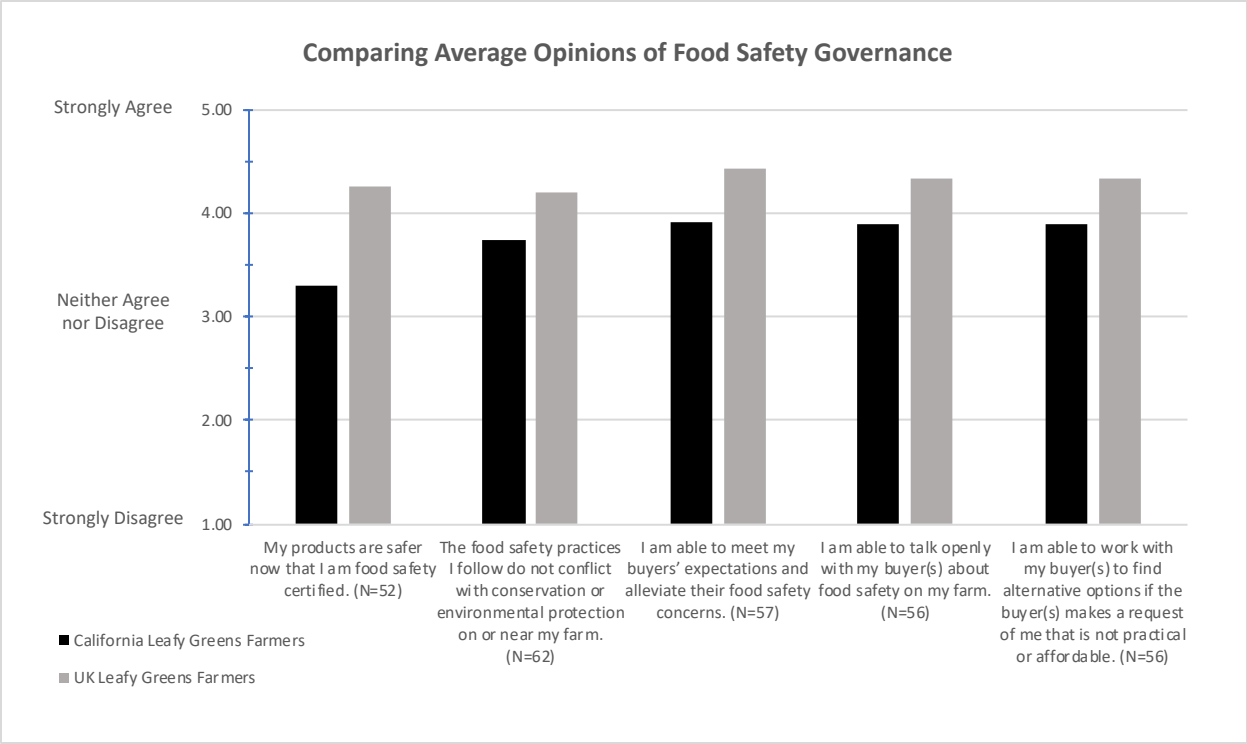

Figure 3.3: Comparison of average farmer opinions of food safety governance, by country.

CA farmers overall were highly critical of whether food safety rules actually make their products safer, while UK farmers believed more strongly that food safety rules do make their products safer. With 5 as "strongly agree" and 1 representing "strongly disagree", average responses for CA certified farms were at 3.3/5, while the average response for UK certified farms was 4.25/5.

III. Results at Industry Level

Structural Differences Observed Between US and UK Leafy Greens Industries

My research revealed structural differences between the two industries that create stark contrasts in how food safety risk is handled. Contrary to US farmers who most commonly sell to packer/shippers, UK producers most commonly sell directly to a grocery retailer (Figures 3.4 and 3.5). My farmer surveys illustrate this trend: None of the UK producers interviewed during my research reported selling their leafy greens to a packer/shipper. Instead, the majority sold directly to a grocery retailer, accomplishing many of the intermediate steps such as trimming and bagging while still in the field[6]. California leafy greens farmers, by contrast, are typically growers and harvesters only. They sell their products to intermediaries such as processors, pack

[6] It is not uncommon for leafy greens sold by both small grocers and major retailers in the UK to be packaged unwashed, in packaging that touts that fact as a mark of freshness. Farmers report that some buyers consider additional processing steps such as trimming, washing, and mixing to be unnecessary sources of additional food safety risk. Several smaller producers I interviewed indicated that they market some of their greens both ways, to cater to consumers who want salads that have been washed clean, as well as consumers who believe that the lowest risk salads are those that are as few steps away from the field as possible.

houses, packer-shippers, and wholesalers, with products changing hands multiple times between initial harvest and final sale to the consumer.

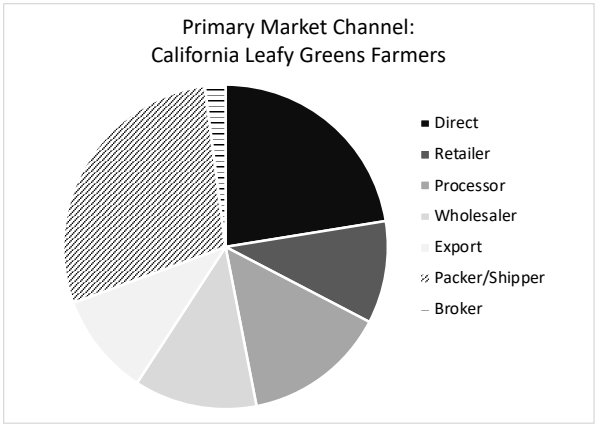

Figure 3.4: Primary Market Channel, California Farmers.

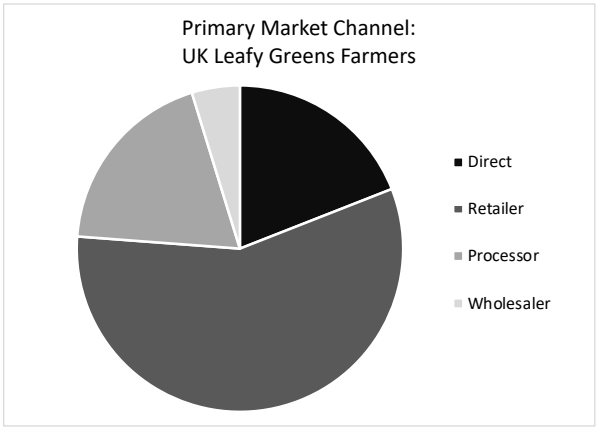

Figure 3.5: Primary Market Channel, UK Farmers.

This structural difference has direct implications for how food safety is managed, and which actor in the supply chain holds responsibility for achieving food safety outcomes. In California, the name on the package at time of final sale can reflect the grower, the packer, the wholesaler, or the grocery retailer, meaning that any or all of those entities could face legal sanctions and loss of reputation in the event of a food safety failure and an ensuing lawsuit. By contrast, UK producers often package leafy greens in the field during harvest and ship ready-to-sell produce direct to retailers, who market the produce under their own store brand. As a result, it is typically the retailer's name which appears on a leafy greens product purchased by a UK consumer, concentrating potential public responsibility for any food safety problems on the retail brand. In the words of one supply chain expert I interviewed:

> "For growers in the UK, the biggest pressure on them is from the supermarkets. Around 80% of British vegetable production goes through the multiples [supermarkets]. Not very much goes into wholesale or direct to consumers, so the retailers have a lot of power. They also feel very exposed. There's a lot energy spent on safeguarding the brand." – UK Regulator

> "Farmers in the UK are reliant on their retail customers interpreting rules and regulations for them… Because in this country it's the retailer brands that are on shelf, so it's the retailer's responsibility to protect their brand." – UK Trade Association Representative

My research suggests that the impact of this difference combines with the due diligence focus of UK public regulation, contributing to effects I observed relating to farmer experience of harmonization challenges between overlapping standards, and the breadth of risk management activities included by food safety standards of different types.

Farmer Experience of Overlapping Public and Private Standards

Farmers in both geographic regions complain that there are too many standards they must follow simultaneously, and a challenging lack of harmonization between different sets of requirements. My research reveals that in both locations, farmers feel negatively about the overlap and proliferation of private standards, but in CA, the structure of the leafy greens

industry creates more opportunities for overlapping standards to disagree. In the UK, the larger number of private standards still creates this possibility, but the structure of the industry eliminates the potential for industry buyers to impose different requirements than the prevailing private standards.

In CA, the Leafy Greens Marketing Agreement (LGMA) produce standard functions as its own private entity, not owned by government, by retailers, or by farmers. As a marketing agreement under US law, it invokes the inspection powers of the California Department of Food and Agriculture and the USDA to back its standard but sets and promulgates its own rules[7]. Because the standard is not operated by the downstream buyers and retailers in the supply chain, there is sometimes conflict between the requirements that buyers impose, and the requirements of the LGMA certification standards. Research indicates that CA farmers feel their buyers often impose requirements on them that are not part of private standards like the LGMA, let alone the background regulatory process (Karp et al. 2015). For example, some buyers in California went beyond the LGMA requirements, adding their own seemingly arbitrary requirements for leafy greens growers around allowed soil amendments and appropriate time intervals to be followed when harvesting land that had been exposed to floodwater during weather events (Lowell et al. 2010). In the UK system, the setters of private standards and the downstream buyers are the same entity; grocery retailers are by far the biggest buyers, and many have their own standards which suppliers must follow in addition to public regulatory rules. But because the retailers own and operate the standards, there is no time when the retailer as downstream buyer will specify different measures from what the relevant produce safety standard—in this case also created by the retailer—commands.

Examples of frustrated responses from multiple-certified farmers in both locations include:

> "There are too many standards now, and they overlap. If you look at the laws, we have two certifications with different audits. Those two should suffice. But the retailers want a point of difference between them so they each do their own one on top. Some standards even conflict with each other. [For example] one that we are certified under says that the field hands must wear gloves during harvest, and another certification we have says they must not wear gloves. So, in a case like that you have to compromise, by agreement with the customer." – UK leafy greens farmer

> "I used to jokingly call it the 'audit week from hell'. And during those four days, one auditor comes and audits me against all the different standards I need. We get the four certificates at the end of that. But it would be far more efficient if they could agree on some common standard between them rather than having so many." – UK leafy greens farmer

> "Well, there is the regulatory process, and then there is the marketing process that the large buyers and handlers have foisted on agriculture. There are far too many standards all at once. It can be very expensive. Most of the egregious pressure and bad results are from pressure originating from the buyers, the processors and the shippers, not the regulators. On that account, we are very dissatisfied with the response of the buyers to food safety concerns." – CA leafy greens farmer)

[7] Auditors are from CDFA, and are licensed by USDA, but independent of LGMA and the produce industry. LGMA requires 100% compliance, and the auditors must report any hazards or lack of compliance to state public health departments.

However, adherence to certain specific standards in my research was correlated with increased farmer satisfaction with the regulatory apparatus regardless of number of standards followed, suggesting that certain combinations of public and private requirements are more harmonious for farmers than others. These results are presented in more detail in Figures 3.8-3.11.

UK Private Standards View Food Safety More Broadly

Echoing results at policy level, the subset of standards that I examined indicated that food safety is managed in a more holistic way by private standards active in the UK than by those operating in CA. UK standards range more widely, often including additional values such as environmental health, social justice concerns, animal welfare, and chemical safety alongside food safety requirements. By contrast, US (CA) food safety controls follow a narrower focus on specific foodborne pathogens, and may contain few if any mentions of other concerns. This separated, piecemeal approach to ensuring diverse public goods encourages management of food safety goals in a vacuum, and my research supports the idea that this may pit different goals against one another rather than encouraging their mutual achievement.

Each of the eleven standards for which an audit checklist could be obtained were evaluated and categorized clause-by-clause according to two parameters: Style and Focus. **Style** was measured by how many of the audit clauses in each standard were prescriptive in nature (stipulating specific targets, specific wording that must be used, specific parameters that must be included, specific forms that must be filled out, or specific outcomes that must be ensured), vs. how many were process-oriented (requirements that a process must be followed but without stipulating the specifics of what that process must look like or include). **Focus** was measured by how many of the audit clauses in each standard were focused on achieving increased food safety, vs. how many were focused on achieving better environmental health. Explanatory examples of standard clauses and my coding rationale are detailed in Table 3.3:

Table 3.3 Coding Rationale: Style and Focus of Standard Audit Clauses

Standard	Standard Audit Clause	Style Code	Focus Code	Reasoning
USDA Harmonized GAP 2015	3.4.2: "Product that contacts the ground shall not be harvested unless the product normally grows in contact with the ground. "	Prescriptive	Safety	Clause stipulates a specific action that does not rely on interpretation or discretion. Safety is specified as the goal.
LGMA 2018	EA 13d: "If product was harvested, was a 30' (min) "no harvest" buffer from the high water mark established?"	Prescriptive	Safety	Clause stipulates a specific practice and exact measurement to be taken. Practice is designed to control pathogen presence.
USDA Harmonized GAP 2018	F-7.2: "If a soil amendment containing raw or incompletely treated manure is used, it shall be used in a manner so as not to serve as a source of contamination of produce."	Process	Safety	Clause requires a process be followed but does not stipulate the steps in that process. Food product contamination is given as the reason.
GlobalGAP v5	FV 2.1.1: "Is there a written justification for the use of soil fumigants?"	Process	Both	Clause requires a management system but does not stipulate its form. Process impacts both food safety and environment.
GlobalGAP v5.1	CB 7.5.1: "Is surplus application mix or tank washings disposed of in a way that does not compromise food safety and the environment?"	Process	Both	Clause requires a management process but permits the grower discretion in shaping that process. Both food safety and environmental purposes are noted.
Tesco NURTURE v10	6.2: "In product grading and packing operations, is the generated waste vegetable material recylced responsibly?"	Process	Environment	Clause requires an outcome rather than specific actions required to achive it. Purpose is to minimize environmental impact.
Red Tractor v3.0	EC.m.2: "Where an adviser advises on fertiliser usage a FACTS Professional Register number must be provided."	Prescriptive	Both	Clause stipulates a specific action to be carried out. The purpose is to ensure both food safety and environmental protection.
LEAF Marque Global v13.0	4.2: "Do you have a Manure Management Plan, and is it integrated with the Nutrient Management Plan?"	Prescriptive	Environment	Clause stipulates specific processes that are controlled by the standard-setting body. Parent section deals with environmental protection.

Any audit requirements assessed as having implications for both food safety and environmental health were coded as a separate, blended category, "Both". Coding robustness was verified by measuring intercoder agreement, comparing codes assigned to standard clauses by two independent coders, both of whom also coded a single standard more than once to establish reliability of coding for each individual. Intercoder agreement varied between 85-97% for standards compared.

From these data, I was able to graphically represent the differences between the standards. Figure 3.6 shows how the style and focus of audit clauses in each standard compare to similar standards examined in my sample. From this structural comparison, four distinct categories of standards emerged, detailed in Table 3.4 and Figure 3.7 below.

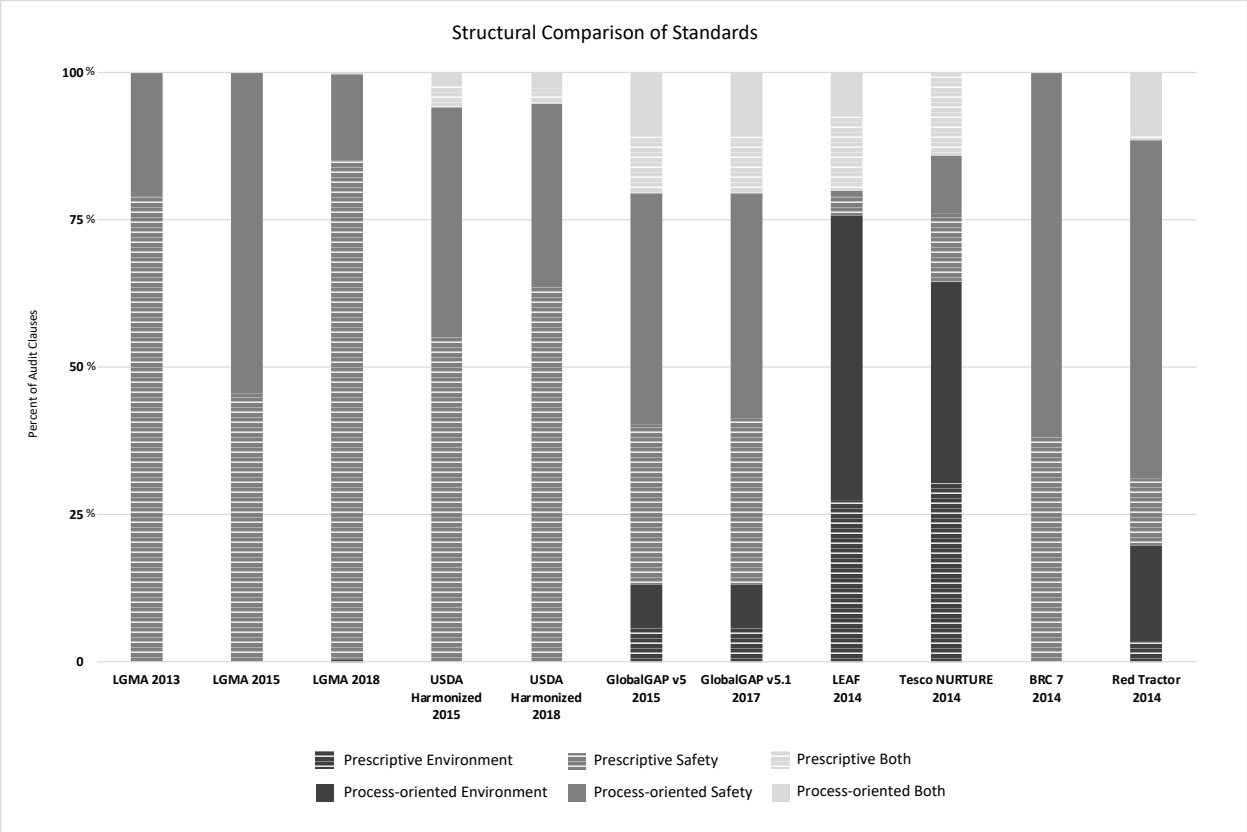

Figure 3.6 Structural Comparison of the Standards by style and focus of audit clauses.

Category 1: "Prescriptive Safety" is characterized by standards composed mostly of prescriptive clauses, and entirely based around a narrow focus on food safety. Category 2: "Prescriptive Safety Plus" is very similar to the previous category, but differs in that these standards include at least a small number of clauses with a broader view of combined environmental and food safety concerns, and process-oriented controls in addition to prescriptive food safety clauses. Category 3: "Flexible Safety" includes standards that use a significant number of process-oriented clauses, but still limit their coverage to a relatively narrow focus on food safety, while Category 4: "Balanced" includes standards that contain a notable mixture of both styles and both focuses (Figure 3.7)., and greater use of on-farm environmental conservation practices.

Table 3.4 Standards examined, in four categories	
1. Prescriptive Safety	**3. Flexible Safety**
LGMA 2013	LGMA 2015
LGMA 2018	BRC
2. Prescriptive Safety Plus	**4. Balanced**
USDA Harmonized 2015	Red Tractor
USDA Harmonized 2018	Tesco NURTURE
	LEAF
	GlobalGAP v5
	GlobalGAP v5.1

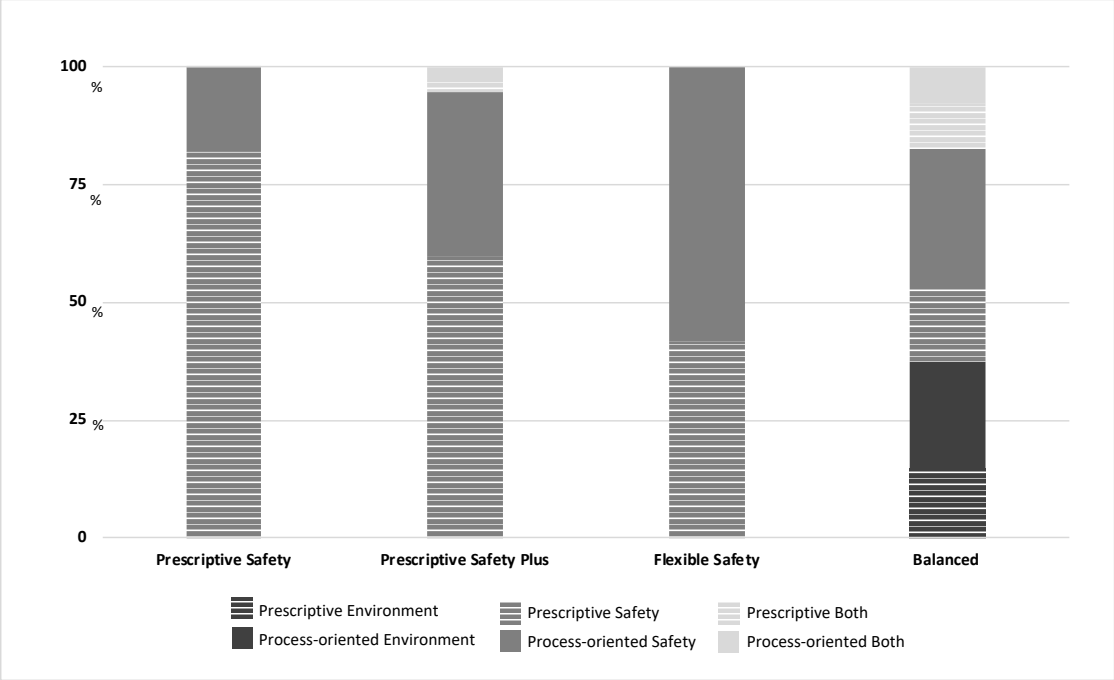

Fig. 3.7: Comparison of the standards, by category.

In a strikingly simple result, standards active in CA account for all of those in the first two categories most prescriptive and most focused on safety, and only one of the standards I classified as category 3: Flexible Safety. Standards active in the UK, by contrast, account for the second category 3 standard and the entirety of the fourth and most balanced category.

Farmer Perceptions of the Standards

To test my hypothesis that prescriptive rules may not lead to better outcomes, I explored whether categories 3 and 4 would show the best outcome for favorable farmer perception of the standards in the context of their state regulatory process. Multiple overlapping standards can present a financial burden to farmers who must pay for successive audits and for the implementation of new technologies and practices to meet audit requirements. During my survey efforts, farmers in both the UK and CA expressed doubts about the effectiveness of the food safety standards they follow, complaining that the safety rules seem more about retailers escaping liability or seeking to differentiate themselves from their competition, and less about genuine solutions for pathogen control.

> "There's fierce competition between the supermarkets; If one's got its own safety standard that producers are following, then if your brand hasn't got one you are probably doing something horrendous. That's what everyone assumes." – UK leafy greens farmer

> "The safety standards affect management for the better because of the fear factor of audits, but otherwise they may not be worth much. It's not clear from the evidence." – UK researcher

> On the one hand, there is the regulatory process, and then there is the marketing process that the large buyers and handlers have foisted on agriculture. – CA leafy greens farmer

Although this type of criticism came from both farmer populations, my data suggest that standards with a more balanced approach may still correlate with overall higher farmer confidence in the effectiveness of standards. The following charts report responses from farmers to interview questions that asked them to indicate how strongly they agreed or disagreed with certain statements. For this analysis, I have simplified the presentation of results to show the individual standards that reflect the largest coverage of my respondents. Some farmers included in these analyses were certified to an additional standard that is considered a baseline requirement for market entry (i.e. BRC and Red Tractor), so I have assigned them here to the optional additional standard that differentiates them from those following baseline requirements. As a result, some standards will not be displayed.

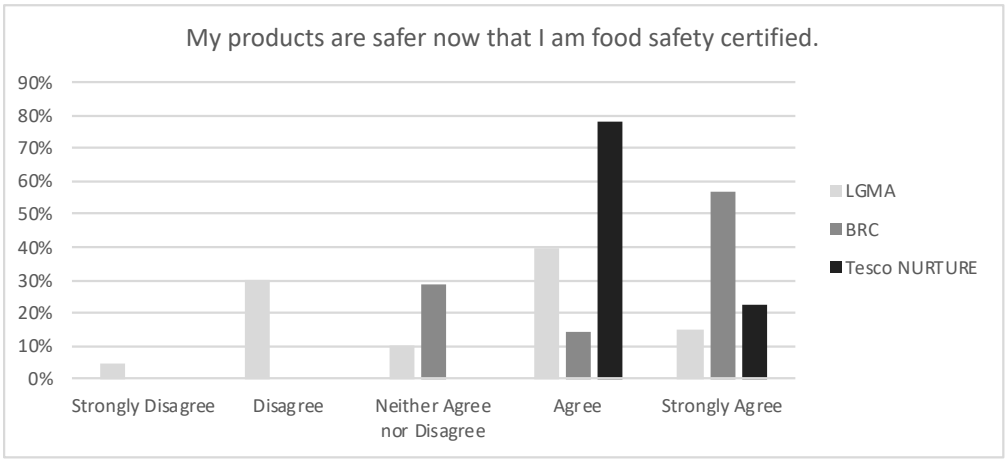

Fig. 3.8: Percent of responses for each certification. (N=41)

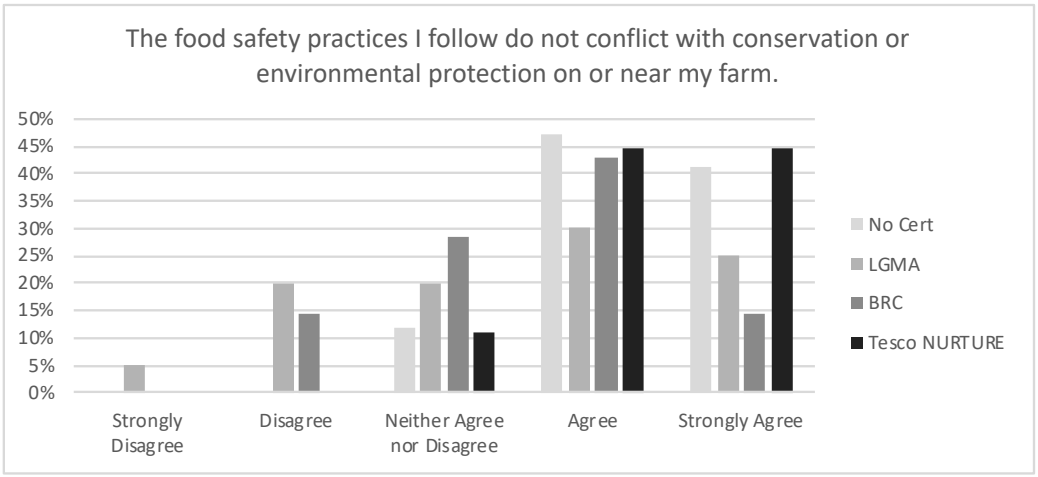

Fig. 3.9: Percent of responses for each certification. (N=62)

In response to the statement "My products are safer now that I am food safety certified," US farmers certified to the LGMA standard indicated ambivalence, while US and UK farmers certified to the BRC standard indicated qualified agreement, and UK farmers certified to the more balanced Tesco NURTURE standard indicated fairly strong agreement. Responding to the statement "The food safety practices I follow do not conflict with conservation or environmental

protection on or near my farm," US farmers certified to the LGMA standard again indicated ambivalence and some outright disagreement, showing lower confidence than those not certified to any standard at all. Farmers certified to the BRC standard indicated agreement, while farmers certified to the Tesco NURTURE standard indicated stronger agreement. That certified farmers feel more ambivalent than non-certified farmers, and that certified farmers feel differently depending on which standard they follow, suggests that farmers perceive clear differences in the standard process from one standard to the next. That those results do not simply differ along national lines suggests that the effect is more likely due to the standards, than due to social differences in how farmers perceive and react to the audit process.

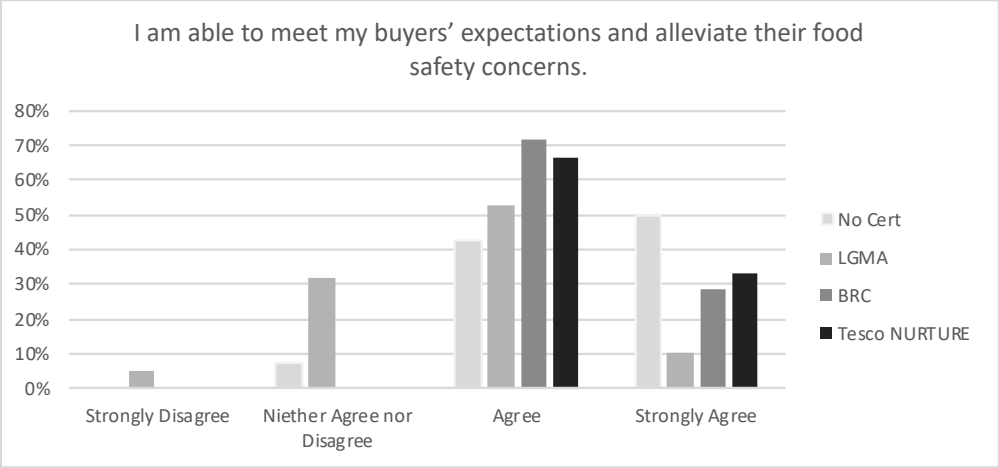

Fig. 3.10: Percent of responses for each certification. (N=57)

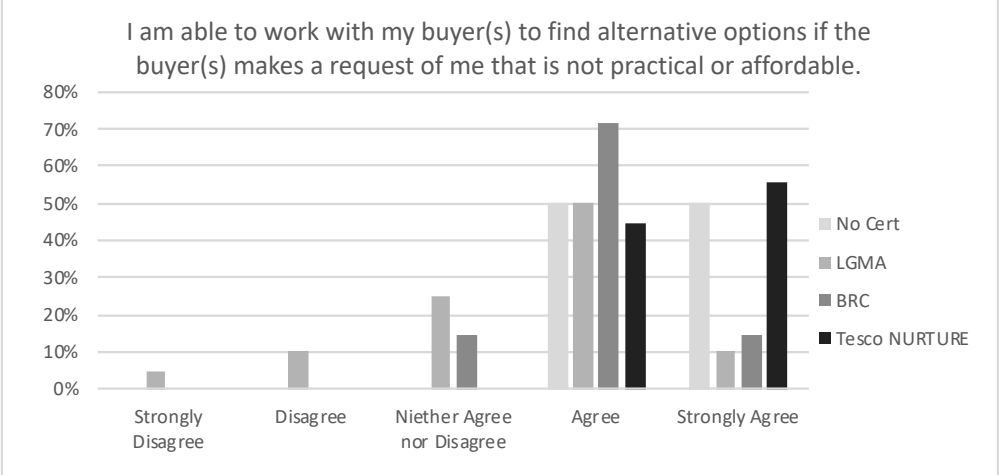

Fig. 3.11: Percent of responses for each certification. (N=56)

In any system that relies on third party audits upon which commercial contracts are contingent, those subject to audits may experience stress and worry, and difficult feelings may arise between auditor and audited. My research supports the conclusion that more balanced standards correlate with more comfortable relationships between farmers and auditors, and more flexibility in responding to buyer concerns. When asked to agree or disagree with the statement

"I am able to meet my buyers' expectations and alleviate their food safety concerns," US farmers following the LGMA standard indicated limited agreement, compared to complete agreement for farmers following either BRC or Tesco NURTURE. When asked to respond to the statement "I am able to work with my buyer(s) to find alternative options if the buyer(s) make a request of me that is not practical or affordable," US farmers certified to the LGMA standard indicated qualified agreement with a long tail trailing off toward disagreement, while BRC certified farmers indicated agreement, and Tesco NURTURE farmers indicated strong agreement.

These responses reveal the potential impacts of the US focus on greater top-down prescriptive detail in food safety regulations, compared to the UK focus on identifying mutually satisfactory control mechanisms through collaborative negotiation between regulators and retailers. Taken together, results in this section of my analysis suggest that more balanced standards from a more participatory framework may correlate with more comfortable relationships between farmers and their auditors, effects which persist between different state regulatory frameworks.

Comparison of On-Farm Food Safety and Environmental Practices

During the pilot phase of my study, a range of salient food safety practices and environmental practices were identified through consultation with farmers in both California and the United Kingdom. These conversations yielded a final list of 9 food safety practices and 15 environmental practices recognized and employed in comparable ways by farmers in both locations, as well as three additional food safety practices undertaken only by UK farms and one undertaken only by California farms (Table 3.5). Food safety practices were defined as practices followed specifically to reduce food safety risks, while environmental practices were defined as those practices to enhance the health and resilience of agricultural environments. During interviews and site visits, I asked farmers to indicate which of these food safety and environmental practices they currently employ on their agricultural lands.

Table 3.5 Farming practices followed for Food Safety or Environmental Concerns

Where Used	Practices Undertaken for Food Safety Purposes
Both UK and US (CA)	Clearing of vegetation at field margins
Both UK and US (CA)	Removal of vegetation from ditches and ponds
Both UK and US (CA)	Wildlife exclusion fences around fields
Both UK and US (CA)	Poison bait to control pest animals
Both UK and US (CA)	Non-poison traps to control pest animals
Both UK and US (CA)	Direct depredation of pest animals
Both UK and US (CA)	Planting of low-risk crops or natural fallow cycles
Both UK and US (CA)	Draining of ponds and standing water on or near fields
Both UK and US (CA)	Treating irrigation water to control pathogens
UK	Netting entire crop to prevent incursions from birds
UK	Glasshouse enclosure of entire crop
UK	Tree removal to prevent dropping nuts (allergen) on crops
US (CA)	Copper sulfate added to water to kill tadpoles
Where Used	**Practices undertaken for Environmental Conservation Purposes**
Both UK and US (CA)	Installation of constructed wetland to filter runoff water
Both UK and US (CA)	Vegetated treatment system to filter runoff water
Both UK and US (CA)	Vegetated buffer zone around field
Both UK and US (CA)	Cover crop used in time interval between main crop plantings
Both UK and US (CA)	Application of heat treated compost
Both UK and US (CA)	Grassed waterway margins or roads when they cross through fields
Both UK and US (CA)	Restoration of riparian habitats near field margins
Both UK and US (CA)	Use of hedgerows between fields
Both UK and US (CA)	Tailwater recovery ponds
Both UK and US (CA)	Sediment stormwater basin / stormwater retention basins
Both UK and US (CA)	Strips of non-crop vegetation to encourage pollinator presence
Both UK and US (CA)	Strips of non-crop vegetation to encourage predators of crop pests
Both UK and US (CA)	Crop rotation between plantings
Both UK and US (CA)	Use of no-till practices to minimize soil disturbance
Both UK and US (CA)	Integrated Pest Management (IPM)

To provide a fair comparison, only practices which were followed by farmers in both locations were analyzed. To reflect the differences that began to emerge from my sample using descriptive statistics, I assigned a score of 1 for each practice used by each farmer, and a score of 0 for each practice not used, and analyzed the resulting data in two ways: 1) I compared practices between standards based on my four-way categorization system, and 2) I compared practices between my UK sample and my CA sample. My research revealed differences between types of standards followed by farmers in both locations, as well as differences among food safety and environmental practices between the UK and California, even though similar non-state risk management frameworks are in effect in both locations and similar goals are sought by all of the standards.

Farming Practices Compared by Type of Standard

For this first analysis, I excluded farmers not following a certification standard. For those that remained, I used the four-way typology of standards I created in Table 3.4, with one omission: Because the USDA Harmonized GAP 2015 and 2018 standards had not yet gone into effect at the time of field work, it was not possible to analyze responses from farmers certified to a standard in category 2. As a result, the two figures that follow only show results for categories 1: Prescriptive Safety, 3: Flexible Safety and 4: Balanced. For the purpose of representing these results graphically in figures 3.12 and 3.13, I put both food safety and conservation practices in order on the x-axis from most environmentally impactful on the left to least environmentally impactful on the right.

This section of my analysis also takes into account that many farmers carry multiple certifications at the same time, and aim to meet multiple overlapping sets of requirements and standards at once. For example, the BRC Global Food Safety Standard and the Red Tractor Assured Fresh Produce Standard are used as pre-regulatory risk assessments in the UK which prioritize state regulatory enforcement measures, meaning that all producers must go through these audit processes in order to be able to sell their products through grocery retailers. Those producers then quite often take on additional standalone certifications at the behest of their retailer partners. In cases such as these where a farmer in my sample was certified to multiple standards, I have simplified the information I present by analyzing them based on the standalone standard they follow, on the assumption that that additional level of requirement beyond the baseline will be responsible for observed differences in practices. Additionally, there is a limitation of this method that must be explained: While I did interview several farmers who did not sell to retailers and thus did not carry the mandatory BRC and Red Tractor certifications, no UK farmer in my sample was certified to only one of those two standards, but not both at once. This is problematic because the BRC and Red Tractor are different in their style and focus, and fall into category 3 and category 4 of my typology, respectively. In order to faithfully represent my data with this overlap in mind, the data presented here assume that farmers certified to both of the pre-regulatory assessments can be represented under category 3 because of their BRC membership, while those additionally certified specifically to e.g. the Tesco NURTURE standard, are assigned to category 4 even though they also carry BRC and Red Tractor certifications.

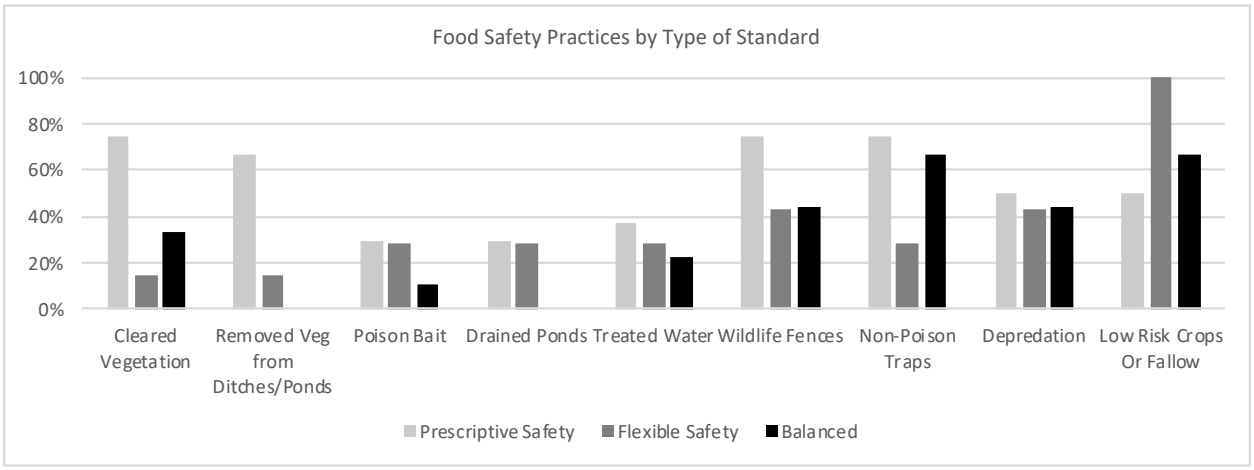

Figure 3.12: Percentage of farmers certified who report using each of the named practices for a food safety reason, based on type of standard followed. (N=41)

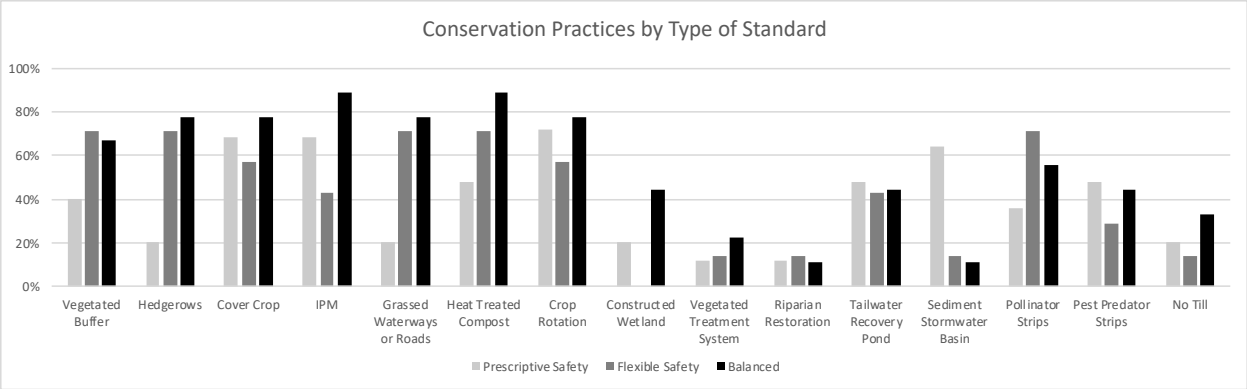

Figure 3.13: Percentage of farmers certified who report using each of the named practices for environmental conservation reasons, based on type of standard followed. (N=41)

Using this method of analysis, my data appear to support the conclusion that certification to a standard from category 4: Balanced may be more likely to engage in beneficial environmental practices, and less likely to engage in environmentally impactful food safety practices. Responses from farmers certified under Balanced standards scored lower in most cases than those certified under either Prescriptive Safety standards or Flexible Safety Standards on negatively environmentally impactful food safety practices, appearing to favor the use of less impactful measures (e.g. setting non-poison traps and planting fields to low-risk crops or fallow periods) over the most environmentally impactful practices (e.g. clearing non-crop vegetation from field margins and water bodies). Farmers certified to Balanced standards also scored consistently higher on the use of beneficial environmental conservation measures, compared to farmers certified to Prescriptive Safety or Flexible Safety standards.

Farming Practices Compared by Nation

In the second part of my analysis of farmer practices, I took note of the fact that no UK farmers I interviewed were certified to an entirely prescriptive safety standard, while no California farmers I spoke with were certified only to a Balanced standard. As a result, I found it useful to analyze the two samples by country as a second layer of analysis beyond category of standard. To illuminate statistical differences between my UK and California interviewees, I conducted t-tests comparing the means for each practice, between the California sample and the UK sample.

Table 3.6 Results of t-test and Descriptive Statistics for On-Farm Food Safety Practices by Country

	UK (N = 21)		USA:CA (N = 46)			
	M	SD	M	SD	t	df
Cleared Vegetation	0.29	0.46	0.43	0.50	-1.19	42
Removed Vegetation from Ditches/Ponds	0.10	0.30	0.61	0.49	-5.24	59
Wildlife Fences	0.38	0.50	0.59	0.50	-1.57	39
Poison Bait	0.14	0.36	0.37	0.49	-2.13	52
Non-Poison Traps	0.52	0.51	0.74	0.44	-1.66	34
Depredation	0.43	0.51	0.54	0.50	-0.86	39
Low Risk Crops Or Fallow	0.86	0.36	0.37	0.49	4.59**	52
Drained Ponds	0.10	0.30	0.26	0.44	-1.79**	55
Treat Water	0.19	0.40	0.22	0.42	-0.25	40

** p < .03.

Food safety practices varied between the two groups. UK farmers were less likely overall to report using all but one of the surveyed food safety practices (planting portions of crop area to low risk crops or fallow cycles). California farmers, by contrast, were more likely to clear vegetation, remove vegetation from ditches and ponds, erect wildlife exclusion fences, use poison bait, use traps, employ active depredation of pest species, drain ponds, and treat water. UK farmers were especially unlikely to remove vegetation from ditches and ponds, or to drain ponds entirely.

Table 3.7 Results of t-test and Descriptive Statistics for On-Farm Conservation Practices by Country

	UK (N = 21)		USA:CA (N = 46)			
	M	SD	M	SD	t	df
Constructed Wetland	0.19	0.40	0.13	0.34	0.59	34
Vegetated Treatment System	0.29	0.46	0.11	0.31	1.59	29
Vegetated Buffer	0.76	0.44	0.28	0.46	4.11*	40
Cover Crop	0.71	0.46	0.70	0.47	0.15	39
Heat Treated Compost	0.76	0.44	0.30	0.47	3.90*	41
Grassed Waterways or Roads	0.81	0.40	0.15	0.36	6.39*	35
Riparian Restoration	0.29	0.46	0.15	0.36	1.17	32
Hedgerows	0.81	0.40	0.20	0.40	5.80*	39
Tailwater Recovery Pond	0.52	0.51	0.37	0.49	1.16	37
Sediment or Stormwater Basin	0.19	0.40	0.43	0.50	-2.13*	48
Pollinator Strips	0.67	0.48	0.43	0.50	1.80*	40
Pest Predator Strips	0.52	0.51	0.46	0.50	0.50	38
Crop Rotation	0.76	0.44	0.85	0.36	-0.79	33
No Till	0.38	0.50	0.22	0.42	1.31	33
IPM	0.71	0.46	0.74	0.44	-0.21	37

* p < .05.

On-farm practices for environmental conservation looked statistically different as well. UK farmers in this sample were more likely to report using the majority of the surveyed environmental conservation practices, with statistically significant differences in the use of vegetated buffers, heat treated compost, grassed waterways or roads, hedgerows, and pollinator strips. California farmers were more likely to report using crop rotation and Integrated Pest Management, with a statistically significant difference in the use of sediment stormwater basins (referred to as stormwater retention basins in the UK).

IV. Conclusions

My top policy level hypothesis concerned process-oriented requirements in public regulation, which I expected to be used more in UK law than in US law. Somewhat contrary to my expectations, UK and US styles of regulation for food safety are broadly similar. Both UK law and US law include regulatory goals at multiple levels, with more general process-oriented language at higher levels and more specific and prescriptive requirements conveyed at the local level. However, the EU policy influence on UK food safety laws is reflected by a strong emphasis on cooperative process and stakeholder education, and a conviction that food businesses are the actor group closest to the problem of food safety and therefore best situated to solve it. In comparison, the US model contains similar efforts toward cooperative education-based regulation and process-oriented controls, but at the state rather than the federal level. Collaborative US efforts to educate at the state level are still backgrounded by the context of inspection demands and punitive sanctions emanating from the federal level. In summary, my H1 hypothesis was not entirely borne out in the structure of the legal frameworks, but is more closely reflected in the way national level regulation is implemented.

Regarding my second policy level hypothesis that the UK's state regulatory model would show a greater and more broadly-ranging environmental focus than comparable US regulation, my data provide qualified support for this idea. The UK legal framework under EU law contains an explicit focus on use of the precautionary principle in food safety regulation, and specific requirements relating to traceability, both of which are not emphasized to a comparable degree by US laws. Pesticide residues also loom large in EU consciousness, making their way to member state regulatory frameworks and down to farmers, retailers and the consumer public. My interviews with US retailers and growers suggest that the US produce market by contrast has a narrower focus on pathogens, because that is where the majority of US regulatory pressure falls. Priorities such as chemical safety may not occupy center stage in the face of industry-led safety standards that place greatest importance on microbiological threats.

My third policy level hypothesis was also well supported. The regulatory model evidenced by the UK's due diligence framework acts to protect food businesses from threats beyond the realm of reasonable caution, while motivating broad-based action to control all reasonable avenues of risk. Food businesses know that they must prove they did what they could, so they cover their bases widely. By contrast, the punitive legalistic mobilization of the US's Park Doctrine in food safety court cases implies that neither ignorance nor due diligence can protect the individual from bearing responsibility. Risk managers under this framework seek to complete specified requirements, and to move remaining potential responsibility for mistakes as far back along the supply chain as possible. As a result, primary agricultural producers bear both the stress and the costs of complying with checklist standards.

My first hypothesis at industry level concerned the breadth of food safety framings and use of process-oriented vs. prescriptive controls in food safety standards. Echoing results at policy level, the set of standards followed by farmers in my sample indicated that food safety is indeed managed in a more holistic way by private standards active in the UK than by those operating in CA. Standards commonly followed by my UK interviewees included a range of additional values such as environmental health, social justice concerns, animal welfare, and chemical safety alongside food safety requirements. Conversely, food safety standards followed by my California interviewees exhibited a narrower focus on foodborne pathogens, and contained few, if any, mentions of other concerns. The second part of this hypothesis, was borne

out with striking simplicity. Among the four categories that I created to describe the types of standards active among the farmers I interviewed, standards active in California were the most prescriptive and the most narrowly safety oriented, belonging to my categories 1 and 2, and extending to just one standard in category 3. By contrast, standards followed by my UK sample were largely from the most balanced category reflecting both process and prescriptive controls and a shared focus on food safety and environmental concerns.

My second hypothesis at industry level was also potentially borne out, although it is impossible in this study to fully separate individual variables responsible for the effect. The standards evaluated as being most balanced did correlate with most positive farmer opinions about the safety of certified produce and satisfaction with the multi-layered public-private regulatory process. However, different types of standards also corresponded among my farmers with two distinctly different structures of fresh leafy greens supply chains between the two nations, which altered social forces of power and responsibility belonging to various actors in the supply chain. As a result, these supply chain differences may be partly or wholly responsible for making the negative aspects of overlapping standards more noticeable for CA farmers than for UK farmers, potentially increasing the negative feelings observed more often from CA farmers. Additional research would be needed to separate these variables and understand precisely why these effects were observed.

My final hypothesis expressed the view that farmers certified to standards with more of an environmental focus and more process-based clauses would be more likely to engage in environmental conservation behaviors, while remaining more satisfied with the food safety regulatory process and its effectiveness. My results indicate that this hypothesis was supported by the data from my comparative sample. Farmers certified to the most balanced standards from category 4 were more likely to engage in beneficial environmental practices, and less likely to engage in environmentally impactful food safety practices. Although this was strongly borne out, the differences also broke down along national lines. Thus, there is an unknown degree of effect from national origin, and it is possible that either national attitudes are responsible for the differences that were observed, or that the differences are to some degree responsible for shaping different framings of environmental issues among the two populations. Additional research would be needed to test and confirm these conclusions.

Overall, my research reveals strong or qualified support for several of my hypotheses, suggesting that process-based controls correlate with more positive farmer experiences, and that standards which use a balance of approaches and an expansive view of food safety correlate with both positive farmer experiences and more environmentally friendly landscape practices. In the chapter that follows, I will discuss current and future trends in private food standards in both nations and internationally. I will explore the interaction of effects observed in this chapter with historically-mediated differences in environmental attitudes and differential framings of food safety problems, pointing a way forward for effective co-management of food safety and environmental conservation.

Chapter 4: Looking to the Future of Transatlantic Food Safety Regulation

In this dissertation, I have so far considered the basis of several challenges evident in the modern food system, and the role that specific types of regulation can and have played in efforts to correct them. I began by exploring the 20th century roots and cumulative effects of factors such as the distancing of consumers from food production, retraction and transformation of state regulatory power, corporate concentration and consolidation, and ongoing health and environmental externalities. As a focal point for considering these problems of the modern food system, I presented the case of fresh leafy greens production in the comparative context of the United States and United Kingdom. I traced the history of various models of regulatory risk management in the food system, exploring the historical roots of each nation's differential focus on food safety, within the context of rising corporate power and the emergence of non-state food safety governance. Lastly, I presented the results of my primary research comparing state, hybrid and non-state food safety controls affecting production of fresh leafy greens.

In this chapter, I will complement these results by exploring several further differences in the socially and historically-shaped discourse of food safety that I observed during my research, and which bear on how I interpret the differences I observed in my study of food safety standards and farmers' practices. Looking toward the future, I will situate my results and observations within the context of ongoing trends in food safety risk management with reference to current events in transatlantic food safety policy. Considering these background factors in concert with the results of my study, I will offer my full conclusions from this research, and my recommendations for ways to optimize the management of food safety in fresh produce during times of continuing regulatory, environmental, market, and political change.

I. Additional Contextual Observations

Throughout my research, I encountered differences in how actors at all levels of the food supply chain approached the task of ensuring food safety in fresh produce. Many of these differences cut across groups and shaped equally the interview conversations I had with regulators, with retailers, and with farmers. Differences that I observed cutting across multiple levels of my research included structural differences in how responsibility is assigned for food safety violations, regional differences in the discourse of food safety, divergent background framings of the growing environment, and different degrees of overlap between utilitarian agricultural use and preservationist conservation. I will present these factors below as a contextual backdrop for my primary research findings, considering them in my final conclusions and recommendations.

The Shape and Transparency of the Lettuce Supply Chain

During my interviews, a simple difference in the marketing information that reveals supplier relationships in the US and UK lettuce markets appeared to have important effects for how food safety goals are approached in each location. In each nation, perceived public responsibility for food safety falls on a different actor in the produce supply chain, altering the solutions pursued by that actor to ensure it. UK leafy greens sold by the largest grocery retailers (e.g. Tesco, Sainsbury's, Marks & Spencer, Waitrose) are typically sold under the retailer's own brand name and packaging, with messaging consistent across the full range of food products

marketed by that retailer. The brand visible to the consumer on a bag of ready-to eat salad greens is the retail brand; this brand visibility invokes for the consumer the marketing promises, values and reputation for quality which the retailer has worked hard to cultivate. It is this hard-won reputation that is then particularly at stake if food products emblazoned with a retail brand name make consumers sick.

Consumers buying California lettuce products, however, are shown a subtly different picture: CA-grown leafy greens are most often sold under individual brand names that either correspond to the actual grower (including some small, independent farms as well as most large, corporate fresh foods conglomerate such as United Fresh), or to a processing company that provides finished products to large agribusiness brands such as Dole. Although many US grocery retailers also market self-branded product lines carrying the name and logo of their retail chain, self-branded offerings are one of many on the shelf, rather than representing most—or even all—of the fresh produce available in a UK retailer's produce section. This seemingly small difference has existed for some time, with important effects for food safety risk management (Henson and Caswell 1999). The retailers and farmers I spoke with in both locations agreed that the name on a consumer package has the important effect of defining which actor in the supply chain is seen as being most immediately responsible when a problem such as a food safety outbreak occurs. Because their own brand name appears on the package, UK retailers publicly carry the responsibility for failures and oversights that may result within the supply chain.[1] In my UK interviews, retail representatives perceived great pressure to complete solid due diligence for produce food safety, pressure which they indicated came both from the requirements of UK law and from the need to preserve consumer trust and avoid a very public loss of face in a country with significant, widely shared consumer concerns about product safety dating back to the late 1980s. Conversely, attention after a food safety debacle in the US can often largely bypass the retailer or retailers who sold the affected food, centering quickly on the specific agricultural supplier responsible for producing the contaminated items.

This difference in how food safety issues are approached is in part an example of the continuing impact of the BSE crisis in British beef, and the ensuing public relations nightmare and largescale loss of public trust that followed on its heels. British retailers grew to their current-day prominence in part because they offered the consumer brand-based extra protections and guarantees in the wake of the scandal over inadequate regulatory hygiene controls and a flawed government response to the issue. As a result, UK consumers have come to trust retailers more than government, basing their trust on a retailer's track record of safety and quality (Ansell and Vogel 2006). Because US consumers never experienced a similar widespread destruction of consumer confidence in the guarantees offered by science-based public regulation[2], US retailers do not approach food safety as an arena in which they must regain the hearts of their customers

[1] For example, a 2013 UK outbreak of *E. coli* from bagged salads was publicized as affecting salads sold by the retailers Morrisons and Asda, although public health officials noted that many producers supply multiple retailers at once; Haley Dixon, "Ready-to-eat salads from Morrisons and Asda caused infection outbreak, HPA say," (March 19, 2013). Similarly, a UK consumer who found a live grasshopper in a sealed bag of Tesco-branded salad greens reported that she felt the incident had put her off shopping at Tesco; Jack Furness and David Burke, "Woman stunned to find a live grasshopper inside a bag of Tesco salad as experts issue warning," November 18, 2017).

[2] Research by Diana Stuart in the wake of the 2006 *E. coli* outbreak in California spinach suggests that leafy greens growers believe this happened in response to that outbreak. However, the pressure is felt by growers of leafy greens, on behalf of themselves and their crop, which matches with my understanding of where responsibility for loss of confidence rests in CA vs. in the UK lettuce industry. See Diana Stuart, "Science, standards and power: New food safety governance in California," *Journal of Rural Social Sciences* 25, no. 3 (2010).

and actively protect themselves from catastrophic losses of consumer trust. Instead, food safety is presumed for all products and all retailers. Retail competition centers around price, freshness, nutrition, and other social values sought by US grocery shoppers. No US retailer wants to be associated with a food safety scare, but if one happens and it can be verified to have come from a specific type of food, the focus of public attention is not usually the name of the retailers. Rather, attention centers generally on the food class responsible, the geographic location of that food's original harvest or production, and, if known, the brand name of the grower or packer whose name appears on the consumer package (Calvin 2007; FDA 2018a; CDC 2018).[3]

During my fieldwork, I found it interesting that I observed this difference despite the strong UK focus on ready traceability of foodstuffs. Traceability to production source is strongly emphasized by EU food hygiene rules articulated at the member state level by UK public health agencies. British produce packaging typically carries clearly visible supplier codes that link each product to its original field and farmer, sometimes including the name of the farm or even farm owner on the back of the package. American packaging does not always contain supplier codes or any specific information on source, beyond regional descriptors of geographic origin. Common leafy greens supply chain practices such as aggregation of many producers' fresh harvests during washing and processing mean that in some cases contaminated products cannot be tracked, and the feasibility of tracing backward from produce outbreaks differs enormously even from one leafy greens product to another (e.g. Calvin 2007).

In another supply chain difference potentially related to traceability, UK fresh produce consumed within national borders does not typically travel as far geographically between harvest and final sale as CA agricultural products, many of which reach their final retail points of sale in the far corners of the United States. This can further complicate tracing efforts in the event of food safety crises, and long storage intervals may contribute to a higher potential for foodborne illnesses to develop and persist in shipped goods (Brown et al. 2015; Koukkidis et al. 2016; Vestrheim et al. 2016). Scholars in both the US and UK have used the transdisciplinary concept of 'food miles' as a way to think about the food system's capacity to deliver desired social goods including food safety and environmental protection (NRDC 2007; Barclay et al. 2012). Invisible structural processes such as long supply chains that distance consumers from the sources of food

[3] For example, the 2018 US outbreak of *E. coli* 0157:H7 in chopped romaine lettuce was eventually traced to the Yuma, Arizona growing region, a seasonal satellite production area used by many of the largest California lettuce growing operations. Official communications from FDA indicated, after a lengthy and difficult trace-back process, that all romaine lettuce from that growing region should be avoided (FDA, "FDA Investigated Multistate Outbreak of E. coli O157:H7 Infections Linked to Romaine Lettuce from Yuma Growing Region," November 7, 2018). Similarly, in the case of the especially deadly and wide ranging 2006 *E. coli* 0157:H7 outbreak from California spinach, public responses implicated first spinach as a food class, then the Salinas Valley of California, and then the corporate leafy greens producer Natural Selection Foods (Linda Calvin, "Outbreak lined to spinach forces reassessment of food safety practices," *Amber Waves* 5 no. 3 (June 1, 2007). At the time of writing in late November 2018, yet another outbreak of *E. coli* 0157:H7 in romaine lettuce has recently sent ripples through the United States. Initially, CDC recommended temporarily avoiding all forms of romaine lettuce, from all growing regions in the nation, until more could be known (CDC, "Food Safety Alert: Outbreak of *E. coli* Infections Linked to Romaine Lettuce", November 20, 2018). Further releases indicated that the affected romaine was sourced from California, and FDA guidance to consumers and industry changed to recommend continued avoidance of California romaine lettuce only. In latest updates, FDA has called for new labeling rules to assist regulators and consumers with the task of identifying the geographic source of leafy greens products, in order to facilitate tracing in the event of outbreaks (FDA 2018d). For more information, see https://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm626716.htm.

production also disempower them from considering potential sources of risks. Although measuring and representing food miles meaningfully presents many challenges (ibid.), food miles as a concept can make visible "missing objects" such as the length of fresh produce supply chains, allowing them to be considered as contributors to observed outcomes and part of social interventions proposed to solve market failures (Iles 2005).

Local Inflections in the Discourse of Food Safety

Consumers in the UK and the US also each have a different culturally-constructed awareness of food safety risks, owing to different histories of food safety failures and regulatory responses in each location. Scholars have noted for many years that US consumers and regulators, in comparison with Europeans, seem to be more worried and anxious about a variety of food risks including inadequate nutrition, foodborne pathogens, harmful macronutrient profiles, carcinogens, and spoilage (Vogel 1986; Ansell and Vogel 2006; Levenstein 2012; Vogel 2012; Thomas 2014). European consumers and regulators have, by contrast, tended to be more cautious in the face of technological threats such as genetically modified organisms. These and other background framings of safety and risk in turn shape how regulators, retailers, and farmers think about what should be controlled, and how consumers think about the risks they may face.

One difference that emerged during my interviews was the differential weight placed by UK regulators and retailers on farm-to-fork supply chain management. Yet another place where the impact of the BSE crisis on the development of UK food safety responses can be felt, the UK's longstanding official focus on farm-to-fork supply chain management at both public and private level creates a system in which the expectation is that field level practices are receiving special regulatory oversight and must be kept under control. In the US, the focus on farm to fork food safety regulation for fresh produce has come somewhat later, and is fully articulated only by the recent FSMA language.

Other differences in how food safety is thought about and framed by various supply chain actors in the UK and in the US most likely stem from the influence of EU consumer protection priorities on UK food safety response. Pesticide use and regulation are very high on the radar for European Union member countries, and farmers and regulators are very aware of the many complex limitations that the EU-coordinated pesticide regulatory system places on them. In my interviews, UK standards and UK farmers I spoke with gave equal or greater priority to chemical safety in comparison with foodborne pathogen safety. During my UK field research, the phrase "food safety risks in fresh vegetables" was most often interpreted by both laypeople and members of industry or government as being a question of pesticide residues, until I offered additional specifics and turned the conversation to pathogenic foodborne illness. By contrast, California farmers, standards, and regulators seemed readily accustomed to separating pathogens from chemical residues, and considered pathogens to be higher priority. In CA, the phrase "food safety risk in fresh vegetables" was most commonly interpreted as having to do with foodborne

pathogens that make people sick, rather than as a question of chemical residues or other hazards.[4] Both concerns exist and are subjects of regulation in both locations, but the differences in discourse between CA and UK stakeholders in the lettuce industry show that different locally-constructed meanings are contributing to different regional framings of food safety.

In another difference over framings of what constitutes appropriate priorities for food safety, my interviews revealed a curious transatlantic bifurcation over the issue of what constitutes clean produce, or dirty produce.[5] In CA, pre-washed lettuce products are seen as cleaner and safer, and washing of leafy greens is a standard step in processing. In the UK, washing of leafy greens is also a common processing step, but a noticeable percentage of the UK consumer market views pre-washed lettuce as potentially more contaminated and less fresh than lettuce that has not been cleaned prior to sale. California lettuce farmers expressed to me that washing in anti-bacterially sanitized water was expected as a minimum level of safety assurance for the US market. The microbiological safety of wash water is typically controlled through disinfectants, added according to prescriptive safety rules that effectively bring microbial risk in wash water below the threshold permitted even in municipal drinking water. One California food safety manager at a leafy greens farm noted to me that this requirement for the disinfection of leafy greens made little sense to her, because the toxic disinfectant has to then be rinsed off with pure water that is technically dirtier from a microbiological standpoint than the initial rinse. By contrast, in my UK interviews, farmers noted that some customers increasingly view unwashed produce as having a higher guarantee of food safety than produce that has been washed and bagged before sale. UK farmers aware of this alternate view of safety made comments like "if we washed it, they'd wonder what happened to it that we wanted to hide" and "unwashed rocket goes for twice the price of washed now because consumers think it's safer if no one has interfered with it."

Although exploring and testing each of these attitudes in depth was beyond the scope of this dissertation, it was clear during my field work that differences in societal expectations of food safety could provide important context for my findings. The language in which food safety is couched and the priorities seen as important in each location have bearing on the overall discursive climate surrounding food safety, potentially shaping or constraining the actions of those who seek to solve produce safety problems.

---

[4] Previous scholarship has offered additional historical context to my observations on these varying levels of risk attributed to pesticides and to foodborne illnesses. Marion Nestle's *Safe Food: The Politics of Food Safety* explores how risk managers and the consumer public in the United States shifted in the early 1990s to view pathogens as a greater threat to food safety than leading prior concerns including food additives and pesticides. In *The Politics of Precaution: Regulating Health, Safety and Environmental Risks in Europe and the United States*, David Vogel addresses how responses to food scares have differed between the two nations due in part to the impacts of the BSE crisis in Europe and European use of the precautionary principle in public health and environmental regulation, whereas the United States escaped much of the public consequences of BSE and has favored a scientific risk assessment approach that invokes regulation only when threats are proven.

[5] This topic is explored at much greater length by several scholars, including Susanne Freidberg in her 2009 book *Fresh: A Perishable History*. Freidberg explores the history and politics of the refrigeration technology that allowed "fresh" products such as lettuces to become commonplace in the grocery markets of developed nations, and the forces of social construction that have contributed to popular notions of freshness with respect to food. Additionally, Mary Douglas's 1966 book *Purity and Danger* details the role that cultural framings of cleanliness and dirtiness have played in how food has been regulated throughout human history. Aaron Bobrow-Strain's 2008 article "White bread bio-politics: purity, health, and the triumph of industrial baking" and 2012 book *White Bread* both examine in a similar light the confluence of cultural narratives of food safety and progress demonstrated by the rise to prominence of American industrial bread products.

Framings of the Growing Environment as Helpful, or Dangerous

Similarly, and not at all unexpectedly, I also noticed a systematic difference between the two nations in how my interviewees described the growing environment in our conversations. Differences in word choice painted a picture of the environment as helpful, or as dangerous and risky. Not every person I spoke with in each location exhibited the same linguistic choices, but a general trend did develop. On the whole, regulators in each location seemed to share similar framings in which the value of the environment was central, while farmers I spoke with in CA showed a much greater focus on the environment as a source of risk. My expectation is that this difference stems from what my interviewees reported as the preferential framing of food safety risks as problems generated by wildlife, as articulated in CA private food safety standards and retail buyer communications.

CA regulators took a fairly balanced approach to the topic, starting from a position of protecting economic concerns and moving between environmental considerations and public health goals when approaching food safety as a topic. Interviewees in state level agencies spoke to me many times of the tide of anti-environment sentiment they saw among farmers of leafy greens and other fresh produce in the wake of outbreaks and private requirements to protect crops from animal incursion. One individual who had been involved in transmitting food safety messaging at the state level and had some experience with assisting farmers to incorporate specific pro-environment land management practices into their operations told me that he was seeing "a reversal of several decades of conservation work" because of new food safety fears. In his view, it had been a long slog getting farmers to abandon the worst herbicides and pesticides and become comfortable with allowing sustainability practices that helped them comply with e.g. official water filtration requirements. Food safety pressure from buyers had brought back those anxieties for farmers, bringing with them the desire to fight and control the wild environment. Both regulators and farmers in CA reported to me that the farming community was worried about nature threatening their operations. Another CA interviewee from the policy side put it succinctly when he summed up the change in discourse by saying "nowadays, you don't want to be encouraging [presence of wildlife], you want to be *dis*couraging."[6]

UK regulators evinced a similar focus on the economics of agriculture and food production, followed by acknowledgement of public health alongside sustainability concerns. But instead of signaling that they had experience with farmers who were preoccupied with food safety to the determent of environment, they unanimously agreed that farmers in the UK would not think of the safety and environmental matters as separate. Rather, they indicated that farmers thought of all of it in hybrid terms, considering the environment in the same breath as economic or public health concerns. Conversations with regulators invariably shifted to discussions of the EU Common Agricultural Policy (CAP) which permits farmers to receive financial benefits for environmental protection practices and sustainable land stewardship efforts. As a result of this official focus and, for some, solid revenue stream for portions of their land not exploited for

[6] Earlier work examining food safety strategies in the Central Coast region of California reported a similar finding soon after the 2006 *E. coli* outbreak from bagged spinach. My research indicates that this viewpoint and its effects on private regulation of food safety in leafy greens persists more than a decade after the spinach outbreak. For additional depth and details on the impacts of this perception of wildlife as a critical threat, see Diana Stuart's work with California growers, specifically: Diana Stuart, *A new wave of environmental degradation in California agriculture: Private standards, constrained choice, and changes in land management,* University of California, Santa Cruz, 2009.

intensive agricultural production, a broad-based environmental awareness was quicker on the lips for the UK farming community. Farmers I spoke with echoed this different starting point, often seeming surprised that I chose to separate my questions into two sections, one for food safety and one for environmental conservation. Many of them specifically indicated to me that "those are really the same, no?" and explained in various terms that food safety was a natural result in their minds of a healthy farming environment and local biodiversity. One interviewee from a trade association who had long experience with UK farmers and some exposure to views from American farming groups via conferences in the US said to me pithily "over here we talk about how to maintain biodiversity and beneficial insects, whereas my American colleagues are much more of the opinion that they should kill *everything*."

A deep accounting of contemporary environmental thought as seen in leafy greens production was not my goal with this study, but this difference did emerge as commentary on a deeper divergence in environmental framings among farmers and supply chain actors that could contribute to broad differences in food safety perspectives surrounding leafy greens.

The Appearance of a Farm

Owing to different histories of agricultural development, UK interviewees I spoke with placed a different value and importance on the visual appearance of farms than did my CA interviewees. The function of farms as visually pleasing parts of the pastoral landscape in the UK seems to be an important background framing for food safety management decisions. Several UK farmers I spoke with indicated that some things they might otherwise do to manage food safety on their farms would not be feasible in their current locations simply because of the impacts they would have on the farm's outward appearance for passersby. These farmers perceived conflicts between what risk management might indicate as the safest route, and what the broader local community would visually allow. Prohibited practices in this vein included fencing of field margins, removal of trees, clearing of bare ground buffer strips between fields and unmanaged lands or field divisions, and building of extensive glasshouses and polytunnels to protect sensitive crops from environmental uncertainty and animal incursion. UK farmers indicated to me that such practices might give them an edge in meeting food safety concerns, but would be simply impossible due to how they would change the farm's outward face.

Part and parcel of this issue, UK "right to roam" laws grant the public the right to walk freely across privately owned parcels of land, along with their domestic animals. This comparatively open and unsecured way of managing farms would make many of the secure fencing and private property-based exclusion measures common in CA incongruous with the English rural landscape, and, in some cases, potentially illegal or flat out impossible to implement. When I surveyed on-farm practices for food safety and conservation, UK farmers were especially unlikely to remove vegetation from around ditches, ponds, and field margins. When I asked them why, farmers indicated to me that the idea of doing so seemed to conflict not only with the right to roam, but also with a popularly held idea of the proper role of a farm as a wild environment. During our interviews UK farmers often noted that local community-level rules (different in each town or village, defined by town and village councils) governing the cosmetic appearance of agricultural fields and associated facilities would prohibit the removal of vegetation around field margins, ponds and watercourses which otherwise serve a scenic purpose. Even without that constraint, treating the farm as something other than a wild place did not seem right to the majority of farmers I spoke with. Those who did not espouse this view

operated the largest farms in my sample, and were those most likely to protect their crops under the cover of largescale glasshouses.

The CA farmers I spoke with showed a subtle but important difference in comparison with these views. California's longstanding legacy as a highly capitalized agricultural economy dominated since its founding by large farms, commodity crops, and production-oriented agricultural methods has created a long-standing capitalist framing and sense of separation between agricultural and residential or recreational lands (McWilliams 2000). Farming in California is clustered into areas of historical agricultural intensification, far from the population centers of urban and suburban living. On these dedicated agricultural expanses, land management decisions are somewhat insulated from conflicting suburban views of what agriculture should be or should look like. The sheer amount of land available for agricultural use in the United States generally and California specifically has allowed agriculture to make its own rules, less concerned with sharing space with nearby towns. California farmers I interviewed indicated that they were consumed entirely by the challenge of maintaining the land they have while producing the crop their buyers wanted to see, in the ways required by law, standards, and buyer requests. They primarily focused on economics and capacity when deciding how to do so, and what it looked like to anyone outside of the farming lifestyle was essentially immaterial.

Illustrating this difference, the California farmers I interviewed agreed with their UK counterparts that agricultural lands can serve a valuable purpose as wildlife habitat if practices such as clearing buffer strips and erecting wildlife exclusion fences are not undertaken, but this fact was most often mentioned by them as a serious liability rather than a competing desired outcome. At best, it was noted as a fraught conflict between different sets of values; on the one hand, there were what they saw as the ideals of environmental health, or romanticized notions of productive wilderness and movements 'back to the land', and on the other side came the discordant reality of what is feasible on tight economic margins and large commercial contracts, and what is simply too risky to—quite literally—bet the farm on. Their explanations highlighted values echoed by my UK sample: commitment to safe food, respect for nature, and the desire to protect both the long-term financial and ecological viability of their farms. However, California farmers in my sample did not mention being motivated at all by values associated with the scenic appearance of their fields, or the accessibility of their land for recreational value. These values did not appear to be strong motivators for their practices in comparison with the clearly articulated expectations of food safety audits and buyer requirements.

Ownership and Stewardship Against the Backdrop of Food Safety

Lastly, as my field work progressed, I found growing evidence that farm ownership patterns may be having a specific impact on certain kinds of food safety efforts. Specifically, farmers with a deep personal connection to the land they farmed described their on-farm food safety practices in language that made explicit reference to environmental health as a component of safe food.

Since the late 19th century with the advent of modern farming technologies and increasing concentration of populations in urban centers, many the industrialized nations of the Global North have experienced a sharp decline in the percentage of their populations working in agriculture (Buttel 1997; Lyson 2008). Falling numbers for population working in agriculture come on the heels of rising farm productivity and the development and proliferation of non-agricultural employment opportunities, all of which combine to endanger family farm ownership

and the transgenerational transfer of farming knowledge. However, UK regulators and trade associations stressed for me that the majority of the farmland in the UK is nevertheless still family-owned and operated, often by families that have run their farms for generations. "It's a long game," I was told by one trade association representative who worked closely with farms. "This land has been theirs for a long time." My archival research echoed this finding, and my interviews bore this out as well.[7] Most of my UK farms still under direct family ownership. In several cases, I interviewed the farm's owner, who was also the on-site harvest manager, and who shared a surname with the commercial name of the farm. Several more of my UK interviewees represented associations of several small family farms that had banded together to achieve economies of scale in a competitive agricultural market, but in a way that preserved individual family management of original family-held lands. Once this history was spelled out, I could see that the names of these companies often reflected their conglomerate nature through acronyms or group nouns composed of the sum of their parts. Importantly though, each family remained in control of the land it had brought to the association. Management decisions were still made at the local level, by the manager of each individual farm. Several times my questions about farm management could only be answered by my initial interviewee for their section of the farm's land, and I had to be routed to another family within the association to hear about management on their portion of the farmland (which turned out to be different in terms of on-farm practices followed).

My work in CA suggested a subtle difference here, which was outside the scope of my research and would need to be verified and explored further. Family farm ownership is certainly not unknown in CA, nor is it especially uncommon. Several of my CA interviewees represented family-owned farms, even if the farm had never carried the surname of the individuals running it. Even one of the CA farms I spoke at length with, that was among the largest and the most factory-run and thus potentially the farthest from a pastoral family farming ideal, had started at one point as family farm and grown through land acquisitions. What I found important here was that the land had been acquired, not simply joined together in name. What had been a large number of independent holdings, some of which may have originally been family operated, was now a large conglomerate run by managers who do not and have never had a personal family association with the land they now manage. One of the farm managers I spoke with who worked for a CA grower that splits its production between California and Arizona depending on time of year, told me that he moves to Arizona when the season there begins. Neither place is home, he reported; his family is in Georgia. This is a job.[8]

Scholars examining the sociology of rural agriculture have noted instances of this difference in other places and at other times. Comparing environmental regulation in the UK and US in the mid 1980s, David Vogel notes that greater population density and less available arable land in the UK has been a factor in making conservation and land use issues take center stage more easily than in the US (Vogel 1986, p.151). In the US, Julie Guthman has explored the

[7] In the 2016 version of their yearly report "Agriculture in the United Kingdom", DEFRA lists the percentage of UK farms that are family owned and owner-occupied at 70%. Specific family farm ownership statistics in California are unavailable, there is not an accepted international

[8] In her 2009 work with California farmers, Diana Stuart notes that this detached commercial focus can be seen in the terminology used to describe primary producers. Rather than "farmers," California leafy greens are produced by "growers," individuals who oversee aspects of production without—in some cases—ever visiting the farm. (Diana Stuart, *A new wave of environmental degradation in California agriculture: Private standards, constrained choice, and changes in land management*, University of California, Santa Cruz, 2009).

history of California farming and its lack of a true family-farm agrarian past at any point. Instead, farming in CA has been pushed toward larger-scale and more production-oriented models that focus on large farms and high valuable crops, in part because of the high property values of CA land (Guthman 2014).

From the descriptions offered by my interviewees, it appeared that persistent differences in how farmland is held and operated in CA and in the UK could be partly responsible for influencing farmers' decisions about the importance of maintaining environmental sustainability practices alongside food safety requirements. If some degree of continued family ownership and personal connection to both the past *and future* of the land increases family farmers' ability to think about food safety requirements with a long-term sustainability framing, this difference in land ownership patterns could be creating an environment where US farms' environmental future is more likely to be discounted in favor of present food safety and economic concerns. However, UK farmers have already experienced and responded in their own ways to market pressures that have incentivized larger landholdings and more intensive production, finding ways to adapt that still preserve family ownership. As the UK grapples with the coming challenge of competing on a global marketplace as a single nation apart from EU common market, it is unlikely that these pressures will lessen. Thus, UK agriculture may be in a transitional period, and headed for a new period of changes in historical patterns of family farm ownership.

II. Looking to the Future of Produce Food Safety Controls

Since my initial data collection began, I have been able to observe the progression of several ongoing trends that may impact how fresh food standards function in the near future and the social and environmental goods they are able to provide for fresh produce markets. These trends include ongoing harmonization efforts and mergers between standard-setting organizations, evolution of the standards I examined from one version to the next, and the looming impacts of the United Kingdom's upcoming exit from the European Union.

Harmonization Efforts and Mergers Between Standards

In the years since my research first began, the state and non-state food safety controls examined in my study have undergone several important changes with the goal of reducing the duplicative and redundant landscape of safety controls active in the fresh produce market. One of the first such efforts was the Global Food Safety Initiative (GFSI) benchmarking effort. Since its launch in May of 2000, GFSI benchmarking has attempted to certify for equivalence many disparate food safety standards operating in multiple food supply chains around the world. GFSI gained recognition in 2007 after seven major global retailers announced they would accept any GFSI-benchmarked safety standard.[9] Nevertheless, wider acceptance difficulties remained, and events such as the 2006 outbreak of *E. coli* in California spinach caused a further proliferation of standards rather than an easy convergence around fewer standards or robust benchmarking.

After a lengthy and remarkably inclusive multi-stakeholder process with the goal of identifying a single safety standard that could serve as a commonly accepted guaranteed of good practices in any national or international market, the United Fresh Harmonized GAP Standard

[9] For more information on the GFSI requirements and history of GFSI's adoption across produce markets, visit https://www.mygfsi.com/news-resources/news/news-blog/1291-gfsi-turns-18-in-2018.html

was created in 2016. In partnership with GlobalG.A.P., the Harmonized Produce Safety Standard (HPSS) was born (GlobalG.A.P. 2016), and later became the USDA Harmonized GAP standard. However, the multi-stakeholder harmonized safety standard created in the aforementioned process was not unified for long; in the course of obtaining GFSI benchmarking, GlobalG.A.P. was forced to update its harmonized standard to a version different from that adopted by the rest of its partners in the original harmonization process,[10] creating a proprietary GlobalG.A.P. harmonized standard alongside the USDA Harmonized GAP standard. The differences between those two standards were small, but in essence, there were still multiple standards even after the harmonization efforts and the attempts to use benchmarking to level playing fields between different standards.

In the context of my research, the private standard for which I gathered the most evidence of positive outcomes in farmer experience and environmental sustainability, the Tesco NURTURE program, has also now been subsumed under the umbrella of the most recent GlobalG.A.P. HPSS. The Tesco NURTURE program provided much of the basis for my conclusions favoring the results from private standards that use a balance of regulatory styles and a wide view of food safety that includes environmental considerations. Both GlobalG.A.P. and NURTURE were among my category 4, representing standards that were the most balanced in both style and focus. As a module within the newest version of the GlobalG.A.P. standard, NURTURE's transformation is an early example of one possible outcome of ongoing efforts to achieve harmonization between the many overlapping food safety standards current active in fresh produce markets.

It will be crucial to see if the benefits of NURTURE that I saw evidence for in my interviews carry over now that NURTURE is a module within GlobalG.A.P., or whether the character of those interactions and the high quality environmental and food safety "license to operate" that they helped to shape are significantly changed under GlobalG.A.P. management. It will also be interesting to see how this merger of standards affects market penetration of the GlobalG.A.P. standard. GlobalG.A.P. certifications active between 2014 and 2015 were not followed exclusively by any farmer interviewed during my study, but did show up as an additional standard followed concurrently by several farmers in my sample. If the merger with NURTURE allows GlobalG.A.P. to extend its market impact over a larger number of suppliers without fundamentally changing the structure of the NURTURE standard or its potential for positive landscape-level impacts, this merger could be one sign of positive evolution within harmonization of international food safety standards.

Evolution of Standards Over Time

Since I began this research, the FDA Food Safety Modernization Act in the United States has gone from a proposed rulemaking, to a final rule awaiting implementation, to the early stages of implementation within the US agricultural economy. Collection of the California data examined in this dissertation began while the proposed rulemaking was undergoing public comment, and concluded soon after initial publication of the final rule. At the time of publication of this dissertation, the Produce Rule is in effect. The first inspections called for under the FSMA Produce Rule were delayed in the beginning of 2018 by budget concerns for training new FDA

[10] GlobalG.A.P details this process and the reasons for it at https://www.globalgap.org/uk_en/for-producers/globalg.a.p./harmonized-produce-safety/faq-harmonized-produce-safety/

inspectors, issues around feasibility and definitions of certain requirements, and the complexities of developing state-level inspection protocols for the new rule.[11] Although the new requirements are now in full effect as of September 2018 for all food businesses at all levels, FDA has reported that requirements for some types of produce farms will see a delay in enforcement reaching into 2019, or even 2020 (FDA 2018b, c). For many larger farms, changes have amounted to only minor refinements to existing food safety measures, because these producers already adhere to the most stringent rules in production due to their articulation with international trade networks and their deeper financial capacity to pay for audits and absorb additional costs. Conversely, for small and medium sized farms without large financial resources and for alternative producers following ecological farming methods that fit less readily into current HACCP risk-assessment frameworks without necessarily being less safe, the enforcement of FSMA's newest provisions (even as late as mid-2019) will present significant hurdles for day-to-day operations. Small farmers commented during the initial notice and comment cycle for FSMA that the new rules would likely put some smaller and alternative producers out of business due to the high cost of additional adaptation measures and inspections.

The two iterations of the new USDA Harmonized GAP standard that I included in my analysis prior to their full implementation have also now gone into effect and have been adjusted for the enforcement of FSMA. This standard in its two iterative versions formed my category 2 Prescriptive Safety Plus, reflecting their attempts to incorporate clauses with a broader view of combined environmental and food safety concerns, and process-oriented controls in addition to prescriptive clauses. With my results from the previous chapter in mind, entry onto the state regulatory stage of standards with even a slight additional inclusion of these elements that I saw positively correlated with environmentally friendly farming practices and improved farmer experience could be a positive sign for the regulatory landscape. However, it will be necessary to see whether harmonization efforts are durable over the longer term, or if the landscape of standards remains subject to fragmentation.

Hybrid food safety controls in the United States have also changed to accommodate new requirements at the national level. According to the LGMA board, as of August 2017, the LGMA standards applicable in both California and Arizona have been updated to reflect the new regulatory baseline represented by the FSMA Produce Rule.[12] This update was responsible for the increase in prescriptive safety controls I observed in my comparison of standards, which saw the 2018 LGMA standard move back into my category 1: Prescriptive Safety. In comparison, the previous 2015 LGMA revision had contained enough process-oriented controls to place it within my category 3: Flexible Safety, representing a significant transition toward process-oriented controls that has now been reversed as private standards have intersected with changing public regulation. Producers entering into or maintaining certification to the LGMA in 2018 and beyond are now considered to be in full regulatory compliance with FSMA through the audits they already undergo. With the ability to signal full compliance through an already established public-private partnership with USDA backing, the LGMA standard appears to have enhanced value and durability in a post-FSMA leafy greens market. This may complicate harmonization efforts,

[11] After the publication of FDA's final Produce Rule, confusion centered around such details as the definition of what FDA considered to be a "farm", how inspectors would be trained and whether funding would be adequate, and the potentially prohibitive cost of FSMA adaptation for certain smaller farms and those following alternative agricultural methods.

[12] LGMA announced these changes in August of 2017. Details available at https://lgma.ca.gov/2017/08/lgma-metrics-now-alignment-fsma-produce-safety-rule/

while also demonstrating an important back-tracking of the prior trend toward greater reliance on process-oriented food safety controls.

Expected Effects of UK's "Brexit"

On June 23rd, 2016, residents of the United Kingdom voted in a historic referendum over the future of their membership in the European Union. The campaign to leave the EU won the vote by a margin of 51.9% to 48.1%, providing the popular basis for initiating the political process of exiting from the EU's economic and political partnership represented by the EU. Under the terms of Article 50 of the Treaty on European Union, the UK has until March 29th, 2019 to officially leave the EU with a negotiated agreement and its mutual parliamentary ratification. As of the time of writing, negotiations over the agreement are still underway, and although agreement has been reached on many specifics, the full terms have not yet been permanently established. Among many pressing economic questions for the nation, questions remain over what the UK's exit will do to build upon or alter the functioning of the existing food safety and environment regulatory landscape in which fresh produce is currently grown.

No matter what the precise terms of the final agreement, the UK's exit will almost certainly change the face of British agriculture. The current UK leafy greens market benefits from a high degree of migrant labor drawn from other member countries within the EU under free migration rules. If it becomes significantly harder for migrant laborers to gain access to the UK to work in agriculture, the UK produce sector could face steep competition from nearby EU countries where low-wage field labor is more easily attainable. Additionally, current environmental requirements and income support programs that some UK farmers presently enjoy under the EU's Common Agricultural Policy[13] will end by claim year 2020 under the terms currently provisionally agreed by EU and UK negotiators as of November 14th, 2018 (Department on Exiting the European Union 2018, p. 218). These direct payments and the regulatory mechanisms and requirements that underlie them provide the basis for UK environmental regulation in the farming sector, ensuring minimum standards of environmental protection and stewardship (European Commission 2017).

Direct income support payments to farmers are slated to continue in the form of internal payments from the UK treasury until the next Parliamentary elections, due in 2022. Commentary from the UK parliament cites reasons that this exit and reorganization could be favorable for UK farmers, including relief from the more onerous parts of EU bureaucratic control and standardization of farming methods, record keeping, and crop timing (European Union Committee 2017). The UK's DEFRA has announced plans to replace the direct payments with a new system designed to fix certain problems within the CAP payments, which some UK critics say do too much to reward large landholdings and too little to support real environmental stewardship. In a speech given to the Oxford Farming Conference in January 2018, Michael Gove, current UK Secretary of State for Environment, Food and Rural Affairs, explained that DEFRA plans to move the nation away from CAP and its "resource-inefficient" methods of production, moving from "subsidies for inefficiency to public money for public goods" such as

[13] These direct payments are currently authorized for member states under Regulation (EU) No 1307/2013 of the European Parliament and of the Council. Additional information on EU direct payments can be found at https://ec.europa.eu/agriculture/direct-support/direct-payments_en

natural capital and environmental land stewardship.[14] Such statements contain important clues for basic framings of the values of food and farming which will soon decide which paths are considered by policy makers. Public expressions such as these pay service to the goals of environmental conservation and public goods such as food safety, but with uncertain guarantees during this ongoing time of negotiation.

In February of 2018, ahead of major EU-UK negotiations, Britain's National Farmers Union (NFU) released a collaborative statement from 37 organizations representing the UK food and farming industries, in which they detailed their shared vision for what a successful British exit from the EU should aim to establish. Among other trade related goals, the statement calls on UK policy makers to ensure that new UK agricultural standards after the separation continue existing commitments to high environmental, health and animal welfare standards.[15]

However, recent evidence from the ongoing Brexit negotiations suggests that food standards may not be on track to ensure ideal outcomes for public health. With the announcement of a new program titled "Regulating Our Future" the UK Food Standards Agency has announced that its plans for food standards after Brexit will strongly favor private regulation over public regulation. This has some industry watchers worried that the future may hold a return to the scandals and failures of food industry self-regulation that plagued UK food production in the 1980s and 90s. Critics have warned that the new program undermines the publicly accountable enforcement provisions of the UK's 1990 Food Safety Act by placing responsibility for food inspections on private commercial assurance providers instead of local and central government. Those wary of such a shift warn that this would be a misstep because private assurance firms would have a commercial incentive to serve their food industry clients over the interests of the public (Millstone and Lang 2018). Moreover, critics point out that regulatory over-influencing by corporate food actors was exactly the problem that the FSA, as a central independent watchdog agency, was famously created to solve. Non-state and hybrid standards can be effective tools for ensuring desired outcomes for food safety and the environment (Morris 2000; Gunningham, Kagan and Thornton 2003; Henson and Reardon 2005), but are most effective when paired with strong state regulation.

III. Conclusions and Recommendations

First and foremost, I suggest that ensuring optimal outcomes for food safety and environmental management will require additional efforts to combat the division of food safety and environmental concerns into separate administrative and industry silos. Currently, my data show that these goals are being pursued separately by public and private standards in the United States, and through imperfect overlapping agencies within the UK government. In many cases, private standards push the frontier of regulation farther than public mechanisms, and form the most immediate point of contact uniting regulatory goals with buyer requirements and farmer practice. Currently, private standards in both nations are facing changes and updates in the wake of fluctuating regulatory climates, leaving private standards in a state of uncertainty and flux. I suggest that it is now especially important for private food safety standards in both nations to

[14] Quotes taken from a transcript of Michael Gove's speech to the Oxford Farming Conference in January of 2018, available at https://www.ofc.org.uk/sites/ofc/files/papers/Farming%20for%20the%20next%20generation%20-%20GOV.UK_.pdf

[15] This multi-stakeholder statement was released online, available at https://www.nfuonline.com/news/latest-news/uk-food-farming-sector-unites-to-highlight-impact-on-home-grown-production/

explicitly consider environmental goals alongside food safety goals. My results indicate that more balanced standards of this nature are correlated with more positive farmer experience, improved attitudes toward the natural environment, and higher use of conservation-oriented practices, goals which should be among those established during the current reorganization of regulatory priorities at public and private levels.

Private standards are increasingly becoming international or global in scope, extending the reach of private regulation far beyond that of public regulation. Delivering effective food safety guarantees in global supply chains will require a shift toward more complete, internationally benchmarked or otherwise harmonized standards, and nimble governance frameworks with a view of safety that does not ignore sustainability. However, market forces are currently still encouraging standards to proliferate and stay focused on food safety to the exclusion of other concerns. Additionally, regime transitions in both UK and US government make it less likely that the most balanced food safety standards currently available will be able to maintain their environmental completeness and broad conception of food safety going forward. It will be important for areas of the developed world that have rigorous and effective standards to maintain them in the face of incentives to race to the bottom, converging around standards which aim to deliver safety instead of other goods, rather than in addition.

As it leaves the European Union, the UK must ensure that its agricultural standards remain high and robust, its farm supports reflect the popular desire for greater equity and incentives for deep environmental stewardship, and its regulatory process is not overly controlled by private interests. In turn, the United States will need to find ways to incentivize the pursuit of environmental goals alongside food safety goals, an outcome currently disincentivized by the prevailing prescriptive regulatory climate and focus on a singular vision of food safety. As the early years of FSMA implementation begin, standard setting bodies at state, hybrid and non-state levels may wish to seek compliance with food safety requirements through process-oriented controls, relying less on prescriptive standards.

Internationally, benchmarking and harmonization efforts will need to gain ground, to avoid further fragmentation of the produce market in response to Brexit and FSMA, and to serve as a step toward 'governing the governance' of food safety. Harmonization efforts are seeing gradual gains. However, these efforts thus far have failed to deliver the goal of true harmonization within the realities of articulated global markets. In the face of regime transitions and evolving regulation, attempts at harmonization are still resulting in additional complexity and overlap between standards. It will remain to be seen over the coming years whether benchmarking can deliver on its full promise, and whether new global bars will be set by the biggest international standards.

Additional research that could follow my work in this dissertation might examine whether and to what degree different structures of fresh leafy greens supply chains affect how farmers view the standards they must meet, and how food safety requirements are built. It would be useful to explore whether the differences I observed between US and UK leafy greens farmers can also be observed within only one nation, to separate and evaluate the influence of national attitudes and of different kinds of standards. Work could also meaningfully examine how length of supply chain and time elapsed between harvest and sale impact food safety risk management in particular contexts, to establish whether and why safety outcomes are inherently better in shorter supply chains than in longer ones. It will be crucial in the near term to evaluate how well harmonization and benchmarking efforts are able to reduce the audit burden that farmers face, while ensuring adequate food safety controls across globally articulated markets. Future research

will be needed to assess social and environmental impacts brought by the full implementation of FSMA requirements, conveyed to farmers through certifications such as LGMA, USDA Harmonized GAP, and GlobalGAP HPSS. Research will also be needed to assess the impacts of a redesigned UK agricultural policy after withdrawal from the EU, and the effects of greater privatization of food safety enforcement.

Food safety risk management in 2018 is at a global inflection point. As outbreaks in developed nations continue to highlight problems within fresh produce supply chains, both governments and private actors are devising controls to manage risk within extensive global supply networks. At the same time, food safety market pressures are creating environmental externalities and sustainability of agriculture is increasingly under fire. Global supply chains today demand solutions that can simultaneously yield safety guarantees for the consumer, legal protection for the retailer, and sustainability and feasibility for the farmer. Supply chains worldwide are extending, but fresh lettuce is partly insulated from this effect due to its short shelf life. The future of risk management in fresh lettuce may not be one of longer supply chains in the same way as for other commodities, but rather of a search for improvements in efficiency of supply chains (i.e. more vertical integration, harmonization of standards, reduction of transaction costs). Food safety standards are evolving rapidly in the face of these many competing concerns, responding to calls for harmonization, changing borders, and new regulations. Finding the ideal toolkit for food safety requirements and the proper balance between private and public regulation will be essential as these processes continue.

Closing Thoughts

Farming is inherently an activity born of nature and natural processes that are not entirely subject to human control. Without careful efforts to the contrary, taking food safety protection to its logical extremes within capitalist production systems can deliver less than ideal results, leading to fresh goods becoming manufactured goods, retailers becoming regulators, and a farming landscape that ceases to be in harmony with the natural environment. This dissertation is ultimately full of questions: What is our relationship to our food? What are the right goals by which to manage a farm, and for whom? Should the provision of one social good outweigh another when public health is at stake? In the search for answers at all levels, I believe that it is morally incumbent upon the observers of a market economy to understand and advocate for the most inclusive solutions possible. Inclusive solutions to the problem of ensuring food safety in fresh produce must consider impacts on the land, on the farmers who grow food, and on the consumers whose choices are enabled or constrained by how food is marketed to them. Models of risk management in agricultural production are made better or worse by how broadly costs and benefits are conceptualized, and how well ecological goals are managed alongside social and economic ones. Those models which best deliver, at once, on all the many social and environmental goals which we ascribe to farming are those which we as a society should strive to enable; those models that take a narrower view are those which we should strive to transform.

Bibliography

Adak, G. K., Long, S. M., & O'Brien, S. J. (2002). Trends in indigenous foodborne disease and deaths, England and Wales: 1992 to 2000. *Gut*, *51*(6), 832–841.

Allain, M.-L. (2002). The Balance of Power between Producers and Retailers: a Differentiation model. *Recherches économiques de Louvain*, *68*(3), 359.

Agyeman, J., Bullard, R. D., & Evans, B. (2003). *Just sustainabilities: Development in an unequal world*. Earthscan.

Andrews, R. N. (2006). *Managing the environment, managing ourselves: A history of American environmental policy*. Yale University Press.

Ansell, C. K., & Vogel, D. (2006). *What's the Beef?: The Contested Governance of European Food Safety Regulation*. MIT Press.

Antle, J. M. (1999). Benefits and costs of food safety regulation. *Food Policy*, *24*(6), 605–623.

Ayres, I., & Braithwaite, J. (1992). *Responsive Regulation: Transcending the Deregulation Debate*. Oxford University Press.

Bain, C. (2010). Governing the Global Value Chain: GlobalG.A.P. and the Chilean Fresh Fruit Industry, *17*(1), 1–23.

Barclay, C. (2012). *Food Miles* (No. SN/SC/4984). Retrieved from http://allotmentresources.org/wp-content/uploads/2013/09/Barclay_2012_food_miles.pdf

Barling, D. (2004). Food agencies as an institutional response to policy failure by the UK and the EU. *Qualities of Food*, 108–128.

Baur, P., Driscoll, L., Gennet, S., & Karp, D. (2016). Inconsistent food safety pressures complicate environmental conservation for California produce growers. *California Agriculture*, *70*(3), 142–151.

Beck, U. (1992). *Risk Society: Towards a New Modernity*. SAGE.

Beretti, M., & Stuart, D. (2008). Food safety and environmental quality impose conflicting demands on Central Coast growers. *California Agriculture*, *62*(2), 68–73.

Bloomfield, D., Collins, K., Fry, C., & Munton, R. (2001). Deliberation and inclusion: vehicles for increasing trust in UK public governance? *Environment and Planning C: Government and Policy*, *19*(4), 501–513.

Bonanno, A., Busch, L., Friedland, W., Gouveia, L., & Minzione, E. (1994). *From Columbus to Conagra: the globalisation of food and agriculture*. University of Kansas Press.

Bové, J., & Dufour, F. (2001). *The world is not for sale: Farmers against junk food. Interviewed by Gilles Luneau, Translated by Anna De Casparis*. London: Verso.

Boyd, W. (2001). Making meat: Science, technology, and American poultry production. *Technology and Culture*, *42*(4), 631–664.

Boyd, W., & Watts, M. (1997). Agro-Industrial Just-in-Time: The chicken industry and postwar American capitalism. In *Globalising food: Agrarian questions and global restructuring* (pp. 139–164). Psychology Press.

Brown, W., Gorman, L., Steinmaus, S., Vorst, K., & Ryser, E. (2015). Temperatures experienced by fresh-cut leafy greens during retail storage and display. In *III International Conference on Fresh-Cut Produce: Maintaining Quality and Safety 1141* (pp. 103–108).

Buck, D., Getz, C., & Guthman, J. (1997). From farm to table: The organic vegetable commodity chain of Northern California. *Sociologia Ruralis*, *37*(1), 3–20.

Busch, L. (1994). The state of agricultural science and the agricultural science of the state. In *From Columbus to ConAgra: The globalization of agriculture and food* (pp. 69–84).
Busch, L. (2010). Can fairy tales come true? The surprising story of neoliberalism and world agriculture. *Sociologia Ruralis*, *50*(4), 331–351.
Busch, L., & Bain, C. (2004). New! Improved? The Transformation of the Global Agrifood System. *Rural Sociology*, *69*(3), 321–346.
Buttel, F. H. (1997). Some observations on agro-food change and the future of agricultural sustainability movements. In *Globalising food: agrarian questions and global restructuring.* (pp. 344–365). Psychology Press.
Cafaggi, F., & Renda, A. (2012). Public and private regulation: mapping the labyrinth. *DQ*, 16.
California Department of Food and Agriculture. (2017). *California Agricultural Statistics Review 2015-2016*.
Calvin, L. (2007). Outbreak linked to spinach forces reassessment of food safety practices. *Amber Waves*, *5*(3), 24.
Campbell, H. (2009). Breaking new ground in food regime theory: corporate environmentalism, ecological feedbacks and the "food from somewhere" regime? *Agriculture and Human Values*, *26*(4), 309.
Cash, D. W., Adger, W. N., Berkes, F., Garden, P., Lebel, L., Olsson, P., … Young, O. (2006). Scale and cross-scale dynamics: governance and information in a multilevel world. *Ecology and Society*, *11*(2), 8.
Castles, F. (1998). *Comparative public policy: Patterns of post-war transformation*. Edward Elgar Publishing.
Centers for Disease Control and Prevention (CDC). (2006). Ongoing multistate outbreak of Escherichia coli serotype O157:H7 infections associated with consumption of fresh spinach--United States, September 2006. *MMWR. Morbidity and Mortality Weekly Report*, *55*(38), 1045–1046.
Centers for Disease Control and Prevention. (2018, November 20). Outbreak of E. coli Infections Linked to Romaine Lettuce. Retrieved November 20, 2018, from https://www.cdc.gov/ecoli/2018/o157h7-11-18/index.html
Claeys, E. R. (2004). The Food and Drug Administration and the Command-and-Control Model of Regulation. *Saint Louis University Law Journal*, *49*, 105.
Clapp, J., & Fuchs, D. A. (2009). *Corporate Power in Global Agrifood Governance*. MIT Press.
Clapp, J. (2012). *Food. Cambridge: Polity* (Cambridge). Polity Press.
Clapp, J. (2014). Financialization, distance and global food politics. *The Journal of Peasant Studies*, *41*(5), 797–814.
Coglianese, C., & Lazer, D. (2003). Management-Based Regulation: Prescribing Private Management to Achieve Public Goals. *Law & Society Review*, *37*(4), 691–730.
Collins, J. (2000). Tracing social relations in commodity chains: The case of grapes in Brazil. In *Commodities and Globalization: Anthropological Perspectives* (pp. 97–109). Rowman & Littlefield Publishers, Inc.
Constance, D. H., Choi, J. Y., & Lyke-Ho-Gland, H. (2008). Conventionalization, bifurcation, and quality of life: Certified and non-certified organic farmers in Texas. *Southern Rural Sociology*, *23*(1), 208-234.
Cooter, R., & Fulton, R. (2001). Food matters: food safety research in the UK public sector, 1917-1990. Leatherhead Food Industry Journal, *4*, 251–262.

Davey, S. S., & Richards, C. (2013). Supermarkets and private standards: unintended consequences of the audit ritual. *Agriculture and Human Values*, *30*(2), 271–281.
DeLind, L. B., & Howard, P. H. (2008). Safe at any scale? Food scares, food regulation, and scaled alternatives. *Agriculture and Human Values*, *25*(3), 301–317.
Demeritt, D., Rothstein, H., Beaussier, A.-L., & Howard, M. (2015). Mobilizing risk: explaining policy transfer in food and occupational safety regulation in the UK. *Environment and Planning A*, *47*(2), 373–391.
Department for Environment Food & Rural Affairs. (2016). *British Food and Farming At A Glance*.
Department for Environment Food & Rural Affairs. (2017). *Horticulture Statistics 2016* (Horticulture Statistics).
Department for Environment, Food & Rural Affairs. (2017). *Agriculture in the United Kingdom 2016* (Agriculture in the United Kingdom).
Department on Exiting the European Union. (2018). *Draft Agreement on the withdrawal of the United Kingdom of Great Britain and Northern Ireland from the European Union and the European Atomic Energy Community* (Policy Paper). Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/756374/14_November_Draft_Agreement_on_the_Withdrawal_of_the_United_Kingdom_of_Great_Britain_and_Northern_Ireland_from_the_European_Union.pdf
Diaz, R., & Rosenberg, R. (2008). Spreading Dead Zones and Consequences for Marine Ecosystems, *321*, 926–929.
Dixon, H. (2013, March 19). Ready-to-eat salads from Morrisons and Asda caused infection outbreak, HPA say. Retrieved from https://www.telegraph.co.uk/news/health/news/9939839/Ready-to-eat-salads-from-Morrisons-and-Asda-caused-infection-outbreak-HPA-say.html
Dodds, A. (2018). *Comparative public policy*. Macmillan International Higher Education.
DuPuis, E. M., & Goodman, D. (2005). Should we go "home" to eat?: toward a reflexive politics of localism. *Journal of Rural Studies*, *21*(3), 359–371.
European Commission, G. F. (2002). Regulation (EC) No. 178/2002 of the European Parliament and of the Council of 28 January 2002, laying down the general principles and requirements of food law, establishing the European Food Safety Authority, and laying down procedures in matters of food safety. *Official Journal of the European Communities*, *L31*, 1–24.
European Commission. (2017). *CAP Explained: Direct Payments for Farmers 2015-2020* (Agriculture and Rural Development).
European Commission. Regulation (EC) No 764/2008 of the European Parliament and of the Council (2015).
European Commission. Regulation (EC) No 883/2004 of the European Parliament and of the Council of 29 April 2004 (2004).
European Union Committee. (2017). House of Lords - Brexit: Agriculture. Retrieved November 21, 2018, from https://publications.parliament.uk/pa/ld201617/ldselect/ldeucom/169/16907.htm
Eurostat. (2018). *Farm Structure Survey 2013: Main Results* (Statistics Explained).
FDA. (2010). *Program Information Manual Retail Food Protection: Recommendations for the Temperature Control of Cut Leafy Greens During Storage and Display in Retail Food Establishments*. Washington, DC, USA: U.S. Food and Drug Administration. Retrieved

from https://www.fda.gov/downloads/Food/GuidanceRegulation/RetailFoodProtection/UCM218902.pdf
Fearne, A. (1998). The evolution of partnerships in the meat supply chain: insights from the British beef industry. *Supply Chain Management: An International Journal*, *3*(4), 214–231.
Fearne, A., & Garcia Martinez, M. (2005). Opportunities for the coregulation of food safety: insights from the United Kingdom. Retrieved from http://www.choicesmagazine.org/2005-2/safety/2005-2-04.htm
Federici, S. (2004). *Caliban and the Witch*. Autonomedia.
Fisher, E., Sheppard, H., Bain, C., Ransom, E., Higgins, V., & others. (2013). Pushing the boundaries of the social: Private agri-food standards and the governance of fair trade in European Public Procurement. *International Journal of Sociology of Agriculture & Food*, *20*(1), 31–49.
Fitzgerald, D. K. (2003). *Every farm a factory: The industrial ideal in American agriculture*. Yale University Press.
Food and Drug Administration of the United States Department of Health and Human Services. FDA Food Safety Modernization Act, Pub. L. No. 111–353, § 2201, 2201 21 U.S.C. 124 STAT.3885 (2011).
Food and Drug Administration of the United States Department of Health and Human Services. Food Code, UCM374510 Food Code § (2013). Retrieved from https://www.fda.gov/downloads/food/guidanceregulation/retailfoodprotection/foodcode/ucm374510.pdf
Food and Drug Administration of the United States Department of Health and Human Services. (2018a). Outbreaks: Environmental Assessment of Factors Potentially Contributing to the Contamination of Romaine Lettuce Implicated in a Multi-State Outbreak of E. coli O157:H7. Retrieved November 12, 2018, from https://www.fda.gov/Food/RecallsOutbreaksEmergencies/Outbreaks/ucm624546.htm
Food and Drug Administration of the United States Department of Health and Human Services. (2018b). Food Safety Modernization Act (FSMA) - What to Expect with the Next Compliance Dates for the FSMA Preventive Controls for Animal Foods Rule. Retrieved November 7, 2018, from https://www.fda.gov/food/guidanceregulation/fsma/ucm570439.htm?utm_campaign=8-14-2018-PCAnimalFood&utm_medium=email&utm_source=Eloqua
Food and Drug Administration of the United States, Office of Foods and Veterinary Medicine. (2018c). *Enforcement Discretion for Certain FSMA Provisions* (Fact Sheet).
Food and Drug Administration of the United States Department of Health and Human Services. (2018d). Press Announcements - Statement from FDA Commissioner Scott Gottlieb, M.D., on the current romaine lettuce *E. coli* O157:H7 outbreak investigation. Retrieved December 5, 2018, from https://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm626716.htm
Food and Drug Administration of the United States. Federal Food, Drug, and Cosmetic Act (FD&C Act), 21 U.S.C. § (1938).
Food Standards Agency. (2009). *The Food Safety Act 1990 - A Guide for Food Businesses* (pp. 1–29).

Frances, J., Barrientos, S., & Rogaly, B. (2005). Temporary workers in UK agriculture and horticulture: A study of employment practices in the agriculture and horticulture industries and co-located packhouse and primary food processing sectors. *Food and Rural Affairs (DEFRA)*.
Freidberg, S. (2004). *French beans and food scares culture and commerce in an anxious age*. New York, N.Y.: Oxford University Press.
Freidberg, S. (2009). *Fresh*. Harvard University Press.
Freidberg, S. (2017). Big Food and Little Data: The Slow Harvest of Corporate Food Supply Chain Sustainability Initiatives. *Annals of the American Association of Geographers*, *107*(6), 1389–1406.
Friedland, W. H. (1997). Commentary on Part III: 'Creating space for food' and 'agro-industrial just-in-time'. *Globalising Food: Agrarian Questions and Global Restructuring*, 166-171.
Friedmann, H. (1992). Distance and durability: Shaky foundations of the world food economy. *Third World Quarterly*, *13*(2), 371–383.
Friedmann, H., & McMichael, P. (1989). Agriculture and the state system: The rise and decline of national agricultures, 1870 to the present. *Sociologia Ruralis*, *29*(2), 93–117.
Fuchs, D., & Kalfagianni, A. (2010). The Causes and Consequences of Private Food Governance. *Business and Politics*, *12*(03), 1–34.
Fuchs, D., Kalfagianni, A., & Arentsen, M. (2009). Retail power, private standards, and sustainability in the global food system. In *Corporate power in global agrifood governance* (pp. 29–59). MIT Press.
Fulponi, L. (2006). Private voluntary standards in the food system: The perspective of major food retailers in OECD countries. *Food Policy*, *31*(1), 1–13.
Funtowicz, S. O., & Ravetz, J. R. (1996). Risk management, post-normal science, and extended peer communities. *Accident and Design–Contemporary Debates in Risk Management. UCL Press, London*, 172–181.
Furness, J., & Burke, D. (2017, November 18). Woman stunned to find a live grasshopper inside a bag of Tesco salad. Retrieved November 15, 2018, from http://www.mirror.co.uk/news/uk-news/woman-stunned-find-live-grasshopper-11541601
Geisseler, D., & Horwath, W. R. (2016). *Lettuce Production in California* (p. 4). California Department of Food and Agriculture Fertilizer Research and Education Program (FREP). Retrieved from http://anrcatalog.ucdavis.edu/pdf/7216.pdf.
Gennet, S., Howard, J., Langholz, J., Andrews, K., Reynolds, M. D., & Morrison, S. A. (2013). Farm practices for food safety: an emerging threat to floodplain and riparian ecosystems. *Frontiers in Ecology and the Environment*, *11*(5), 236–242.
Gereffi, G., & Lee, J. (2009). A global value chain approach to food safety and quality standards. *Global Health Diplomacy for Chronic Disease Prevention Working Paper Series, February*.
Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Economy*, *12*(1), 78–104.
Gibbon, P. (2003). Value-chain Governance, Public Regulation and Entry Barriers in the Global Fresh Fruit and Vegetable Chain into the EU. *Development Policy Review*, *21*(5–6), 615–625.
Gibbon, P., Bair, J., & Ponte, S. (2008). Governing global value chains: an introduction. *Economy and Society*, *37*(3), 315–338.

Gil, M. I., Selma, M. V., Suslow, T., Jacxsens, L., Uyttendaele, M., & Allende, A. (2015). Pre- and postharvest preventive measures and intervention strategies to control microbial food safety hazards of fresh leafy vegetables. *Critical Reviews in Food Science and Nutrition*, *55*(4), 453–468.

Global Food Safety Initiative. (2011). *Enhancing Food Safety Through Third Party Certification* (White Paper). Retrieved from https://www.mygfsi.com/gfsifiles/GFSI_White_Paper_-_Enhancing_Food_Safety_Through_Third_Party_Certification.pdf

Global Food Safety Intitiative. (2018, March 1). GFSI Turns 18 in 2018: Where We've Been and Where We're Going. Retrieved November 21, 2018, from //www.mygfsi.com/news-resources/news/news-blog/1291-gfsi-turns-18-in-2018.html

GlobalG.A.P. (2016, August 30). GLOBALG.A.P. and United Fresh Produce Association Introduce the First Global Food Safety Initiative (GFSI) Recognized Application of the Produce GAP Harmonized Standards. Retrieved October 21, 2018, from https://www.globalgap.org/uk_en/media-events/news/articles/GLOBALG.A.P.-and-United-Fresh-Produce-Association-Introduce-the-First-Global-Food-Safety-Initiative-GFSI-Recognized-Application-of-the-Produce-GAP-Harmonized-Standards./

Goodman, D., & Redclift, M. (2002). *Refashioning nature: food, ecology and culture*. Routledge.

Goodman, D., & Watts, M. (1994). Reconfiguring the rural or fording the divide?: Capitalist restructuring and the global agro-food system. *The Journal of Peasant Studies*, *22*(1), 1–49.

Goodman, D., DuPuis, E. M., & Goodman, M. K. (2012). *Alternative food networks: Knowledge, practice, and politics*. Routledge.

Goodman, D., Watts, M., & Watts, M. J. (1997). *Globalising food: agrarian questions and global restructuring*. Psychology Press.

Gove, M. (2018, January). *Farming for the Next Generation*. Presented at the Oxford Farming Conference, Oxford, UK. Retrieved from https://www.ofc.org.uk/sites/ofc/files/papers/Farming%20for%20the%20next%20generation%20-%20GOV.UK_.pdf

Griffin, K. (1979). *The political economy of agrarian change: An essay on the Green Revolution*. Springer.

Gunningham, N., Kagan, R. A., & Thornton, D. (2003). *Shades of green: business, regulation, and environment*. Stanford University Press.

Guthman, J. (2004). *Agrarian dreams: The paradox of organic farming in California*. University of California Press.

Guthman, J. (2007). The Polanyian way? Voluntary food labels as neoliberal governance. *Antipode*, *39*(3), 456–478.

Guthman, J. (2014). *Agrarian Dreams: The Paradox of Organic Farming in California*. University of California Press.

Hammoudi, A., Hoffmann, R., & Surry, Y. (2009). Food safety standards and agri-food supply chains: an introductory overview. *European Review of Agricultural Economics*, *36*(4), 469–478.

Harvey, M., McMeekin, A., & Warde, A. (2010). *Qualities of food*. Manchester University Press.

Hatanaka, M., & Busch, L. (2008). Third-Party Certification in the Global Agrifood System: An Objective or Socially Mediated Governance Mechanism? *Sociologia Ruralis*, *48*(1), 73–91.

Hatanaka, M., Bain, C., & Busch, L. (2005). Third-party certification in the global agrifood system. *Food Policy*, *30*(3), 354–369.
Havinga, T. (2006). Private regulation of food safety by supermarkets. *Law & Policy*, *28*(4), 515–533.
Havinga, T., & Verbruggen, P. (2017). Understanding Complex Governance Relationships in Food Safety Regulation: The RIT Model as a Theoretical Lens. *The ANNALS of the American Academy of Political and Social Science*, *670*(1), 58–77.
Hawkins, K., & Hutter, B. M. (1993). The response of business to social regulation in England and Wales: an enforcement perspective. *Law & Policy*, *15*(3), 199–217.
Heffernan, W. D. (2000). Concentration of ownership and control in agriculture. *Hungry for Profit: The Agribusiness Threat to Farmers, Food, and the Environment*, 61–75.
Heffernan, W. D., & Constance, D. H. (1994). Transnational corporations and the globalization of the food system. *From Columbus to ConAgra: The Globalization of Agriculture and Food*, *33*, 29–51.
Hendrickson, M., & Heffernan, W. (2007). Concentration of agricultural markets. *Columbia, MO, Department of Rural Sociology, University of Missouri*. Retrieved from http://www.foodcircles.missouri.edu/CRJanuary02.pdf
Henson, S. (2008). The role of public and private standards in regulating international food markets. *Journal of International Agricultural Trade and Development*, *4*(1), 63–81.
Henson, S., & Hooker, N. H. (2001). Private sector management of food safety: public regulation and the role of private controls. *The International Food and Agribusiness Management Review*, *4*(1), 7–17.
Henson, S., & Humphrey, J. (2009). The impacts of private food safety standards on the food chain and on public standard-setting processes. *Rome: Food and Agriculture Organisation of the United Nations (FAO)*. Retrieved from http://www.ijhar-s.gov.pl/pliki/download/090525_104321_6195_ALINORM%2009.32.9D.part2.pdf
Henson, S., & Humphrey, J. (2010). Understanding the Complexities of Private Standards in Global Agri-Food Chains as They Impact Developing Countries. *The Journal of Development Studies*, *46*(9), 1628–1646.
Henson, S., & Northen, J. (1998). Economic determinants of food safety controls in supply of retailer own-branded products in United Kingdom. *Agribusiness*, *14*(2), 113–126.
Henson, S., & Reardon, T. (2005). Private agri-food standards: Implications for food policy and the agri-food system. *Food Policy*, *30*(3), 241–253.
Hobbs, J. E. (2010). Public and Private Standards for Food Safety and Quality: International Trade Implications. *Estey Centre Journal of International Law & Trade Policy*, *11*(1).
Hobbs, J. E., Fearne, A., & Spriggs, J. (2002). Incentive structures for food safety and quality assurance: an international comparison. *Food Safety Incentives in a Changing World Food System*, *13*(2), 77–81.
Hoffmann, S. (2010). Food safety policy and economics. *Resources for the Future*. Retrieved from https://pdfs.semanticscholar.org/de79/43a27b55df86c4ee6fe7ba56e555173dd933.pdf
Holt Giménez, E., & Shattuck, A. (2011). Food crises, food regimes and food movements: rumblings of reform or tides of transformation? *J Peasant Stud*, *38*(1), 109–144.
Horlings, L. G., & Marsden, T. K. (2011). Towards the real green revolution? Exploring the conceptual dimensions of a new ecological modernisation of agriculture that could 'feed the world.' *Global Environmental Change*, *21*(2), 441–452.

Horrigan, L., Lawrence, R. S., & Walker, P. (2002). How sustainable agriculture can address the environmental and human health harms of industrial agriculture. *Environmental Health Perspectives*, *110*(5), 445–456.
Horsfall, S. (2017, August 28). LGMA Metrics Fully Align with FSMA Produce Safety Rule. Retrieved from https://lgma.ca.gov/2017/08/lgma-metrics-now-alignment-fsma-produce-safety-rule/
Howard-Grenville, J. A. (2005). Explaining "Shades of Green": Why Do Companies Act Differently on Similar Environmental Issues? *Law & Social Inquiry*, *30*(3), 551–581.
Howard, P. (2006). Consolidation in Food and Agriculture: Implications for Farmers & Consumers. *The Natural Farmer*, 17–20.
Howard, P. H. (2016). *Concentration and power in the food system: Who controls what we eat?* (Vol. 3). Bloomsbury Publishing.
Hutter, B. M., & Amodu, T. (2008). Risk regulation and compliance: Food safety in the UK. *LSE, London*. Retrieved from http://www.lse.ac.uk/accounting/CARR/pdf/NCP04219.pdf
Iles, A. (2005). Learning in Sustainable Agriculture: Food Miles and Missing Objects. *Environmental Values*, *14*(2), 163–183.
Iles, A. (2007). Seeing sustainability in business operations: US and British food retailer experiments with accountability. *Business Strategy and the Environment*, *16*(4), 290–301.
IPES-Food. (2016). *From Uniformity to Diversity: A paradigm shift from industrial agriculture to diversified agroecological systems* (No. 2). International Panel of Experts on Sustainable Food systems.
IPES-Food. (2017). *Unravelling the Food-Health Nexus: Addressing Practices, Political Economy and Power Relations to Build a Healthier Food System*. The Global Alliance for the Future of Food and IPES-Food. Retrieved from http://www.ipes-food.org/images/Reports/Health_FullReport.pdf
Irwin, A. (2006). The politics of talk: coming to terms with the 'new'scientific governance. *Social Studies of Science*, *36*(2), 299–320.
Jaffee, S., & Henson. (2004). *Standards and agro-food exports from developing countries: rebalancing the debate*. The World Bank.
Jasanoff, S. (1997). Civilization and madness: the great BSE scare of 1996. *Public Understanding of Science*, *6*(3), 221–232.
Jasanoff, S. (1999). The Songlines of Risk. *Environmental Values*, *8*(2), 135–152.
Jay-Russell, M., & Doyle, M. P. (Eds.). (2016). *Food Safety Risks from Wildlife*. Cham: Springer International Publishing. Retrieved from http://link.springer.com/10.1007/978-3-319-24442-6.
World Health Organization. (2003). *Diet, nutrition, and the prevention of chronic diseases: report of a WHO-FAO Expert Consultation; [Joint WHO-FAO Expert Consultation on Diet, Nutrition, and the Prevention of Chronic Diseases, 2002, Geneva, Switzerland*. Geneva: World Health Organization.
Karp, D. S., Baur, P., Atwill, E. R., De Master, K., Gennet, S., Iles, A., Nelson, J. L., Sciligo, A. R., Kremen, C. (2015). The Unintended Ecological and Social Impacts of Food Safety Regulations in California's Central Coast Region. *BioScience*, 65(12), 1173-1183.
Kirk-Wilson, R. (2002). *Review of Food Assurance Schemes for the Food Standards Agency* (p. 95). Food Standards Agency.

Konefal, J., Mascarenhas, M., & Hatanaka, M. (2005). Governance in the Global Agro-food System: Backlighting the Role of Transnational Supermarket Chains. *Agriculture and Human Values*, *22*(3), 291–302.
Koukkidis, G., Haigh, R., Allcock, N., Jordan, S., & Freestone, P. (2016). Salad leaf juices enhance Salmonella growth, fresh produce colonisation and virulence. *Applied and Environmental Microbiology*, *83*(1), 1–13.
Kremen, C., & Miles, A. (2012). Ecosystem services in biologically diversified versus conventional farming systems: benefits, externalities, and trade-offs. *Ecology and Society*, *17*(4), 40.
Laffont, J.-J., & Tirole, J. (1991). The politics of government decision-making: A theory of regulatory capture. *The Quarterly Journal of Economics*, *106*(4), 1089–1127.
Langholz, J., & Jay-Russell, M. T. (2013). Potential role of wildlife in pathogenic contamination of fresh produce. *Human-Wildlife Interactions*, *7*(1), 140–57.
Levenstein, H. (2012). *Fear of food: A history of why we worry about what we eat*. University of Chicago Press.
Lewis, K. A., Green, A., Tzilivakis, J., & Warner, D. J. (2010). The contribution of UK farm assurance schemes towards desirable environmental policy outcomes. *International Journal of Agricultural Sustainability*, *8*(4), 237–249.
Lichbach, M. I., & Zuckerman, A. S. (2009). *Comparative Politics: Rationality, Culture, and Structure*. Cambridge University Press.
Lin, B.-H., Buzby, J., Anekwe, T., & Bentley, J. (2016). *U.S. Food Commodity Consumption Broken Down by Demographics, 1994-2008* (ERR-206). U.S. Department of Agriculture, Economic Research Service.
Little, C. L., & Gillespie, I. A. (2008). Prepared salads and public health. *Journal of Applied Microbiology*, *105*(6), 1729–1743.
Locke, R. M., Rissing, B. A., & Pal, T. (2013). Complements or Substitutes? Private Codes, State Regulation and the Enforcement of Labour Standards in Global Supply Chains: Complements or Substitutes? *British Journal of Industrial Relations*, *51*(3), 519–552.
Loconto, A., & Busch, L. (2010). Standards, techno-economic networks, and playing fields: Performing the global market economy. *Review of International Political Economy*, *17*(3), 507–536.
Lowell, K., Langholz, J., & Stuart, D. (2010). Safe and sustainable: Co-managing for food safety and ecological health in California's Central Coast region. *Available at Ucfoodsafety*. *Ucdavis*. *Edu*/*Files*/*198568*. *Pdf*. Accessed January 1, 2015.
Lynch, M. F., Tauxe, R. V., & Hedberg, C. W. (2009). The growing burden of foodborne outbreaks due to contaminated fresh produce: risks and opportunities. *Epidemiology and Infection*, *137*(03), 307–315.
Lyson, T. A., Stevenson, G. W., & Welsh, R. (2008). *Food and the mid-level farm: Renewing an agriculture of the middle*. MIT Press.
Majone, G. (1997). From the Positive to the Regulatory State: Causes and Consequences of Changes in the Mode of Governance. *Journal of Public Policy*, *17*(2), 139–167.
Marx, K. (1976). *Capital, Volume I, translated by Ben Fowkes*. Harmondsworth: Penguin.
Mayo, J. M. (1991). The American Public Market. *Journal of Architectural Education*, *45*(1), 41–57.
Mayo, J. M. (1993). *The American grocery store: the business evolution of an architectural space*. JSTOR.

Mazoyer, M., & Roudart, L. (2007). *A history of world agriculture: from the neolithic age to the current crisis*. Routledge.
McMahon, M. (2013). What Food is to be Kept Safe and for Whom? Food-Safety Governance in an Unsafe Food System. *Laws*, *2*(4), 401–427.
McMichael, P. (2002). The Global Restructuring of Agro-food Systems. *Mondes En Développement*, *No 117*(1), 45–53.
McMichael, P. (2005). Global Development and The Corporate Food Regime. In *Research in Rural Sociology and Development* (Vol. 11, pp. 265–299). Emerald Group Publishing Limited.
McMichael, P. (2009). A food regime analysis of the "world food crisis." *Agriculture and Human Values*, *26*(4), 281–295.
McMichael, P. (2011). *Development and social change: A global perspective*. Pine Forge Press.
McWilliams, C. (2000). *Factories in the field: The story of migratory farm labor in California*. University of California Press.
Mei Soon, J., & Baines, R. (2013). Public and Private Food Safety Standards: Facilitating or Frustrating Fresh Produce Growers? *Laws*, *2*(1), 1–19.
Millstone, E., & Lang, T. (2018). *Weakening UK Food Law Enforcement: A risky Tactic in Brexit* (FRC Food Brexit Policy Briefing).
Mintz, S. (1985). *Sweetness and Power: the place of sugar in world history*. London: Penguin Books.
Monaghan, J., & Hutchison, M. (2010). *Monitoring microbial food safety of fresh produce* (Factsheet No. 13/10) (p. 9). Food Standards Agency and Horticultural Development Company.
Morris, C. (2000). Quality assurance schemes: a new way of delivering environmental benefits in food production? *Journal of Environmental Planning and Management*, *43*(3), 443–448.
Munton, R. (2003). Deliberative democracy and environmental decision making. Edward Elgar.
Murdoch, J., & Miele, M. (2004). A new aesthetic of food? Relational reflexivity in the 'alternative' food movement. *Qualities of Food*, 156–175.
Murdoch, J., Marsden, T., & Banks, J. (2009). Quality, Nature, and Embeddedness: Some Theoretical Considerations in the Context of the Food Sector*. *Economic Geography*, *76*(2), 107–125.
Nadvi, K. (2008). Global standards, global governance and the organization of global value chains. *Journal of Economic Geography*, *8*(3), 323–343.
National Farmers Union. (2018, February). UK food and farming sector unites to highlight impact on production. Retrieved November 21, 2018, from https://www.nfuonline.com:443/news/latest-news/successful-brexit-set-out-by-sector/
Natural Resources Defense Council. (2007). *Food Miles: How far your food travels has serious consequences for your health and the climate* (Health Facts). National Resources Defense Council.
Nestle, M. (2010). *Safe food: Bacteria, biotechnology, and bioterrorism* (Vol. 5). Berkeley: University of California Press.
Nestle, M. (2013). *Food Politics: How the Food Industry Influences Nutrition and Health, Revised and Expanded Edition*. University of California Press.
O'Neill, K. (2017). *The Environment and International Relations*. Cambridge University Press.
O'Rourke, D. (2005). Market movements: Nongovernmental organization strategies to influence global production and consumption. *Journal of Industrial Ecology*, *9*(1–2), 115–128.

OECD. (2014). Competition Issues in the Food Chain Industry. Directorate For Financial And Enterprise Affairs Competition Committee.
Otter, C. (2015). Industrializing Diet, Industrializing Ourselves: Technology, Energy, and Food, 1750–2000. *The Routledge History of Food. New York: Routledge*, 220–249.
Painter, J. A., Hoekstra, R. M., Ayers, T., Tauxe, R. V., Braden, C. R., Angulo, F. J., & Griffin, P. M. (2013). Attribution of foodborne illnesses, hospitalizations, and deaths to food commodities by using outbreak data, United States, 1998–2008. *Emerging Infectious Diseases*, *19*(3), 407–415.
Pannell, D. J., & Schilizzi, S. (1999). Sustainable Agriculture: A Matter of Ecology, Equity, Economic Efficiency or Expedience? *Journal of Sustainable Agriculture*, *13*(4), 57–66.
Paul, K. T. (2012). The Europeanization of food safety: a discourse-analytical approach. *Journal of European Public Policy*, *19*(4), 549–566.
Peine, E., & McMichael, P. (2005). Globalization and global governance. *Agricultural Governance: Globalization and the New Politics of Regulation*, *10*, 19.
Petrini, C. (2003). *Slow food: The case for taste*. Columbia University Press.
Ponte, S., & Gibbon, P. (2005). Quality standards, conventions and the governance of global value chains. *Economy and Society*, *34*(1), 1–31.
Princen, T. (2002). Distancing: Consumption and the severing of feedback. In *Confronting consumption* (pp. 103–131). Cambridge, MA, USA: MIT Press.
Quested, T. E., Cook, P. E., Gorris, L. G. M., & Cole, M. B. (2010). Trends in technology, trade and consumption likely to impact on microbial food safety. *International Journal of Food Microbiology*, *139*, S29–S42.
Ratzan, S. C. (1998). *The Mad Cow Crisis: Health and the Public Good*. New York University Press.
Redclift, M. (1997). Sustainability and theory: an agenda for action. In *Globalising food. Agrarian questions and global restructuring. New York: Routledge*.
Rekhy, R., & McConchie, R. (2014). Promoting consumption of fruit and vegetables for better health. Have campaigns delivered on the goals? *Appetite*, *79*, 113–123.
Roberts, C., Steer, T., Maplethorpe, N., Cox, L., Meadows, S., Nicholson, S., … Swan, G. (2018). *National Diet and Nutrition Survey: Results from Years 7-8 (combined) of the Rolling Programme (2014/15 to 2015/16)*. Public Health England.
Rogaly, B. (2008). Intensification of workplace regimes in British horticulture: the role of migrant workers. *Population, Space and Place*, *14*(6), 497–510.
Rosenbaum, W. A. (2017). *Environmental Politics and Policy*. CQ press.
Rossignoli, C. M., & Moruzzo, R. (2014). Retail Power and Private Standards in the Agri-Food Chain. *Agroecology and Sustainable Food Systems*, *38*(9), 1108–1124.
Rothstein, H. (2013). Domesticating participation: participation and the institutional rationalities of science-based policy-making in the UK food standards agency. *Journal of Risk Research*, *16*(6), 771–790.
Rothstein, H. F. (2004). Precautionary bans or sacrificial lambs? Participative risk regulation and the reform of the UK food safety regime. *Public Administration*, *82*(4), 857–881.
Sagoo, S. K., Little, C. L., Ward, L., Gillespie, I. A., & Mitchell, R. T. (2003). Microbiological study of ready-to-eat salad vegetables from retail establishments uncovers a national outbreak of salmonellosis. *Journal of Food Protection*, *66*(3), 403–409.
Samuels, W. J. (1981). *Whigs and Hunters*. Taylor & Francis.

Scallan, E., Hoekstra, R. M., Angulo, F. J., Tauxe, R. V., Widdowson, M.-A., Roy, S. L., Jones, J. L., Griffin, P. M. (2011). Foodborne Illness Acquired in the United States—Major Pathogens. *Emerging Infectious Diseases*, *17*(1), 7–15.

Selma, M. V., Martínez-Sánchez, A., Allende, A., Ros, M., Hernández, M. T., & Gil, M. I. (2010). Impact of Organic Soil Amendments on Phytochemicals and Microbial Quality of Rocket Leaves (Eruca sativa). *Journal of Agricultural and Food Chemistry*, *58*(14), 8331–8337.

Sexton, R. J., Sheldon, I., McCorriston, S., & Wang, H. (2007). Agricultural trade liberalization and economic development: the role of downstream market power. *Agricultural Economics*, *36*(2), 253–270.

Sharma, L. L., Teret, S. P., & Brownell, K. D. (2010). The food industry and self-regulation: standards to promote success and to avoid public health failures. *American Journal of Public Health*, *100*(2), 240–246.

Shaw, G., Curth, L., & Alexander, A. (2004). Selling Self-Service and the Supermarket: The Americanisation of Food Retailing in Britain, 1945–60. *Business History*, *46*(4), 568–582.

Sheingate, A. D. (2003). *The rise of the agricultural welfare state: institutions and interest group power in the United States, France, and Japan*. Princeton University Press.

Shiva, V. (2016). *The violence of the green revolution: Third world agriculture, ecology, and politics*. University Press of Kentucky.

Smil, V. (2002). Nitrogen and food production: proteins for human diets. *AMBIO: A Journal of the Human Environment*, *31*(2), 126–131.

Stigler, G. J. (1971). The theory of economic regulation. *The Bell Journal of Economics and Management Science*, 3–21.

Stuart, D. (2009). *A new wave of environmental degradation in California agriculture: Private standards, constrained choice, and changes in land management*. University of California, Santa Cruz.

Stuart, D. (2010). Science, standards and power: New food safety governance in California. *Journal of Rural Social Sciences*, *25*(3), 111–140.

Stuart, D. (2011). "Nature" is Not Guilty: Foodborne Illness and the Industrial Bagged Salad: Foodborne illness and the industrial bagged salad. *Sociologia Ruralis*, *51*(2), 158–174.

Stuart, D., & Worosz, M. R. (2012). Risk, anti-reflexivity, and ethical neutralization in industrial food processing. *Agriculture and Human Values*, *29*(3), 287–301.

Stuart, D., Shennan, C., & Brown, M. (2006). Food Safety versus Environmental Protection on the Central California Coast: Exploring the Science Behind an Apparent Conflict. *Center for Agroecology & Sustainable Food Systems*. Retrieved from

Sunstein, C. R. (1993). *After the Rights Revolution: Reconceiving the Regulatory State*. Harvard University Press.

Suslow, T. (2003). *Key points of control and management of microbial food safety: information for growers, packers, and handlers of fresh-consumed horticultural products* (No. ANR Publication 8102). University of California. Retrieved from

Suslow, T., Oria, M. P., Beuchat, L. R., Garrett, E. H., Parish, M. E., Harris, L. J., … Busta, F. F. (2003). Production Practices as Risk Factors in Microbial Food Safety of Fresh and Fresh-Cut Produce. In *Comprehensive Reviews in Food Science and Food Safety* (Vol. s1, pp. 38–77).

Tabor, M. (2018, February 9). Will FSMA Implementation Put American Family Farmers at Competitive Disadvantage? [Opinion]. Retrieved November 16, 2018, from https://www.growingproduce.com/fruits/will-fsma-implementation-put-american-family-farmers-at-competitive-disadvantage/

Takeuchi, K., & Frank, J. F. (2000). Penetration of Escherichia coli O157: H7 into lettuce tissues as affected by inoculum size and temperature and the effect of chlorine treatment on cell viability. *Journal of Food Protection*, *63*(4), 434–440.

Takeuchi, K., Matute, C. M., Hassan, A. N., & Frank, J. F. (2000). Comparison of the attachment of Escherichia coli O157: H7, Listeria monocytogenes, Salmonella Typhimurium, and Pseudomonas fluorescens to lettuce leaves. *Journal of Food Protection*, *63*(10), 1433–1437.

Tallontire, A., Opondo, M., Nelson, V., & Martin, A. (2011). Beyond the vertical? Using value chains and governance as a framework to analyse private standards initiatives in agri-food chains. *Agriculture and Human Values*, *28*(3), 427–441.

Tam, C. C., Larose, T., & O'Brien, S. J. (2014). *Costed extension to the Second Study of Infectious Intestinal Disease in the Community: Identifying the proportion of foodborne disease in the UK and attributing foodborne disease by food commodity* (No. Project B18021 (FS231043)). University of Liverpool. Retrieved from https://www.food.gov.uk/science/research/foodborneillness/b14programme/b14projlist/fs231043ext

Thomas, C. I. (2014). *In Food We Trust: The Politics of Purity in American Food Regulation*. U of Nebraska Press.

Thorlakson, T., Hainmueller, J., & Lambin, E. F. (2018). Improving environmental practices in agricultural supply chains: The role of company-led standards. *Global Environmental Change*, *48*, 32–42.

Tilman, D., Cassman, K. G., Matson, P. A., Naylor, R., & Polasky, S. (2002). Agricultural sustainability and intensive production practices. *Nature*, *418*(6898), 671-677.

Tyrrel, S. F., Knox, J. W., & Weatherhead, E. K. (2006). Microbiological water quality requirements for salad irrigation in the United Kingdom. *Journal of Food Protection*, *69*(8), 2029–2035.

USDA NASS. (2014). *2012 Census of Agriculture*. Retrieved from https://www.nass.usda.gov/Publications/AgCensus/2012/

USDA NASS. (2017). 2016 State Agriculture Overview: California. Retrieved March 25, 2018, from https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=CALIFORNIA

Van Boxstael, S., Habib, I., Jacxsens, L., De Vocht, M., Baert, L., Van De Perre, E., … Uyttendaele, M. (2013). Food safety issues in fresh produce: Bacterial pathogens, viruses and pesticide residues indicated as major concerns by stakeholders in the fresh produce chain. *Food Control*, *32*(1), 190–197.

van der Meulen, B. (2013). The Structure of European Food Law. *Laws*, *2*(2), 69–98.

van Larebeke, N., Hens, L., Schepens, P., Covaci, A., Baeyens, J., Everaert, K., … De Poorter, G. (2001). The Belgian PCB and dioxin incident of January-June 1999: exposure data and potential impact on health. *Environmental Health Perspectives*, *109*(3), 265–273.

Vandemoortele, T., & Deconinck, K. (2014). When Are Private Standards More Stringent than Public Standards? *American Journal of Agricultural Economics*, *96*(1), 154–171.

Vasileska, A., & Rechkoska, G. (2012). Global and Regional Food Consumption Patterns and Trends. *Procedia - Social and Behavioral Sciences*, *44*, 363–369.

Vestrheim, D. F., Lange, H., Nygaard, K., Borgen, K., Wester, A. L., Kvarme, M. L., & Vold, L. (2016). Are ready-to-eat salads ready to eat? An outbreak of Salmonella Coeln linked to imported, mixed, pre-washed and bagged salad, Norway, November 2013. *Epidemiology & Infection*, *144*(8), 1756–1760.

Vogel, D. (1986). *National styles of regulation: Environmental policy in Great Britain and the United States*. Cornell University Press.

Vogel, D. (2012). *The Politics of Precaution: Regulating Health, Safety, and Environmental Risks in Europe and the United States*. Princeton University Press.

von Schlippenbach, V., & Teichmann, I. (2012). The Strategic Use of Private Quality Standards in Food Supply Chains. *American Journal of Agricultural Economics*, *94*(5), 1189–1201.

Wallerstein, I. (2011). *The modern world-system I: Capitalist agriculture and the origins of the European world-economy in the sixteenth century* (Vol. 1). University of California Press.

Wesselink, A., Paavola, J., Fritsch, O., & Renn, O. (2011). Rationales for public participation in environmental policy and governance: practitioners' perspectives. *Environment and Planning A*, *43*(11), 2688–2704.

Wiener, J. B., & Rogers, M. D. (2002). Comparing precaution in the United States and Europe. *Journal of Risk Research*, *5*(4), 317–349.

World Health Organization. (1998). *Guidance on regulatory assessment of HACCP. The report of a Joint FAO/WHO Consultation on the Role of Government Agencies in Assessing HACCP* (No. WHO/FSF/FOS/98.5). Geneva.

Worosz, M. R., Knight, A. J., & Harris, C. K. (2008). Resilience in the US red meat industry: the roles of food safety policy. *Agriculture and Human Values*, *25*(2), 187–191.

Wynne, B. (2002). Risk and Environment as Legitimatory Discourses of Technology: Reflexivity Inside Out? *Current Sociology*, *50*(3), 459–477.

Appendix 1: UK Survey Instrument

Section 1 of 4: About Your Farming Operation

1. What type of farm operation are you representing? Circle the most accurate option:
    a. Independent primary farmer of fresh vegetables, selling directly to retail
    b. Association of primary farmers of fresh vegetables, selling directly to retail
    c. Independent primary farmer of fresh vegetables, selling to a processor or other intermediary
    d. Association of primary farmers of fresh vegetables, selling to a processor or other intermediary
    e. Independent primary farmer of fresh vegetables, selling to channels other than consumer retail
    f. Association of primary farmers of fresh vegetables, selling to channels other than consumer retail
    g. Other (please explain: _____
2. Location of farm fields within UK: _____
3. Farm Size (or total area of all supplier farms): _____
4. Business Name: _____
5. What fresh vegetable products do you grow?
6. How long have you personally been involved in production?
7. What is your role/title at this farming business?
8. Which of these options best describes your farm's gross vegetable sales per year?
    a. Less than £14,500
    b. £14,501 - £60,000
    c. £60,001 - £145,000
    d. £145,001 - £600,000
    e. £600,001 - £1 million
    f. £1 million – £5 million
    g. More than £5 million
    h. Prefer not to say
9. What is your farm's organic or conventional status? Circle the best option:
    a. Certified Organic (Who is your certifier/organic control body? _____
    b. Organic but not certified
    c. In transition to organic
    d. Conventional, non-organic
    e. Mixed organic and conventional
    f. Prefer not to say
    g. Other, please specify:
10. To whom do you sell your produce? Please rank your top 3 market channels in order of importance below, with #1 being most important:
    a. Grocery Retailer(s) (Name of retailer(s): _____)
    b. Food Service
    c. Processor
    d. Packer/Shipper
    e. Farm Stand
    f. Farmer's Market or Street Market
    g. CSA or other direct delivery to consumer
    h. Wholesaler
    i. Broker
    j. Other:_____

Section 2 of 4: About Your Food Safety Practices

11. To which standard(s) is your farm food safety certified? (circle all that apply)
    a. I am not food safety certified

b. Red Tractor Assured Produce Standards
c. Marks & Spencer "Field to Fork"
d. Tesco NURTURE
e. GlobalG.A.P.
f. BRC
g. ISO 22000
h. International Featured Standards (IFS) Food
i. Safe Quality Food (SQF)
j. Other(s): _____

12. Which certifying body certifies you for food safety, if you are certified?
13. Where do you most often get information about food safety practices? Rank your top 3 sources by adding #1, #2 and #3 below and explain how you interact with them.
    a. Buyer
    b. Auditor/Inspector
    c. Other farmers
    d. Working with Academic Institutions
    e. Consultant
    f. Trade association
    g. UK (central or local) Government
    h. Not-for-profit organisation
    i. Other: _____
14. Why did you seek to become food safety certified?
15. How satisfied are you, overall, with the food safety certification process?
16. Do you feel that food safety certification under the current system is working well, both in terms of assuring safe produce, and functioning smoothly as a system? If yes, please explain why. If no, please indicate how you believe it might be improved.
17. In your opinion, who currently holds the most decision-making power in determining what food safety practices farmers should follow? Please rank the top 3 options below by adding #1, #2 and #3 according to the power each of the following entities holds, with #1 being most powerful:
    a. EU government agencies
    b. UK (central or local) government agencies
    c. Grocery retailers
    d. Processors / packers / shippers
    e. Consumers
    f. Farm owners and managers
    g. Other: _____
18. From your farm's experience, what are the most positive and also the most negative aspects of the current food safety regulatory framework in which you operate?
19. Can you describe for me how you feel about the food safety risks that you are aware of in your everyday farming activities? For example, how concerned are you about food safety each day, and what sources of risk do you most often think about?
20. Is there anything you would like to add about food safety concerns, or your experience with food safety requirements?

Section 3 of 4: About Your Environmental Approach and Practices

21. How would you describe your farm's approach to environmental protection? Circle the answer that best describes your approach:
    a. Environmental protection is not important in our operations at all.
    b. Environmental protection is not very important in our operations.
    c. Environmental protection is somewhat important in our operations.
    d. Environmental protection is very important in our operations.

e. Environmental protection is extremely important in our operations.

22. Do you follow a specific environmental strategy or method? If so, please describe:
23. To which environmental standard are you certified? If certified to more than one, please indicate which you consider to be your most rigorous standard
    a. We are not presently environmentally certified
    b. Linking Environment And Farming (LEAF)
    c. Red Tractor Assured Food Standards
    d. Tesco NURTURE
    e. Sainsbury's Environmental Scorecard
    f. Other(s): _____
24. Where do you most often get information about conservation or environmental practices? Please rank your top 3 sources by adding #1, #2 and #3 below and explain how you typically interact with them:
    a. Buyer
    b. Auditor/Inspector
    c. Other farmers
    d. Working with Academic Institutions
    e. Consultant
    f. Trade association
    g. UK (central or local) Government
    h. Not-for-profit organisation
    i. Other: _____
25. In your opinion, who currently holds the most decision-making power in determining what environmental practices farmers should follow? Please rank the top 3 options below by adding #1, #2 and #3 according to the power each of the following entities holds, with #1 being most powerful:
    a. EU government agencies
    b. UK (central or local) government agencies
    c. Grocery retailers
    d. Processors / packers / shippers
    e. Consumers
    f. Farm owners and managers
    g. Other: _____
26. Do you feel that your farm's environmental approach has changed since your food safety certification?
27. If you answered yes, how has your approach changed, and why? Please explain.
28. Has there ever been a case (or more than one) when food safety requirements caused your farm to make a decision that you felt was not in the best interests of environmental protection? Please explain:
29. Are there other factors that have a strong influence on the farm's environmental choices? If so, what are they, and how have you experienced them? Please describe:
30. From your perspective, what does it mean to farm "sustainably"?

Section 4 of 4: Your Personal Opinions

For the next ten questions, please indicate on a scale of 1 to 5 how much you personally agree or disagree with each statement, from the perspective of your farm's experience, using the scale below:

1 Disagree Completely	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Agree Completely	N/A Not applicable or don't know

31. My products are safer now that I am food safety certified. _____
32. I feel more peace of mind now that I am food safety certified. _____
33. The food safety practices I follow do not conflict with conservation or environmental protection 34. on or near my farm. _____
35. My buyer(s) have told me to take further steps to make my products safer. _____
36. I am able to meet my buyers' expectations and alleviate their food safety concerns. _____

37. The food safety practices I am required to follow seem sensible to me, and are feasible. _____
38. I am able to comply fully with all government regulations. _____
39. My farming practices protect the environment. _____
40. I want to plan and implement additional practices to protect the environment. _____
41. I am able to talk openly with my buyer(s) about food safety on my farm. _____
42. I am able to work with my buyer(s) to find alternative options if the buyer(s) makes a request of me that is not practical or affordable. _____
43. I feel that food safety and environmental protection are goals that can be easily aligned. _____

End of Survey. Thank you for participating in this research.

Is there anything else you would like to add about any issue related to this survey?

Would you like to be notified when the results of this research are available?

May I contact you with a follow-up if I need to? Circle Yes or No. (You may always decline to respond later if you do not wish to participate further. Identifying information provided here will be removed before data are stored for analysis.)

Yes. Contact me here_____
No.

Appendix 2: CA Survey Instrument

Food Safety and Conservation Practices

Products and Market Channels

1. Which commodities do you produce? (select all that apply)
    a. Leafy Greens
    b. Other Vegetables
    c. Strawberries
    d. Other Berries
    e. Citrus
    f. Melons
    g. Tree Nuts
    h. Other Fruits
    i. Other (Please specify)
2. How many ground acres do you currently own an/or rent to grow crops?
    a. Own:
    b. Rent:
3. Which of these options best describes your average annual gross farm sales?
    a. Less than $25,000 per year
    b. $25,001 - $250,000 per year
    c. $250,001 - $500,000 per year
    d. $500,001 - $999,999 per year
    e. $1 million – $5 million per year
    f. More than £5 million
4. What would best describe your farming method?
    a. Certified Organic
    b. In transition to organic
    c. Conventional
    d. Mixed Organic and Conventional
    e. Other (please specify)
5. Which of these options best describes your primary market channel(s)? Please rank the following options from most to least important for your sales:
    a. National/International Buyer
    b. Broker
    c. Farm Stand
    d. Processor
    e. Wholesale Distributor
    f. Packer/Shipper
    g. Farmer's Market
    h. Local/Regional grocers or food service
    i. CSA
    j. Other
6. What type(s) of insurance do you carry for your operation? (select all that apply)
    a. Farm liability Policy
    b. commercial general liability policy
    c. Recall Policy
    d. Other policy
7. Are you aware of the new federal regulations currently being developed as part of the Food Safety Modernization Act (FSMA)?
    a. Yes
    b. No

8. Do you believe you will you have to make changes to your current practices to comply with the new FSMA regulations?
   a. No
   b. Yes, minor changes
   c. Yes, major changes
   d. Unsure or don't know
9. To which food safety standard(s) are you certified? Please select all that apply.
   a. GlobalG.A.P .
   b. IFS
   c. Not Certified
   d. CanadaGAP
   e. California LGMA (Leafy Greens Marketing Agreement)
   f. FSSC 22000 (Food Safety System Certification) PrimusGFS
   g. SQF (Safe Quality Food) BRC
   h. USDA GAP
   i. Other (please specify)
10. Who certifies you for food safety? [select all that apply]
   a. Primus Labs
   b. Not Certified
   c. NSF
   d. CA LGMA / CDFA (California Department of Food and Agriculture) NCSI Americas
   e. Ceres Certifications, International
   f. AZ LGMA
   g. Other (please specify)

Food Safety Concerns of 3rd-party Auditors and Buyers

11. In your experience, whose food safety requirements are most strict for each of the following?
   [Government or 3rd party audit programs are most strict
   Buyer requirements are most strict
   Both are about the same
   N/A or don't know]
   a. Heat-treated compost, e.g. thermally processed chicken manure pellets
   b. Birds in field
   c. Proximity to water bodies
   d. Irrigation water from wells
   e. Bioterrorism
   f. Signage around fields
   g. Amphibians/reptiles in field
   h. Irrigation water from ponds or open waterways
   i. Worker hygiene
   j. Other animals in field
   k. Flooding
   l. Rodents in field
   m. Proximity to riparian vegetation
   n. Records and documentation
   o. Proximity to livestock on adjacent lands
   p. Proximity to residential areas
   q. Irrigation water from municipal sources
   r. Untreated compost made with animal products (e.g. chicken manure), not heat treated
   s. Equipment and facilities sanitation
   t. Untreated compost made from vegetative material only

u. Worker training
v. Deer or pigs in field
w. Do you have any additional comments? (please specify):

12. How important is each of the following in resolving your buyers' concerns? Please rank in order of most to least important:
    a. On-site visits or inspections by the buyer (i.e. buyer/shipper audit)
    b. Records (e.g. worker training, pre-harvest self-inspections, water tests) and Documentation (e.g. SOPs, SSOPs, letters of assurance, documented recall protocol, etc.)
    c. Third-party audit score/report
    d. Certification to a government or third-party food safety standard (e.g. CA LGMA, PrimusGFS, Global G.A.P.)
    e. Length of business relationship with buyer
    f. Training or credentials of me and/or my employees

Changing Practices

13. Please indicate when, if ever, you have used the following management practices in your operation specifically because of a food safety concern.
    [Not used in last 5 years
    Used in last 5 years, but not currently
    Use currently]
    a. Cleared vegetation to create or expand bare ground buffers
    b. Removed vegetation from ditches or farm ponds
    c. Wildlife fences
    d. Poison bait
    e. Copper sulfate
    f. Plant low-risk crops or fallow land near adjacent land uses of potential food safety concern (e.g. livestock operations, grazing land, water bodies etc.)
    g. Falconers or owl boxes
    h. Stopped use, drained, or filled ditch or farm pond
    i. Other (please explain)
    j. Non-poison traps (e.g. rodent traps)
    k. Depredation (i.e. removing pest animals)
    l. Treat irrigation water (e.g. chlorination)
    m. Other (please explain)
14. Please indicate during which time periods, if any, you have used one of the following conservation practices on land you farm.
    [Not used in last 5 years
    Used in last 5 years, but not currently
    Use currently]
    a. Integrated Pest Management (IPM)
    b. Release of biocontrol agents
    c. Beetle banks
    d. Native bee nest boxes
    e. No-till agriculture
    f. Crop rotation
    g. Flower or native plant strips to attract natural pest predators
    h. Sediment or stormwater basin
    i. Tailwater recovery ponds
    j. Hedgerow or windbreak
    k. Grassed waterways or roads
    l. Heat Treated Compost (Soil amendments containing animal manure that HAS been physically heat treated)

m. Cover cropping
n. Bird nest boxes (e.g. for bluebirds or owls)
o. Flower or native plant strips for native pollinators (e.g. bees)
p. Riparian/stream bank restoration
q. Raw Manure (manure, green waste or other soil amendments containing animal products that have NOT been fully composted)
r. Natural compost (fully composted soil amendments containing animal manure or animal products that has NOT been physically heat treated
s. Vegetated filter or buffer strips
t. Vegetated treatment system
u. Constructed wetland
v. Other (please specify)

Costs

15. In the past 3 years, how many crop acres have you tilled back into the soil due to food safety concerns when the product is contaminated or no longer deemed consumable? Please enter a whole number with no decimal places or commas.
16. Please estimate the costs or financial losses, in dollars, you have incurred due to food safety concerns in the past 3 years. Please enter a whole number with no decimal places or commas.
17. Please enter any comments or elaborations on costs here.

Agree/Disagree

18. Please indicate to what extent you agree or disagree with the following statements:

1 Disagree Completely	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Agree Completely	N/A Not applicable or don't know

a. In my experience, my buyer (s) cooperate with me to address food safety concerns identified in my operation.
b. I feel it is my responsibility to protect water quality and the environment on my farm.
c. When third-party auditors identify site conditions or management practices that pose a potential food safety risk, I generally agree with their assessment.
d. My food safety related management practices are compatible with my environmental stewardship/protection objectives for my operation.
e. My products are safer now that I am food safety certified.
f. I have been able to adapt my practices to address buyer concerns about food safety hazards in or around my fields during growing or harvesting.
g. Auditors are consistent in their interpretation of food safety standards.
h. I feel it is my responsibility to protect food safety on my farm.
i. I have or can easily get the information I need on food safety management practices.

Accessing Food Safety and Conservation Information

19. How do you prefer to get information about food safety or conservation management and practices? Please rank in order from most to least preferred:
a. Written material on paper
b. Webinars or online training/info sessions
c. Videos
d. In-person workshops, information or training sessions
e. Written material online
f. Private conversation (e.g. phone call)

20. From whom do you get information about food safety and conservation or environmental protection practices? Please select all that apply:
    [Food Safety Information
    Conservation or Environmental Protection Information
    Do not use or N/A]
    a. Government (e.g. CDFA, LGMA, FDA, USDA NRCS, RCDs)
    b. 3rd-party auditor/inspector
    c. Trade association
    d. Other growers or farmers
    e. Non-profit organization
    f. Cooperative Extension
    g. My buyer(s)
    h. I do not get information about food safety
    i. Other (please specify)
21. What kind of information is useful to you? Please select all that apply:
    a. Evidence on the effectiveness of different practices or technologies for managing food safety hazards What technologies or tools are available
    b. Detailed best practices guidance
    c. Regulatory requirements
    d. Costs of implementing new practices or adopting new technologies What consulting services are available
    e. How to co-manage food safety and agricultural conservation practices How to prepare for a food safety audit
    f. Guidelines and tools to developing GAPs
    g. Other (please specify)

Wrapping Up

22. Is there anything else you would like to add?