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Gleanings from the Field

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Photo credit: Salvation Farms; used with permission.

Reviews

The Thomas A. Lyson Center for Civic Agriculture and Food Systems, a project of the Center for Transformative Action (an affiliate of Cornell University), is grateful for the support of **JAFSCD's partners:**

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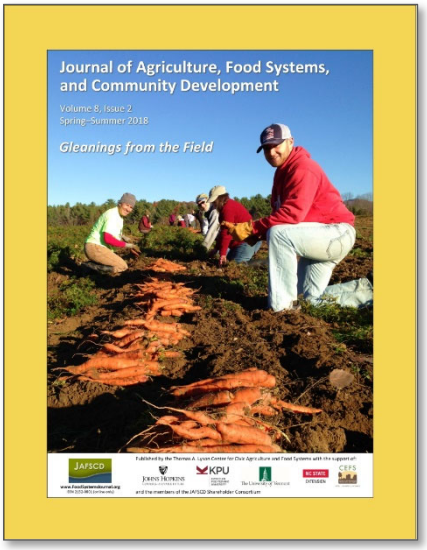
In This Issue

Duncan Hilchey

Gleanings from the field



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Food waste and food rescue have been hot topics in recent years (although gleaning dates back to at least biblical times in the ancient traditions of *tzedakah* and *pe'ah*). Our cover photo for this issue, courtesy of Salvation Farms, shows a group of volunteers joining Salvation Farms and two other Vermont Gleaning Collective organizations gleaning a crop of carrots too large and misshapen for market. I first learned of the great work Salvation Farms is doing a couple of years ago from the Food Feed blog (https://learn.uvm.edu/foodsystemsblog/) of the University of Vermont (a founding partner of JAFSCD). Salvation Farms had just published a report assessing on-farm food loss in Vermont, and I thought its methodology should be peer-reviewed and in the applied research literature. I contacted report authors Elana Dean and Salvation Farms director Theresa Snow and suggested they find a scholar who could work with them on a manuscript. They found Roni Neff, a food-waste expert at the Johns Hopkins Center for a Livable Future (coincidentally also a founding partner of JAFSCD). Their collaboration has yielded a seminal work on estimating on-farm food loss. I share this story as a model of food system researchers and professionals collaborating to produce applied research that benefits all parties concerned—and the greater community. We are likely to do a special issue on food waste in the near future, and we hope to see more researcher-professional collaborations like this one.

In this open call issue, we give you our spring and summer gleanings from the field and elsewhere in the

On our cover: A group of volunteers joins Salvation Farms and two other Vermont Gleaning Collective organizations at Gildrien Farm just south of Middlebury, Vermont, on a sunny, late fall morning to glean a crop of carrots too large and misshapen for market. In a few hours, more than 30 volunteers from the community harvested over 11,000 pounds (4,990 kg) of carrots. The majority of the harvest was received by Salvation Farms' Vermont Commodity Program, where individuals enrolled in a work-readiness training program cleaned and packaged the carrots for distribution to charitable food sites across Vermont. See *Salvageable Food Losses from Vermont Farms* in this issue (https://doi.org/10.5304/jafscd.2018.082.006). *Photo credit: Salvation Farms; used with permission.*

food system. We start out this issue with John Ikerd's Economic Pamphleteer column. In *A Farm Bill for the Agriculture We Want,* John makes a compelling case for replacing commodity-based insurance programs with a comprehensive, subsidized "whole farm net revenue" insurance program.

Next, we offer a viewpoint by Laura Schreiner, Charles Levkoe, and Theresa Schumilas, entitled *Categorizing Practical Training Programs for New Farmers: A North American Scan,* in which they take the first crack at surveying and typologizing a broad range of new and beginning farmer training programs in the U.S. and Canada, and call for an ongoing census and impact analysis of these program in the future.

In our first installment of *Voices from the Grassroots, Six Critical Solutions to Fix Peoria's Community Emergency Food Assistance System,* Kim Keenan of The gitm (Gifts in the Moment) Foundation provides a roadmap for local agencies in an American Heartland city to coordinate their activities more in reducing food insecurity.

Next is a paper from the EFSNE project, *Baselines, Trajectories, and Scenarios: Exploring Agricultural Production in the Northeast* U.S. Timothy Griffin, Christian Peters, David Fleisher, Michael Conard, Zach Conrad, Nicole Tichenor, Ashley McCarthy, Emily Piltch, Jonathan Resop, and Houman Saberi make very detailed estimates of regional food production potential in the Northeast. See volume 7, issue 4 (https://www.foodsystemsjournal.org/index.php/fsj/issue/view/29) for other papers in this series.

Our first open call paper is also our title paper: *Salvageable Food Losses from Vermont Farms.* In it, Roni Neff, Elana Dean, Marie Spiker, and Theresa Snow provide an estimate and new methodology for calculating on-farm food loss on farms in Vermont and consider how reducing it could put more fresh food on the plates of those who need it.

Next, Amy Guptill, David Larsen, Rick Welsh, and Erin Kelly explore the relative importance of privileged customers in the local food movement in *Do Affluent Urban Consumers Drive Direct Food Sales in the Northeast United States? A Three-part Analysis.*

In *The SNAP Challenge: Communicating Food Security Capabilities through Anti-Hunger Advocacy,* Kathleen Hunt documents the difficulty of surviving on less than US$132 per month for food—the maximum amount allowed for individual SNAP recipients.

Urban Farmers Markets as a Strategy to Increase Access to and Consumption of Fresh Vegetables among SNAP and non-SNAP Participants: Results from an Evaluation, by Rebecca Woodruff, Kimberly Arriola, Kia Powell-Threets, Rashid Nuri, Carol Hunter, and Michelle Kegler, explores whether farmers markets have their intended impact on SNAP recipients.

Charles Levkoe, Colleen Hammelman, Luke Craven, Gavin Dandy, Jeff Farbman, James Harrison, and Phil Mount then present the collective findings of a diverse group of food hub experts In *Building Sustainable Communities Through Food Hubs: Practitioner and Academic Perspectives.*

In *Three-year Case Study of National Organizations Participating in a Nutrition Cohort: A Unique Funder-initiated Learning Collaborative,* Sarah Amin, Megan Lehnerd, Sean Cash, Christina Economos, and Jennifer Sacheck find that trust building among participants is job #1 when creating learning collaboratives (or communities of practice).

In our final open call paper, *Soil Contaminant Concentrations at Urban Agricultural Sites in New Orleans, Louisiana: A Comparison of Two Analytical Methods,* Kyle Moller, James Hartwell, Bridget Simon-Friedt, Mark Wilson, and Jeffrey Wickliffe take us one step closer to identifying the most cost-effective methods of identifying contaminants in urban soils.

To wrap up the issue, we offer five book reviews. First, Teresa Mares reviews *A Foodie's Guide to Capitalism: Understanding the Political Economy of What We Eat* by Eric Holt-Giménez (Monthly Review Press).

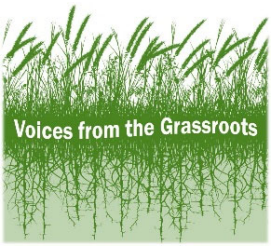
Amber Heckelman reviews *Selling Local: Why Local Food Movements Matter,* by Jennifer Meta Robinson and James Robert Farmer (Indiana University Press).

Darcy Mullen reviews *A Precautionary Tale: How One Small Town Banned Pesticides, Preserved Its Food Heritage, and Inspired a Movement,* by Philip Akerman-Leist (Chelsea Green Publishing).

Salma Loudiyi reviews *The Politics of Food Sovereignty: Concept, Practice and Social Movements,* edited by Annie

Shattuck, Christina Schiavoni, and Zoe VanGelder (Routledge).

And finally, Keith Williams reviews *Food Leadership: Leadership and Learning for Global Food Systems Transformation*, edited by Catherine Etmanski (Sense Publishers).



I want to take this opportunity to encourage nonprofit, agency staffers, food policy council members, activists, consultants and others working in food systems to contribute 1,000-word Voices from the Grassroots commentaries at any time. *Voices* is a new professional-development opportunity for those folks working on the front lines of the good food movement. It's also a great way to share your experiences and best practices with colleagues around the world, and to share your needs with policy-makers and may present opportunities to collaborate with researchers. Find details at https://www.foodsystemsjournal.org/index.php/fsj/grassroots.

With appreciation,

Duncan Hilchey

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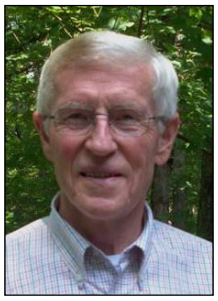

THE ECONOMIC PAMPHLETEER
JOHN IKERD

A farm bill for the agriculture we want

Published online May 2, 2018

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The United States farm bill expires in 2018 and is scheduled to be replaced by new legislation approved by the U.S. Congress and implemented by the U.S. Department of Agriculture (USDA). The USDA has already announced its farm bill preferences and the legislative principles it hopes will guide the 2018 legislative process (USDA, 2018). Its policy agenda for 2018 seems to be pretty much the same as those for past farm bills—at least for those over the past 50 years. Regardless of whether we like what we have been getting, the USDA apparently plans to give us more of the same.

"We can have any kind of agriculture we want, if we choose the right agricultural policies." This was a frequent statement of Harold Breimyer, one of the most respected agricultural economists in the U.S. during the last half of the 20th century. He was my professional mentor in that he was an unabashed advocate of traditional family farming. He also continued to be active professionally for as

John Ikerd is professor emeritus of agricultural economics, University of Missouri, Columbia. He was raised on a small farm and received his BS, MS, and PhD degrees from the University of Missouri. He worked in the private industry prior to his 30-year academic career at North Carolina State University, Oklahoma State University, the University of Georgia, and the University of Missouri. Since retiring in 2000, he spends most of his time writing and speaking on issues of sustainability. Ikerd is author of six books and numerous professional papers, which are available at http://johnikerd.com and http://faculty.missouri.edu/ikerdj/

Why an Economic Pamphleteer? Pamphlets historically were short, thoughtfully written opinion pieces and were at the center of every revolution in western history. I spent the first half of my academic career as a free-market, bottom-line agricultural economist. During the farm financial crisis of the 1980s, I became convinced that the economics I had been taught and was teaching wasn't working and wasn't going to work in the future—not for farmers, rural communities, consumers, or society in general. Hopefully my "pamphlets" will help spark the needed revolution in economic thinking.

long as he lived—17 years after retiring from the University of Missouri.

Harold's point was that the economy doesn't dictate the kind of farms or food systems we have in America. Our agri-food system is a reflection of our governmental farm and food policies. Even if we decide to accept any agri-food system that might evolve from market incentives, we still have a choice of whether to impose policy restraints on agricultural markets. The United States, like virtually every other nation in the world, has a long list of laws and regulations that affect farming and food production. Few nations are willing to leave their food security to the indifference of a market economy.

We are often told that if we want something different, we must "vote with our dollars." Our choices among market alternatives reflect our food preferences and certainly have some effect on the kind of food system we have. Breimyer's point was that our market choices *alone* do not, and should not, completely determine the kind of agri-food system we have. Even the market alternatives available to us are affected by farm and food policies.

Government has failed to use its authority to restrain the power of food corporations to influence food prices and consumer choices. In these and other ways, farm and food policies have shaped the agri-food system we have today.

As I have explained in a previous column, U.S. farm policy for at least the past five decades has been designed to promote the industrial model of agriculture (Ikerd, 2015). The intention was to reduce production cost and increase food production, allowing market prices to decline and making good food affordable for everyone. These policies worked as intended by reducing agricultural production costs and increasing supplies of agricultural commodities. There also were initial reductions in food prices. However, lower food prices failed to reduce food insecurity or hunger (Ikerd, 2015). In addition, retail food costs have risen at about the same rate as overall inflation over the past 20 years (Finance Ref/Alioth LLC, 2017).

Most of the recent increases in retail food prices are accounted for by higher marketing costs and increased purchases of foods away from home (Canning, 2011). Food processors have used cheap agricultural commodities as raw materials to manufacture convenience foods and "junk foods." This has not only kept retail food prices higher but also has reduced the nutritional value of food. Government food assistance programs have mitigated food insecurity but have failed to offset the failure of other agri-food policies. As a result, obesity now rivals hunger as a public health concern. Government has failed to use its authority to restrain the power of food corporations to influence food prices and consumer choices. In these and other ways, farm and food policies have shaped the agri-food system we have today.

If we don't like the agri-food system we have today, we will have to change farm and food policies. Industrial agriculture has achieved its profitability by mining the land and exploiting both farmers and consumers. Extraction and exploitation are not sustainable over the long run. If we want a sustainable food system, we must protect and restore productivity to the land and the capabilities of the people who farm it. We must also meet the basic nutritional needs of all. This means we need agri-food policies that support a multifunctional agriculture that is ecologically sound and socially responsible, and well as economically viable over the long run.

To restore the natural productivity of the land, farmers must respect the necessity of diversity for healthy agroecosystems. Farmers must rely on diverse crop rotations and integrated crop and livestock systems to restore physical and biological health to soils, crops, livestock, and ultimately to eaters. If we are to restore integrity to farming, we must make it possible for those who are committed to caring for the land and producing healthful, nutritious foods to make a decent economic living by farming. We must also work together through government to ensure that everyone has access to

enough good food to support healthy, active lifestyles. Market economies alone will do none of these things.

Regarding the 2018 farm bill, I think the highest priority should be to reduce, and ultimately eliminate, commodity-specific programs. Commodity programs mitigate the risk of large-scale, specialized industrial agricultural production. Commodity price supports and price-deficiency payments have been largely replaced by government-subsidized crop insurance, which ensures not only prices but also yields of insured commodities. We taxpayers have been picking up about 60% of the costs of insurance premiums, as well as generously subsidizing the costs of the private insurance companies that administer the program (EWG, n.d.). There are no limits to the amount of money farmers can receive for insured crops. Large crop producers can afford the risks of producing thousands of acres of a single crop only because we taxpayers are absorbing most of the risks.

Ultimately, all commodity-based programs should be replaced with a comprehensive, subsidized "whole farm net revenue" insurance program.

Ultimately, all commodity-based programs should be replaced with a comprehensive, subsidized "whole farm net revenue" insurance program. The USDA currently has a pilot program for whole-farm gross revenue insurance, which gives added credibility to the basic idea (USDA Risk Management Agency, 2018). The insurance premiums paid by farmers should reflect the risk inherent in their overall farming systems. Farms with diverse crop rotations and integrated crop and livestock system would pay lower premiums because diversification reduces economic risk.

The total "gross revenue" losses insured should be limited to typical risks faced by "family-sized" diversified farms, say around US$100,000—not large, industrial operations. In addition, the total "net revenue" or farm income ensured for any full-time farmer should not exceed some percentage of the U.S. median family income, which is around US$60,000. Program details would need to be negotiated, but the basic proposal would be to provide farmers willing to transition to sustainable farming with a secure net farm income—similar to proposals for a guaranteed minimum income (Guaranteed Minimum Income, n.d.). Such a program would incentivize diversified, family-sized farms but would be of only marginal benefit to large, industrial farming operations.

Another urgent priority is to demand a shift in the mandate of publicly funded research and education. Our public institutions should be conducting the basic research and education essential for agricultural sustainability. Large agricultural corporations have adequate economic incentives and means of conducting their own research and training their own workers. Our public institutions should not be allowed to continue using public funds to promote the private interests of industrial agriculture.

We can't transform U.S. agricultural in one farm bill. However, we simply cannot afford for U.S. farm policy to continue to support and promote an unsustainable agricultural system. We can have any kind of agriculture we want. If we want something different, we must choose different agricultural policies.

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Categorizing practical training programs for new farmers: A North American scan

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Abstract

Despite limited study, farmer training is an area of growing interest and concern among new and experienced farmers across North America. It is also an area with broad implications regarding the future of domestic food production. This paper presents findings from a community-campus partnership research study that aimed to explore, document, and categorize existing and emergent models of practical farmer training in North America. We begin by describing the context of practical farming and the need for training programs, followed by a discussion of our findings organized into five analytical categories along with discussion of their implications: (1) Informal farm internship associations; (2) centralized internship programs; (3) private or nonprofit course-based programs; (4) formal academic programs; and (5) independent and self-directed learning. We conclude with some implications from this study and suggest areas for future research. It is our hope that the categories presented here will provide a springboard to support the future research and development of new practical farmer training programs.

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Keywords
Community-Campus Collaboration; Farmer-to-Farmer Education; Farmer Training; Beginning Farmers; New Farmers; North America

Introduction
Despite limited study, farmer training is an area of growing interest and concern among new and experienced farmers across North America. It is also an area with broad implications regarding the future of domestic food production. This paper presents initial findings from a community-campus partnership research study between the Food: Locally Embedded, Globally Engaged (FLEdGE)[1] research collaborative, the Ecological Farmers Association of Ontario (EFAO),[2] and the Collaborative Regional Alliance for Farmer Training (CRAFT) in South West Ontario.[3] The project's goal was to collaboratively explore, document, and categorize existing and emergent models of practical farmer training programs in North America. Given the paucity of published work in this field, our research is exploratory in nature, and the categories developed are intended to propose an initial typology to assist researchers, farmers, and agricultural associations in considering the development of farmer training programs. We describe practical farmer training as farmer-to-farmer education with significant hands-on and theoretical components. The emphasis was on exploring training programs for new farmers, but we also captured some programs focused on knowledge and skill development for experienced farmers. While analyzing approaches to farmer training is an area of growing attention within the agricultural sector and the scholarly literature, there is very little formal research available to date. We begin by describing the context of practical farming and the need for training programs, followed by a discussion of our methodology and findings, organized into five analytical categories along with discussion of their implications: (1) Informal farm internship associations; (2) centralized internship programs; (3) private or nonprofit course-based programs; (4) formal academic programs; and (5) independent and self-directed learning. We present this proposed typology as the first phase of our research, with the intention to lay the groundwork for further study. It is our hope that this study acts as a call to others to work with us as part of a broader census and deeper analysis. We then conclude with some implications from this study and suggest areas for future research.

A New Generation of Farmers
Farmers play a critical role in food systems, rural economies, ecological sustainability, and the social fabric of communities. As farmers age, new farmers are required to maintain the stability of the agricultural sector. Without clear succession plans and a cohort of skilled individuals willing and able to take up farming as a career, the future of domestic food production is in jeopardy, which precipitates a range of environmental, social, and economic implications (Brekken et al., 2016). In Canada, 55% of farm operators are 55 years or older; 20 years ago this figure was only 32% (Statistics Canada, 2017). Over the same time period, the percentage of farm operators under the age of 35 dropped from 16% to 9% (Statistics Canada, 2017). Historically, farm businesses, along with the accompanying knowledge and skills, were passed down from generation to generation within family units (Errington, 1998). The shifting pattern of succession has resulted in many new farmers coming from urban and suburban nonfarming backgrounds with little to no agricultural experience (Ekers & Levkoe, 2016). Further, many of these new farmers are drawn to ecological forms of food production that integrate social justice and ecological sustainability goals with innovative forms of economic viability (Levkoe, 2017; Ngo &

[1] FLEdGE is a collaborative research partnership made up of academics and community partners with the shared goal of building healthy, just, and sustainable food systems (see http://www.fledgeresearch.ca). The action research collaborative is funded by the Social Science and Humanities Research Council of Canada and structured through a series of thematic and geographic nodes across Canada and internationally.

[2] The EFAO was establishing 1979 to advance and explore ecological farming methods by supporting farmer-to-farmer networks (see http://www.efao.ca).

[3] CRAFT South West Ontario is a farmer-led network that supports practical skills and career development in ecological agriculture (see http://www.craftsouthwestontario.ca).

Brklacich, 2014). This phenomenon is furthered by growing interest and demand for more healthy, just, and sustainable food systems by consumers, social movements, and researchers (Blay-Palmer, 2010; Wittman, Desmarais, & Wiebe, 2011). To learn the necessary knowledge and skills, new farmers have come to depend on a range of formal and informal training programs run primarily by nonprofit organizations (Grow a Farmer, n.d.; National Young Farmers Coalition, n.d.; Niewolny & Lillard, 2010). While these types of farmer training programs can yield valuable learning experiences, research has demonstrated that they tend to be limited in educational scope and quite costly (Calo, 2017; Laforge & McLachlan, 2018). Despite the increasing interest and need for new approaches to farmer training, there has been surprisingly little research or analysis on this topic.

Methodology

This research emerged out of a recognition of the limited information on practical training for new farmers by two Ontario-based, farmer-led organizations. In the fall of 2016, two FLEdGE researchers (the second and third authors of this paper) were approached by the EFAO and CRAFT Southwest Ontario with a desire to better understand the existing models of practical farmer training across North America. The research was guided by an advisory committee that met regularly to discuss the design and implementation of the research, while also evaluating and providing feedback on the findings.

Led by a master's degree student (the primary author of this paper), the research involved an environmental scan of farmer training programs across North America using scholarly literature, grey literature, internet webpages, and suggestions from the partners involved. The purpose was to scan a diverse sample in order to develop a preliminary typology of farmer training programs for the benefit of academics, farmers, agriculture associations, and nonprofit organizations that hoped to develop a better understanding of the kinds of programs being run elsewhere. The scan was therefore intended to be illustrative rather than exhaustive, to capture the broad range of farmer training models in operation. The analysis was conducted based on a thorough review of all the information collected to identify emergent patterns and create the categories. This analysis was led by the authors, and the research team verified the findings through reviews of various drafts of the proposed categories and conclusions.

Approximately 40 programs were investigated for their structure and key characteristics (such as program delivery format, program location, funding and/or support mechanisms and sources, nature and degree of formality of curriculum, structure and degree of formality of the organization, and association with formal teaching institutions), at which point the research team felt the sample of farmer training programs was representative of the spectrum across North America. While the intent of this research was to explore all approaches to practical farmer training, all but one of the programs investigated expressed an ecological focus. From this scan, profiles were created for 20 training programs to identify the key characteristics of each model. As noted above, our focus was to develop a typology rather to represent the full variety and range of programs across North America. In some cases, we intentionally left out programs with structural similarities to others already captured in the sample. We analyzed the profiles to identify a set of categories describing the different structural approaches of practical farmer training programs. This approach was informed by a recognition that there were minimal existing data available and by the needs of the partner organizations. The analysis and subsequent categorization were undertaken to provide insight into the different approaches and to identify models into which the existing programs fit. While urban farmer training programs are increasingly popular, the context is significantly different than rural programs. Urban agriculture may warrant a similar typological exploration; however, this was beyond the scope of this study. Also, the research does not address regional differences, which could have a significant effect on farmer training program design, such as the availability of health care or health insurance for new farmers. As previously discussed, this research is exploratory, and it is our hope that a more thorough census of farmer training programs will be developed to provide much greater insight

and additional analysis. This is a key objective of this paper: to review current farmer training programs and identify structures and successes of such programs through the eyes of the educators and learners. We believe this information will contribute to the development of stronger training programs for new and experienced farmers.

Five Categories of Practical Farmer Training Models

In this section we present the research findings described through the five emergent categories of practical farmer training models. Table 1 provides an overview of the categories; the programs listed are primarily focused on beginning farmers, although a small number operate programs for those who are more experienced. The categories are then described in greater detail below, along with a discussion of implications.

Category 1: Informal Farm Internship Associations

Informal associations supporting farm internships provide a network between individual farms that offer internships or other on-farm educational experiences for beginner farmers. These types of internships are typically managed at an individual farm level with little input from external educators. In most cases, the farmer and intern agree to an exchange of agreed-upon amounts and types of labour in return for a range of benefits that may include food, housing, training, and/or a small stipend or wage. In some cases, there is coordination between the member farms to support farmer hosts and add value to the interns' experiences. For example, some associations offer collective field trips, group training lessons, and social events. Some networks also facilitate initial connections between potential interns and farms. In these models, however, there are very few standards, no standard curriculum, and no mediation of the intern-farmer relationship by the association. Examples include the Collaborative Regional Alliance for Farmer Training (CRAFT) networks across North America. We identified many farms offering internships that are not part of any association or network. These programs also fit into this category; however, studying them in detail was beyond the scope of this research due to the high degree of variability and the difficulty in tracking them.

Informal farm internship associations are notable for delivering farmer training with low costs and minimal program administration. They are often developed by farmers using informal networks and depend primarily on the volunteer time of dedicated hosts to manage and implement the training programs. The relative popularity of this type of low-cost, low-infrastructure program in certain regions is indicative of a systemic lack of funding and structural support for practical farmer education. Informal associations rely on programs offering internships within close geographic proximity. While this works well in some of the more densely populated regions (e.g., located near urban centers), it may not be as viable in more sparsely populated areas. Recent studies have identified the value of practical farmer-led internship programs and have also raised some critical questions about their ethical and legal implications (for example, see Ekers, Levkoe, Walker, & Dale, 2016; Levkoe, 2017).

Category 2: Centralized Internships Programs

Centralized internship programs rely on a coordinating mechanism, establishing a semiformalized network between a group of farms that offer internships and other informal training opportunities. In the examples we analyzed, these organizations set minimal standards for host farms, which include curricula, work hours, compensation levels, and other benefits. The host organization also mediates the relationship between interns and farmers to some degree. For example, it serves as a third-party consult for interns if complications arise with the host farmers. In some cases, interns apply to participate directly to the central organization, which then brokers connections with the participating host farms. Generally, the central organization also offers some training directly to the interns, such as workshops, farm tours, and socials. Upon program completion, trainees typically received a certificate or some type of recognition.

Centralized internship programs are advantageous in some cases. For example, it may be easier

Table 1. Categories of Practical Farmer Training

Category	Description	Examples
Informal Farm Internship Associations	An informal network of farmers supporting internship programs managed at the individual farm level	• CRAFT Southwest Ontario (http://craftsouthwestontario.ca/) • WWOOF Canada (https://wwoof.ca/)
Centralized Internship Programs	A central organization sets standards for host farms, offers some trainings, and mediates the relationship between interns and farmers	• Stewards of Irreplaceable Lands (SOIL) (Western Canada) (https://www.soilapprenticeships.com/) • Rogue Farm Corps (Oregon) (https://www.roguefarmcorps.org/) • North American Biodynamic Apprenticeship Program (NABDAP) (https://www.biodynamics.com/farmer-training) • Dairy Grazing Apprenticeship (Wisconsin) (https://www.dga-national.org/) • Quivira Coalition's New Agrarian Program (Southwest USA) (https://quiviracoalition.org/newagrarian/) • FARRMS Internship Program (North Dakota) (http://www.farrms.org/)
Private or Nonprofit Course-based Programs	Courses or training programs delivered for a fee by a private or nonprofit organization	• Everdale's Sustainable Farming Certificate (Ontario) (http://everdale.org/farmertraining/sustainable-farming-certificate/) • Everdale's Farm Planner Course (Ontario) (http://everdale.org/farmertraining/the-farm-planner/) • Farms at Work Skills-Building Workshops (Ontario) (http://www.farmsatwork.ca/workshops) • Farms at Work Farm Business Planning program (Ontario) (http://www.farmsatwork.ca/farm-business-planning-program) • EFAO workshops and courses (Ontario) (https://efao.ca/upcoming-events/) • The Seed Farm Apprenticeship Program (Pennsylvania) (http://www.theseedfarm.org/new-farmer-training) • The Seed Farm individual workshops (Pennsylvania) (http://www.theseedfarm.org/) • Atlantic Canada Organic Research Network's (ACORN) Grow a Farmer Learning Series (https://growafarmer.ca) • School of Adaptive Agriculture (California) (http://www.school-of-adaptive-agriculture.org/) • Stone Barn Apprenticeship (New York) (https://www.stonebarnscenter.org/engage/for-farmers/apprentice-program/) • Canadian Organic Growers (COG) courses (http://cog.ca/) • The Organic Farm School (Washington) (https://organicfarmschool.org/) • Farm Beginnings Class (Minnesota) (https://landstewardshipproject.org/morefarmers/farmbeginningsclass) • Agriculture and Land-Based Training Association (ALBA) Farmer Education Course (PEPA) (California) (http://www.albafarmers.org/programs/)

continued

Formal Academic Programs	Programs run by formal academic institutions, such as a college or university (although not necessarily for academic credit)	• Kwantlen Polytechnic University—Bachelor of Applied Science in Sustainable Agriculture (British Columbia) (http://www.kpu.ca/agriculture) • Kwantlen Polytechnic University—Farm School (British Columbia) (http://www.kpu.ca/farmschool) • UBC farm practicum and internships (British Columbia) (http://ubcfarm.ubc.ca/students/practicum-in-sustainable-agriculture/) • Fleming College—Sustainable Agriculture Program (Ontario) (https://flemingcollege.ca/programs/sustainable-agriculture-co-op) • University of Guelph Dairy Herdsperson Apprenticeship (Ontario) (https://www.ridgetownc.com/future/programs_adh.cfm) • University of Santa Cruz Center for Agroecology & Sustainable Food Systems (CASFS)—Apprenticeship in Ecological Horticulture (California) (https://casfs.ucsc.edu/apprenticeship/) • Michigan State University Student Organic Farm—Organic Farmer Training Program (http://www.msuorganicfarm.org/) • Center for Environmental Farming Systems—Farm Apprenticeship Program (North Carolina) (https://cefs.ncsu.edu/academics-and-education/apprenticeships/) • Warren Wilson College—Farm Crew (North Carolina) (https://www.warren-wilson.edu/academics/work-program/farm-crew/) • New Entry Sustainable Farming Project—Tufts University (https://nesfp.org/node/14)
Independent and Self-Directed Learning	Programs that involve self-directed learning experiences	• Atlantic Canada Organic Research Network's (ACORN) Grow a Farmer mentorship program (https://growafarmer.ca/mentorship/) • Ecological Farmers Association of Ontario Advisory Service (https://efao.ca/advisory-service/) • FarmStart's incubator farms [no longer operating] (Ontario) (http://www.farmstart.ca/) • The Seed Farm incubator program: Steward and Enterprise farmers (Pennsylvania) (http://www.theseedfarm.org/farm-business-incubator) • Farm Beginnings Journeyperson program (Minnesota) (https://landstewardshipproject.org/morefarmers/lspjourneypersonfarmtrainingcourse) • Maine Organic Farming and Gardening Association's Journeyperson Program (http://www.mofga.org/Programs/JourneypersonProgram/tabid/228/Default.aspx) • Agriculture and Land-Based Training Association (ALBA) Organic Farm Incubator (California) (http://www.albafarmers.org/programs/)

to build recognition around one central organization's training program than around many different individual farms. Centralizing some of the training can also help to standardize learning outcomes for participants. Centralized organizations have been developed in some regions where the legality of farm internships has come into question or where farm internships have been banned outright. For example, in Oregon, Rogue Farm Corps developed a structured farm internship program with guidance from the Oregon Department of Agriculture and the Bureau of Labor and Industry (Rogue Farm Corps, n.d.). This approach ensures the continuation of legal farm internships in spite of increasing concern by both farmers and policymakers over the state of quasilegal internships.

Category 3: Private and Nonprofit Course-Based Programs

Private and nonprofit course-based programs include courses or training programs delivered (usually for a fee) by an organization other than a formal academic institution. Typically, these fall into three broad groups: (a) farm schools, which are typically based on an operational farm site offering participants an established curriculum of hands-on training; (b) organized training workshops at other locations (typically on private farms); and (c) business planning courses, which generally operate during the nonfarming season. Farm schools are differentiated from farm businesses that also offer training-focused internship programs (which would fit into categories 1 or 2) because of their primarily educational focus; some of the farm schools studied are in fact registered as educational nonprofit organizations.

Some of the programs in this category are coordinated by organizations that began as informal associations (i.e., category 1) but shifted to a more formalized structure. For example, the Atlantic Canada Organic Research Network (ACORN) coordinated a three-year pilot apprenticeship program (which would have fit into category 1 or 2) but switched to offering a series of workshops and field trips throughout the growing season on a range of topics. Organizations that changed the nature of their programming did not always explicitly articulate their reasons. The shift is notable, however, in light of the evolving regulatory context for nonwaged internships (Levkoe, 2017).

Maintaining funding to continue or build on existing programming is a challenge for many private and nonprofit programs. For example, the farm school model is particularly costly as it requires access to land and the maintenance of a working farm. Teaching farm programs have a difficult time recouping costs through product sales alone. Although this was not set as a criterion for this category, most of the examples we found have nonprofit status or were charitable organizations. This is not surprising given that there are certain financial and practical benefits to operating as a registered nonprofit. Some of these models (e.g., those where students live on site) could be quite practical in remote regions as they do not depend as heavily on proximity to other farms or an urban population to purchase produce.

Category 4: Formal Academic Programs

This category includes practical training for farmers through formal academic institutions, such as colleges and universities. As the emphasis of our research was to identify programs that offer practical training, examples in this category are limited to programs with significant hands-on components. For example, we do not include strictly classroom-based programs. Some programs in this category provide academic credit, diplomas, or certificates, while others focus on enrichment, employment, or summer options. In addition, some are non-accredited training programs open to the general public (e.g., internships or training programs on university- or college-based farms).

The United States has a more institutionalized history of campus-based farms than Canada, in part due to the network of land-grant universities that receive federal support for agricultural education. In some regions of Canada, such as Ontario, there was a significant lack of options in this category, and further research could provide valuable perspectives. Another type of formal academic program is the registered apprenticeship; however, aside from the Dairy Grazing Apprenticeship (Wisconsin), there were very few examples found in agriculture. Credit academic programs in Canada

are rare, although Kwantlen Polytechnic University (British Columbia), the University of Guelph (Ontario), and Fleming College (Ontario) offer formal agricultural degrees and diplomas with significant practical components. Accredited agricultural programs fees are typically higher to accommodate the university's tuition structure and may also be prohibitively expensive for some prospective participants.

Category 5: Independent and Self-Directed Learning

This category captures training opportunities that are independent and self-directed in nature. These models are typically used by new farmers who have some experience and are in the planning or early operational stages of establishing their own farm. They might be considered as a "bridge" or "level two" learning experience for beginning farmers who have received training already in at least one of the other categories, but still desire further support and/or mentoring. Some of these models take the form of incubator farms, where new farmers rent and work a plot of land on an operational farm with some oversight. Examples in this category include Just Food's Start-Up Farm (Ontario) and The Seed Farm's Incubator Program (Pennsylvania). Others function as occasional mentoring programs where new farmers find their own land, such as Atlantic Canada Organic Research Network's (ACORN) Grow a Farmer Mentorship Program.

This category was deemed important to include in this study, despite the fact that it typically draws "level two" or more advanced farmers, while the other categories tend to attract beginning farmers. The lack of access to appropriate programming or options for these not-quite-beginner farmers is a common theme in discussions of the barriers facing new farmers across North America. Organizations like FarmStart (Ontario), Maine Organic Farming and Gardening Association, and Rogue Farm Corps (Oregon) all cited this barrier as a major motivator for the development of their "level two" programs.

Conclusions

This exploratory research confirms that, while practical farmer training is a significant and timely issue in North America, there is little scholarly work dedicated to describing the formats or to supporting the development of these programs. Given the strong interest we encountered from farmers, researchers, and other practitioners, more research in this area is warranted. A fuller census and further documentation and analysis of farmer training programs is needed, both within and beyond North America, to flesh out and evaluate the initial typology we have developed. This would be valuable for providing new perspectives for developing innovative practical farmer training options. In addition, a recurring census would help assess the distribution of the five program categories and track changes over time. Important considerations for future research might include prospective training models, connection between farmer training and formalized education, paths to becoming a farmer, and funding and institutional support structures for all programs. A comparison of financial and institutional support for practical farmer training programs in Canada and the United States would also be valuable. It is our hope that the categories presented in this paper will provide a springboard to support this future area of research and the development of new, high quality practical farmer training programs.

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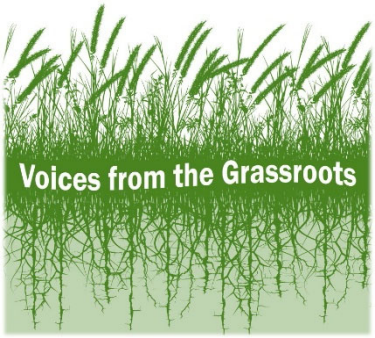
Six critical solutions to fix Peoria's community emergency food assistance system



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The Big Issue

> *No food system can be considered successful unless all people are well fed with the best food available.*
>
> —Ken Meter (2013, p. 11)

For me, Ken Meter's simple statement hits the nail on the proverbial head. In Peoria, Illinois, we see fundamental issues facing many of our community food programs as they attempt to overcome the challenge of providing people in need with good food—food that is healthy, green, fair, and affordable. Not only are we challenged in feeding all of our food-insecure families adequately; we really struggle in offering, on a consistent basis, healthier food options.

In the city of Peoria (population just over 114,000), where I co-founded the Gifts in the Moment Foundation (the gitm Foundation), there

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I received a master's degree in social work from The University of Illinois, a master's degree in Psychology, and a Ph.D. in Applied Ecology. I am a licensed clinical social worker and an adjunct instructor of graduate studies at the University of Illinois. In addition to having maintained a thriving family therapy practice, I have been a social worker in the Peoria area for over 28 years. In 2007 Denise Urycki and I co-founded The gitm Foundation, which created Peoria's first urban farmers market and installed over 80 raised garden beds in Peoria's south village.

† The gitm Foundation is a not-for-profit organization dedicated to improving environmental and community health. Since 2007 we have spearheaded numerous food system initiatives, including developing an urban agriculture training program, creating the first national storm-water farm, and introducing the area's first food-waste program. As the key creator of the Regional Fresh Food Council (https://www.regionalfreshfoodcouncil.org), we strive to collaborate with cross-sector stakeholders in assessing policy and food-security issues impacting our communities. We work diligently to coordinate healthcare needs with these food-security initiatives through the HEAL (Healthy Eating/Active Living) committee that serves the region's Community Health Needs Assessment Strategies. These strategies can be found at https://www.healthyhoi.org.

are over 40 soup kitchens and food pantries that directly serve families as part of the emergency food assistance system. Collectively called community food programs (CFPs), most are part of faith-based organizations, and many exist within mere blocks of one another. Yet in Peoria there exists no mutually shared system for clients to know whether they qualify for participation, where all of these CFPs are located, or even their hours of operation. Most of these well-intentioned emergency food programs admit to poor communication, but are burdened by having volunteer staff and few resources to try to fix our dysfunctional system. In this Voices from the Grassroots brief, I elaborate on these challenges and offer six solutions critical to fixing Peoria's emergency food assistance system. My hope is that this brief will inspire action within our Regional Fresh Food Council (https://www.regionalfreshfoodcouncil.org), and may possibly inform the work of other food policy councils dealing with similar challenges. We welcome input from other organizations and agencies.

The Challenges of the Failing Community Emergency Assistance Food System

1. Increased numbers of food banks and pantries exist with little to no collaboration between them.
   The limitations in funding can create competition between CFP organizations. Vying for these limited funds can be counterproductive in developing and growing successful collaborations. Competition for food donors (such as grocery stores and restaurants) is also a common challenge, as CFPs seek resources to serve their clients. It is not uncommon for food pantries to become discouraged by the news that another CFP has acquired products from "their" food donor.

2. Food banks and food pantries lack a standardized means of measuring program and client data that can meet the needs of the community.
   A missed opportunity for measuring the impacts of CFPs on food-insecure families is the lack of data to support a push for change. There exist wide and varied methods of collecting data on individuals and families who need food assistance and how they are currently being served by community food-based programs. The lack of standardization only makes it more difficult for collaborations to collect meaningful data that can then be reported to the general public.

3. Many food banks and food pantries are limited in their access to consistent amounts of healthy food, storage capacity, and marketing capacity.
   Most CFPs are limited in resources, whether in personnel or capital equipment or facility capacity. Common issues fall within the ability to store food items that are not shelf-worthy, such as produce, fruit, milk, and eggs. CFPs' services are almost exclusively marketed through word of mouth, as many are programs of small not-for-profits or faith-based organizations. This form of disseminating information can be useful but is hardly an effective form of communicating the wealth of emergency food services offered within a community.

4. Healthcare institutions struggle to collaborate with community-based programs.
   One of the most significant challenges facing communities that seek to address hunger and obesity is building true collaboration among key healthcare institutions. A true partnership should manifest mutual goal-setting, shared resource management, and active strategic planning. Many of the healthcare institutions striving to meet the needs of the community spend too much time and energy attempting to supply the community with their own services instead of partnering with community-based organizations to determine the best courses of actions.

The Solutions from My Perspective

1. Support collaboration between local CFPs by aligning all efforts toward the common good.
   Because we know of the need for greater food

security but fail to recognize how to address it, we continue to add new emergency food programs annually as a way to improve our reach. In the absence of intentional collaboration between current and new programs, this only adds unnecessary layers to the existing CFPs system. Additional feeding programs are becoming part of the national food system, such as school breakfast programs and summer feeding centers, all of which are centered around getting good food to families in dire need. However, these programs do not work collectively toward a shared goal. It should be a best practice when starting any new initiative in the emergency food community to do an asset inventory of existing programs to avoid duplication of effort and make the best use of community resources.

2. Design shared metrics for classifying and measuring healthy food options for CFPs.
   While there are several well-regarded tools available for the assessment of healthy foods offered through food pantries, none incorporates a system by which all CFPs can access the same information quickly and effectively without extensive training or the capacity to use online information. A basic food classification system designed by nutrition experts would aid efforts toward providing healthier food items to families in need. This system needs to be user-friendly and integrated into a free technology-based system that all recipient organizations can use. A classification system could help not only the CFPs monitor the amounts and types of healthier food choices offered, but also help food-insecure individuals make healthier choices from the options available. The encouragement and use of a system across CFPs would also assist in the community-based research needed to determine strategies or courses of action that work to promote healthy eating.

3. Developing a "CFP standard of care."
   Standard of care is defined as the "treatment standards applied within public hospitals to ensure that all patients receive appropriate care regardless of financial means" ("Standard of care," n.d.). A patient in New York seen for possible treatment of a streptococcal infection would receive the same standard of care as a patient entering a clinic in Illinois. A "CFP standard of care" would ensure that all people, regardless of income, could have access to the same choice of healthy foods. With regard to the need for standardization of care between CFPs, major health organizations could begin training CFPs in new technology systems, helping to research trends in CFPs and community needs, and providing greater definition of population health issues as they relate to food access.

4. Create a shared analytics system for food banks and pantries.
   Searchable database systems would allow our local CFPs to share information about their specific food needs in order to avoid waste. Many states now use the internet to help match food needs with potential donations. Some of these systems are free, while others require a contract for service. Software systems that require fees are more robust, have greater technical support, and allow for unique features to be added based on community need. These programs have been able to help alleviate some of the concerns surrounding quality product, storage, and timeliness.

5. Promote the public access of all community food programming information.
   One of the benefits of creating a collective technology-based system is the ability of CFPs to enter their location, hours of operation, family and client participation requirements, and contact information. Homeless shelters, hospitals, government offices, healthcare centers, and other organizations could then direct social workers, nurses, doctors, and volunteers to access the system to provide information to help meet the needs of clients who might need food on a specific day, offer locations, hours of operation, and determine whether they even qualify for services. Temporary and special food needs could be

coded in the system for public access as well, such as Meals on Wheels that serve home-bound individuals, holiday gift baskets for Thanksgiving and Christmas, and even feeding sites for children's nutritional needs during the summer break. All of these would have the organizational names, contacts, and specific requirements listed for public access in within a single system.

6. Encourage all healthcare institutions to support these improved operational processes by providing resources to identify, train, and equip all CFPs as critical public healthcare partners.
   All local healthcare organizations, particularly those serving low-income populations, should be actively seeking to collaborate with community-based food programs in order to improve general population health. The use of technology could revolutionize CFPs through the intersection of a patient's Electronic Health Record (EHR) with healthy food access in order to improve their health. Hospital stakeholders can support the collaborative by providing process management staff services in the applications of a new system and in the training of CFP staff on the new technology.

Conclusion

The ways in which we currently approach community-based emergency food need are inefficient and ineffective, leaving countless families without proper amounts of food and good nutrition. In recognizing these issues, we can better understand what changes need to be made in order to make tackling the issue of food insecurity among families a more collaborative and systematic effort. Through the use of technology in creating a standardized shared system in which CFPs collect and share data, health-care partners can aid in community efforts to manage health issues associated with poor access to healthy foods and food insecurity.

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Baselines, trajectories, and scenarios: Exploring agricultural production in the Northeast U.S.

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Abstract

Agricultural production on farms and ranches in the U.S. contributes to the food supply and the food system on local, regional, national, and global scales. Increasing production at the regional scale—the focus of this research—depends on accurately estimating current production and understanding the mechanisms and resource

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requirements of production shifts. The Production Team of the EFSNE Project undertook seven studies that focused on current and potential production in the U.S. Northeast region, which includes nearly one-quarter of the population but only about 3% of national cropland. Here we summarize the results from these studies that: (1) estimate the regional self-reliance of primary crop, livestock products, and livestock feeds; (2) develop and implement a method to delineate urban, peri-urban, and rural zones around cities and analyze the distribution of food chain businesses across these zones; (3) assess crop yield trajectories to refine potential production increases associated with agricultural expansion into different land categories; and (4) model climate change and dietary impacts on yields and land use. The regional self-reliance of food crops varies widely, and the predominant agricultural use of land is for the production of animal feeds. The peri-urban zones contain significant agricultural production and concentrations of supply chain businesses. The potential to expand regional output via yield increases varies by crop and by land category and is strongly influenced by climate change. The diverse disciplines represented on the Production Team, along with significant leadership from graduate students and post-doctoral researchers, contributed to the broad array of studies completed.

Keywords
Regional Self-Reliance, Agricultural Productivity, Regional Food Systems, Climate Change, Peri-Urban Agriculture

Introduction and Literature Review
Following the growth in agricultural output via land expansion in the U.S. prior to 1900, the most notable trends in the agricultural sector have been productivity increases, geographic concentration, and specialization at the farm level. These trends are apparent in both the crop and livestock sectors. The development of efficient transportation networks in the U.S. has led to the relocation (although not elimination) of earlier production centers that relied on perishable crop and livestock products produced near concentrated urban markets. This shift in production centers has been very apparent in the Northeast U.S. For example, the agricultural land base has contracted by nearly 70% for a number of Northeast states, mostly after 1900 (Griffin, Conrad, Peters, Ridberg, & Perry, 2015)

A number of notable trends in the agriculture and foods sectors contribute to a renewed interest in regional food production, including production in the Northeast U.S. First, there is increased risk associated with geographic concentration of production centers for both crops and livestock. These risks could plausibly be due to either biotic (e.g., pest outbreaks) or abiotic (e.g., drought or flooding) stressors, all of which increase under most climate change scenarios (Foley et al., 2011; Wolfe, Ziska, Petzoldt, Seaman, Chase, & Hayhoe, 2008). Lengnick (2015) outlines the principle risks to different crop and livestock systems across the U.S., arguing for the need to increase resilience. Ruhf (2015) provides details on how regionalism can result in increased food system resilience. Second, increases in energy costs (such as those in 2007 to 2009) call into question the viability of long-distance transport without concomitant increases in food costs, an example of the relationship between input price shocks and food price increases (Tadasse, Algieri, Kalkuhl, & von Braun, 2016). Third, in a more qualitative than quantitative trend, there has been a growing research base that examines the potential for regions to become more self-reliant in food provision, which can have positive impacts on food security, economic development, and ecological systems (Ruhf, 2015).

While similar in intent, research on regional food systems varies in scale. There are assessments of self-reliance potential that range from concentric spatial zones around cities such as San Francisco, California (Thompson, Harper, & Kraus, 2008) and Philadelphia, Pennsylvania (Delaware Valley Regional Planning Commission, 2010); individual states (Peters, Wilkins, & Fick, 2007); and multi-state regions (Griffin et al., 2015). In addition, some of these estimates are of *current* self-reliance (Conrad, Tichenor, Peters, & Griffin, 2017) while others are of *prospective* self-reliance, that is, they assess potential changes in output under different scenarios. For example, Peters, Picardy, Darrouzet-Nardi, Wilkins, Griffin, and Fick (2016) evaluated

land use and carrying capacity under a range of dietary scenarios.

The research project entitled Enhancing Food Security in the Northeast through Sustainable Regional Food Systems Development (hereafter, EFSNE) was initiated in 2010 with funding from the U.S. Department of Agriculture's (USDA) Agriculture and Food Research Initiative (AFRI). As noted in the special issue focusing on EFSNE research outcomes (Peters, Clancy, Hinrichs, & Goetz, 2017), one of the research teams contributing to EFSNE focused specifically on agricultural production (and is thus referred to as the Production Team, represented by the authors of this paper). The Production Team undertook a number of research studies to assess current and future agricultural output for the Northeast region, and here we summarize the results of this multi-year interdisciplinary research effort.

Focal Areas of Research by the Production Team

The research of the Production Team focused specifically on the Northeast region of the U.S., inclusive of (approximately north to south): Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Maryland, Delaware, West Virginia, and the District of Columbia. There are seven studies described below, falling into three categories, which we call Baselines, Trajectories, and Scenarios.

Baselines: Potential changes in production are most meaningful in the context of the current system. The research in this section uses data from the recent past (post-2000) to establish benchmarks or baselines for agricultural production and the distribution of food system businesses. Specifically:

1. Estimation of regional self-reliance (RSR) for crop and livestock products consumed as food by people living in the region; we called this RSR_{FOOD}, and it is essentially the net balance between current consumption and production in the region;
2. Estimation of RSR for feed consumed by livestock raised in the region (RSR_{FEED}); and
3. Delineation of zones within the urban/peri-urban/rural continuum and characterization of supply chain business locations along this continuum.

Trajectories: There are a myriad of data sources that can be used to refine productivity estimates in scenario analyses, and these estimates inform how yields or output *may* change in the future. We undertook two analyses, and the output from these served as input to other components of the EFSNE project. Specifically:

4. Calculation of yield trajectories (linear coefficients) for a subset of crops grown in the region using annual data from the period 1980–2013; and
5. Development of a crop productivity index to estimate additional crop output as different land categories are brought into production.

Scenarios: Just as the Baselines (above) are important to establish current conditions, modeling offers the opportunity to assess potential futures or scenarios, at a resolution ranging from 98 ft by 98 ft (30 m by 30 m) to the entire region. We utilized this range of options to:

6. Assess the impact of climate change on crop productivity using robust process-based crop simulations models (CSM). These models are available for only a small set of crops; we used CSM for maize, potato, and wheat (as representative of warm-season grain, cool-season grain, and vegetable crops, respectively); and
7. Quantify the carrying capacity of the Northeast region under different diet scenarios, using the Foodprint model of Peters et al. (2007) and Peters et al. (2016).

Research Methods and Results for the Seven Studies

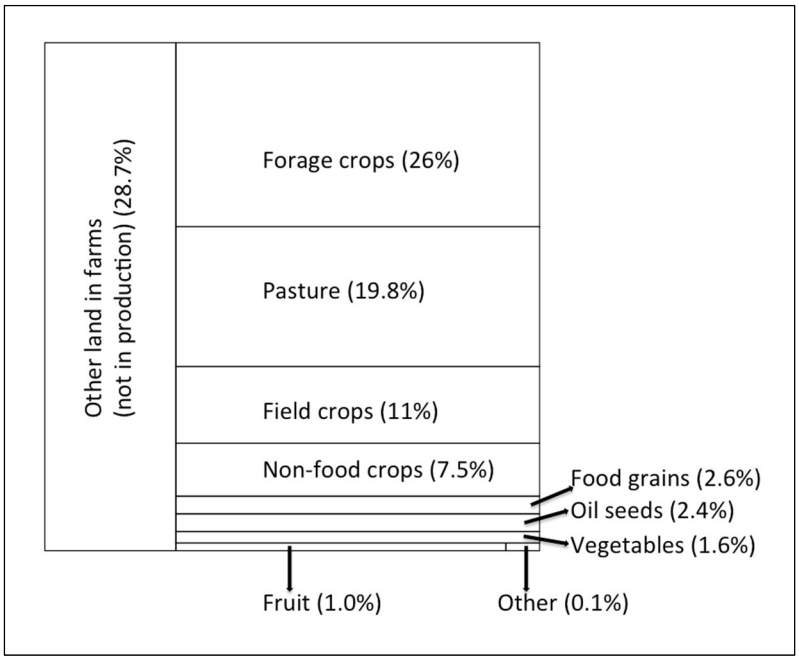
Study 1. Baseline: RSR for Food (RSR_{FOOD})

A critical initial phase of the Production Team research was to establish the baseline for current agricultural production in the region. Because the

EFSNE project also included a component on consumer access to healthy food, we wanted to estimate not only how much raw agricultural commodity was produced by farms in the region, but also to compare that production with total food *consumption* in the region. As stated in Griffin et al. (2015), the objectives of the research were to:

1. "Determine how agricultural land is used in the Northeast region;
2. Determine the variety and amount of foods produced; and
3. Analyze the relationship between food consumption and agricultural output."

Figure 1. Proportional Use of Land for Crop Production in the Northeast U.S., Relative to Land in Farms (Total Land in Farms=11.0 million ha)



We developed a time-series dataset for 2001 to 2010 for land area, crop yield, crop output (land area X yield), and livestock inventory and output. Griffin et al. (2015) described the data development in detail, so we only summarize the approach here. The preferred data sources were the annual National Agricultural Statistics Service (NASS) surveys from the USDA, followed by the USDA NASS Agricultural Censuses (2002 and 2007). These two types of sources provided high-quality data on land area for many crops and agricultural land uses in the region, although less so for fruits, vegetables, and nuts. Estimates of yield from USDA were complimented by data from various state departments of agriculture and Cooperative Extension experts. Data on livestock were developed using USDA-NASS slaughter reports and (in some cases) animal inventory or sales data, and also animal productivity data from USDA Economic Research Service (ERS) sources. Where feasible, data were aggregated first to the state level, and then to the entire region. Per-capita food availability data (from the USDA ERS Food Availability Data System) were used as a proxy for consumption.

The distribution of land uses on farms in the Northeast is summarized in Figure 1. More than a quarter (28.7%) of the Land in Farms[1] was not in production; this included a significant land area devoted to small woodlots on farms. More than one half (56%) of the Land in Farms supported the livestock sectors in the region. The predominant land use of perennial forage crops and pasture support dairy and beef production. The remaining land area, about 13%, is used to produce both food and nonfood crops (the latter encompasses nurseries and ornamental crops, including significant land area in Christmas tree production).

Relative to its population (approx. 23% of the U.S.), the Northeast contains a small portion of Land in Farms (3.9%); this is essentially the land base utilized by operations that meet the USDA definition of a farm. The region contains just 3%

[1] Defined by USDA-NASS (2017, p. 17) as "agricultural land used for crops, pasture, or grazing. Also included is woodland and wasteland not actually under cultivation or used for pasture or grazing, provided it was part of the farm operator's total operation. Land in farms includes acres in CRP, WRP, and other government conservation programs."

Table 1. Mean Production and Consumption of Plant-based Foods in the Northeast Region (2001–2009)

Self-reliance category	Mean regional production (10^6 kg)	Mean regional consumption (10^6 kg)	Mean regional self-reliance (%)[a]
Fruit	1389	7622	18
Commonly Eaten Fruit[b]	1124	6590	17
Berries	167	278	60
Melons	98	754	13
Vegetables	2953	11,387	26
Dark Green Vegetables	39	364	11
Starchy Vegetables	1458	4472	33
Red and Orange Vegetables	452	3554	13
Other Vegetables	1003	2996	33
Food grains	1150	14,627	7.9
Pulses[c]	15	212	7.2
Oils[d]	1396	14,398	9.7
Sweeteners[e]	290	3752	7.7
Total	11,535	71,005	16

[a] Percent of regional consumption met by regional production, (Production/Consumption)*100
[b] All fruit except berries and melons
[c] Dry beans and peas
[d] Corn, soybean, canola
[e] High-fructose corn syrup, glucose, honey, cane and beet sugar, maple syrup, molasses, refiners' syrup, surgarcane syrup, sorgo

of the cropland in the U.S. Additionally, as shown in Table 1, the RSR_{FOOD} is at or above 23% for only a limited number of food categories. Some may be tempted to adopt the value 23% (i.e., the regional proportion of the national population) as a reference point to compare RSR_{FOOD} against, and doing so implies that the region is *over-reliant* on food from outside the region. Yet, importantly, we posit that there is no evidence for assigning any particular value as the optimal RSR_{FOOD}, and we recommend that different reference points be used for interpretation depending on the study question.

The RSR_{FOOD} for livestock-based foods (e.g., meat, dairy, and eggs) ranges from 15% to 76%, for pork and dairy products (fluid milk equivalent), respectively (see Table 3 in Griffin et al., 2015, for details). The high RSR_{FOOD} for dairy reflects not only the large land base used for this subsector, but also the perishability of fluid milk; the region is essentially self-reliant for fluid milk, which is generally transported less than several hundred miles from production.

Study 2. Baseline: RSR for Food (RSRFEED)

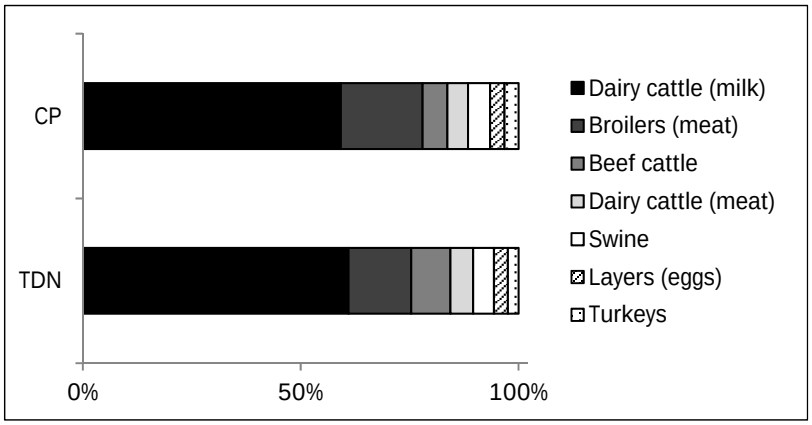
Given the importance of land used to support livestock production in the region, shown in Figure 1, we sought to assess the degree to which the region meets its own *feed* needs for the primary livestock categories. This is directly analogous to the RSR for food (i.e., RSR_{FOOD}) described above, and the supply side of the estimation is largely contained in Griffin et al. (2015). Conrad et al. (2017) extended this approach by estimating regional livestock feed demand for major livestock categories (beef, dairy, swine, poultry including eggs) using the model of Peters, Picardy, Darrouzet-Nardi, and Griffin (2014). This model uses maize and soy as the primary feed components to supply energy and protein, respectively, for all livestock categories. Forage requirements in dairy rations are met with corn silage, alfalfa, and mixed forages (as hay or haylage), but no pasture. As shown in Figure 2 (from Conrad et al., 2017), about 60% of total demand for protein and energy (as total digestible nutrients, TDN) is from the dairy sector, followed by broiler chicken production.

The production of both grain crops (concentrates) and harvested forage, along with pasture use, is concentrated in a few states in the region (see Table 1 in Conrad et al., 2017, for livestock-associated land use for the entire region): New York, Pennsylvania, and West Virginia contain more than 80% of the region's forage and pasture land, while New York, Pennsylvania, and Maryland contain more than 90% of the region's cropland used for grain feeds. The land base used for pasture in the region is more than 2 million hectares (nearly 5 million acres), but is primarily

used at low intensity for beef production.

Using data on livestock product output and feed production, we estimated RSR_{FEED} based on both energy and protein (TDN and CP, respectively), as shown in Figure 3. This shows that the region is almost 93% self-reliant for energy, and about 68% self-reliant for protein. It is assumed that most of the feed entering the region is, in fact, concentrates like corn and soy, as the transportation cost of forage crops is typically not justifiable because of low energy density, high moisture content (for silages), or both.

Figure 2. Proportional Demand for Crude Protein (CP) and Total Digestible Nutrients (TDN) by Livestock Category in the Northeast U.S.



Source: Adapted from Conrad, Tichenor, Peters, & Griffin (2017).

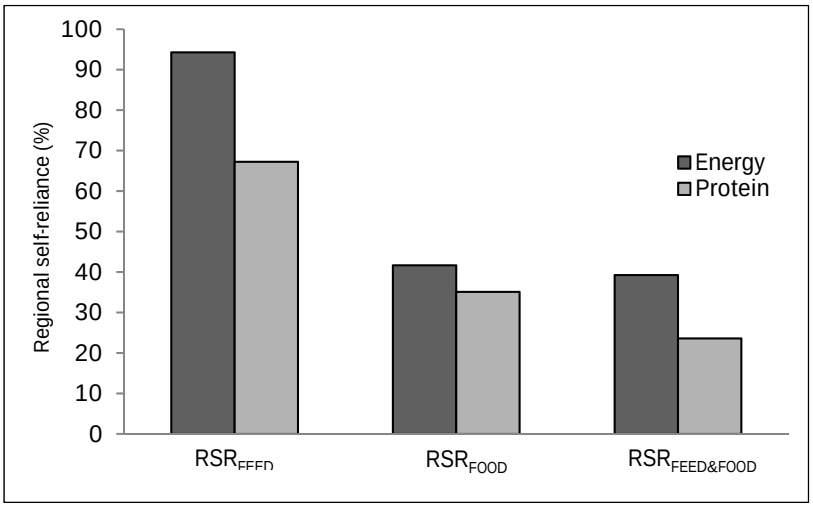
Study 3. Baseline: The Urban/Peri-Urban/Rural Continuum

Agricultural production in the Northeast region, as in other regions, obviously occurs in rural areas—but not exclusively so. The visibility and potential of urban agriculture to both provide educational and cultural opportunities and to contribute to increased food security is also notable. The more ambiguous zone is the peri-urban zone, which contains a mixture of lower-density residential areas, industry, and farms.

Although there is much anecdotal evidence that these peri-urban zones around cities have historically been an important source of food, assessing the current role depends on the ability to delineate the peri-urban area from the urban core and from the outlying agricultural zone. To date, there has not been a codified protocol for this delineation. The Urban Design Lab (Columbia University), as part of the Production Team, led the study described here to develop and implement a data-driven approach that delineates urban, peri-urban, and rural zones around the urban centers in the EFSNE project, and subsequently to assess the distribution of food supply chain business categories across these zones.

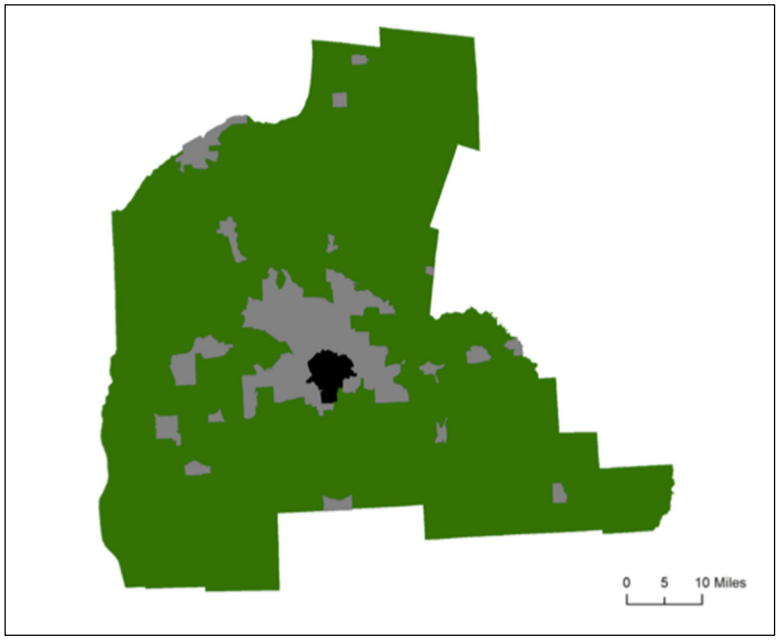
The delineation of zones proceeded in three phases, each of which provided data layers within a geographic information system (GIS). First, the study areas were defined as the cities that served as EFSNE research sites—i.e., Baltimore, Maryland; Charleston, West Virginia; New York City, New York; Philadelphia, Pennsylvania; Pittsburgh, Pennsylvania; and Syracuse, New York. Surrounding counties (43 in total) were included in the study

Figure 3. Regional Self-reliance for Energy and Protein Demand by Livestock in the Northeast U.S.



Source: Adapted from Conrad, Tichenor, Peters, & Griffin (2017).

Figure 4. Rural / Agricultural Zone (Green) Surrounding Syracuse, NY, Urban Core (Black); Delineated Peri-Urban Area Is In Gray

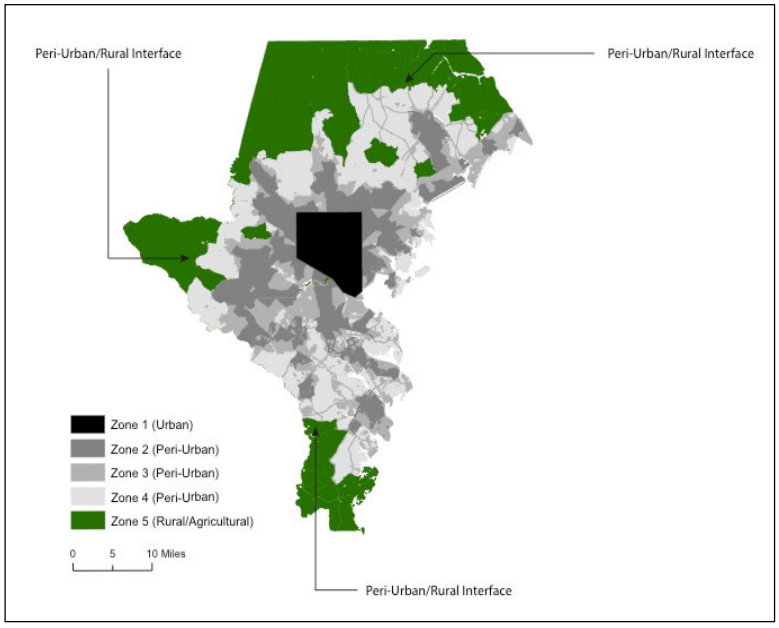


areas (using data on commuting distances) to ensure that the continuum was represented. The second phase was to define and delineate the peri-urban area. This used a combination of Rural-Urban Community Area (RUCA) codes (USDA-Economic Research Service), population density (2010 U.S. Census), and zoning boundaries. Because detailed zoning boundaries only existed for the Baltimore study area, a novel machine learning approach was developed specifically to identify the rural zone of the continuum using the National Land Cover Database. At the resolution of census blocks, an algorithm was trained to recognize land-cover characteristics that are rural or agricultural or both. This algorithm was then applied to the other five study areas in the region. To illustrate the output from these phases, the resulting delineation of the urban (defined by a metropolitan boundary), peri-urban, and rural zones of Syracuse and the surrounding area is shown in Figure 4.

The third phase was to establish a finer gradation or zonation through the peri-urban area, using overlapping map layers for commuting, density, and zoning. The urban core was designated as Zone 1, and the rural / agricultural area was designated as Zone 5; Zones 2, 3 and 4 (moving out from the urban center) are all within the peri-urban zone. These zones were identified as follows:

Zone 2: All three boundaries (commuting, density, and zoning) overlap: heavy pressure.
Zone 3: Two of the three boundaries overlap: medium pressure.
Zone 4: One boundary only: low pressure.

Figure 5: Urban, Peri-urban, and Rural Zones of Baltimore, Maryland, and Surrounding Area

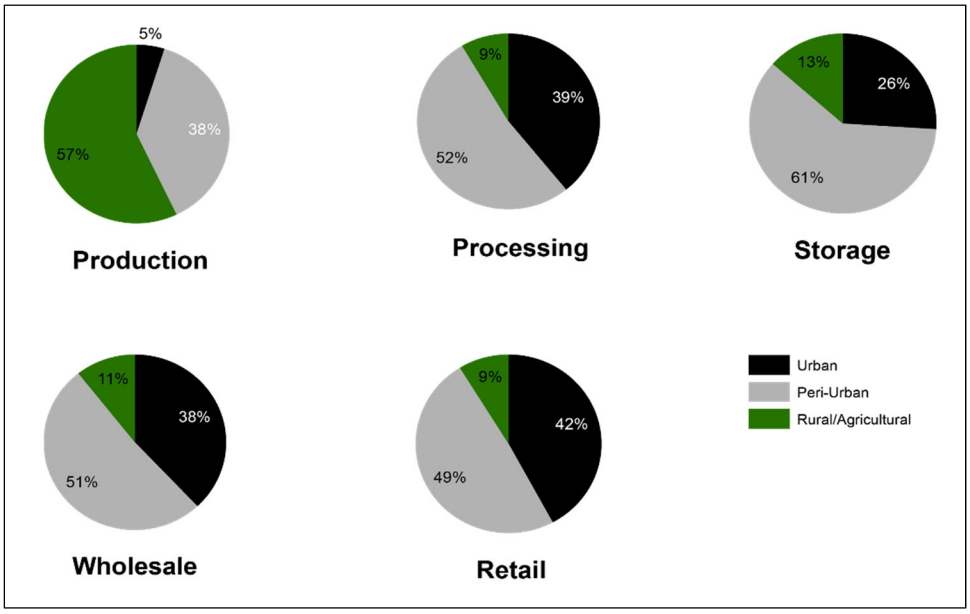


The delineated urban, peri-urban, and rural continuum for Baltimore, Maryland, and the surrounding area is shown in Figure 5. The protocol described above was eventually scaled to the entire Northeast region.

The second objective (above) was to assess the current distribution of

food supply chain businesses across the resulting zones by using business data from the U.S. Census's North American Industry Classification System (NAICS). Included in these data is the location of businesses engaged in agricultural production, storage, processing, wholesale, and retail. This was included as a data layer in the GIS and allowed the number of businesses of each type within each zone (1–5) to be considered.

Figure 6. Distribution of Food Supply Chain Business Categories across Urban, Peri-urban, and Rural Zones for EFSNE Research Sites in the Northeast U.S.



The peri-urban mapping study resulted in consistent and clearly defined urban, peri-urban, and rural zones, as shown above. Analyzing the distribution of agricultural businesses across these zones revealed the disproportional contribution of the peri-urban areas to existing food supply chains. Noting that the peri-urban areas compose about 22% of the land area in the Northeast, Figure 6 shows that, for the entire EFSNE region, one-half or more of each business type's expected production is located within peri-urban areas. Table 2 shows the share of each agricultural business type that is located within the combined peri-urban zones (Zones 2–4) within the six urban research sites. Across the six study cities in the EFSNE project, the peri-urban zones contained the largest share of the production, processing, wholesale, retail, and storage business areas in a majority of instances. There are also distinct differences between EFSNE research sites in how business types are distributed across the zones. For some sites (Baltimore and Philadelphia, for example) one-half to three quarters or more of supply chain businesses are located in the peri-urban zones—and this includes production businesses such as farms. In comparison, Charleston, West Virginia, has only wholesale and retail businesses concentrated within its peri-urban zones.

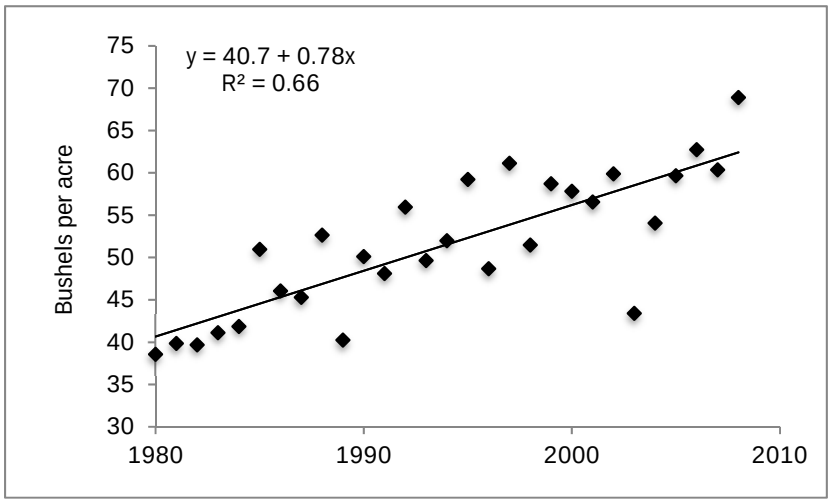
Study 4. Trajectory: Crop Yields

The expanded regional output of any particular crop can be realized only through a limited set of mechanisms, including increased crop yield,

Table 2. Proportion (%) of Food Business Categories Located in the Peri-urban Zones (2-4) Surrounding EFSNE Urban Research Sites in the Northeast U.S.

	Baltimore	Charleston	New York City	Philadelphia	Pittsburgh	Syracuse
Production	51	0	91	81	40	6
Processing	61	35	44	68	71	51
Wholesale	64	58	48	67	73	39
Retail	56	56	41	56	71	36
Storage	75	0	79	84	0	100

Figure 7. Changes in Wheat Yield in the Northeast U.S., 1980–2010



increased land area, or both. In order to assess future scenarios, the Production Team used historical yield data to estimate yield trajectories for a subset of crops. This was done to refine estimates of potential future yield increases (which would be due to both genetic improvement and management changes) within crop simulation models and to provide an estimate of the gain in output over time if the land base for each crop was held constant.

In order to investigate changes in agricultural production in the Northeast U.S. since 1980 (until 2010), a dataset containing the yields of select products in all 297 counties was developed using USDA-NASS data. Presented here are the results for five crops: maize (both grain and silage), soy, wheat, potato, and alfalfa hay. A similar procedure was used to assess changes in milk production (output per cow) over the same period. Data were subjected to simple linear regression:

$$\text{Yield} = a + b^{*}\text{time} \quad [1]$$

where a is the intercept and b is the slope coefficient (yield gain per unit area per year).

An example of yield trajectory is presented graphically in Figure 7 for wheat yield in the region. Because the units of measure vary across these products, we used the following equation to standardize:

$$\text{Relative Yield Gain} = b / a \quad [2]$$

where a and b are the intercept and slope, respectively, as in [1]. This provides an estimate of annual yield gain *relative to the yield in 1980*. This measurement is often misinterpreted as *annual* gain, which would result in an exponential trajectory. The relative yield gain varies widely, from -0.20% to 2.31%, for alfalfa hay yield and milk production, respectively, as shown in Table 3. These coefficients can be used to estimate intervals or ranges for future productivity gains.

Study 5. Trajectory: Development of a Productivity Index

One strategy to increase food production within the region is to bring new land into agriculture. For example, current land in forest could be converted to agricultural production. It is important to consider the differences in productivity across the landscape in order to understand how the region's capacity for food production would change if more land were brought into agriculture. We initiated the development of a productivity index to estimate the potential productivity of an expanded agricultural land base. The productivity index uses geospatial data to quantify the relationship between a specific type of land cover and its potential productivity for different crops. When combined with the amount of land in each type of land cover, the productivity index can be used to estimate the productive potential for each type of land cover and for the region as a whole.

Table 3. Relative Yield Gain for Selected Crops and Milk Production in the Northeast U.S., 1980–2010

Product	Relative Annual Yield Gain (%)
Alfalfa Hay	–0.20
Corn – Grain	1.72
Corn – Silage	1.15
Milk	2.31
Potato	0.91
Soybean	1.64
Wheat	1.91

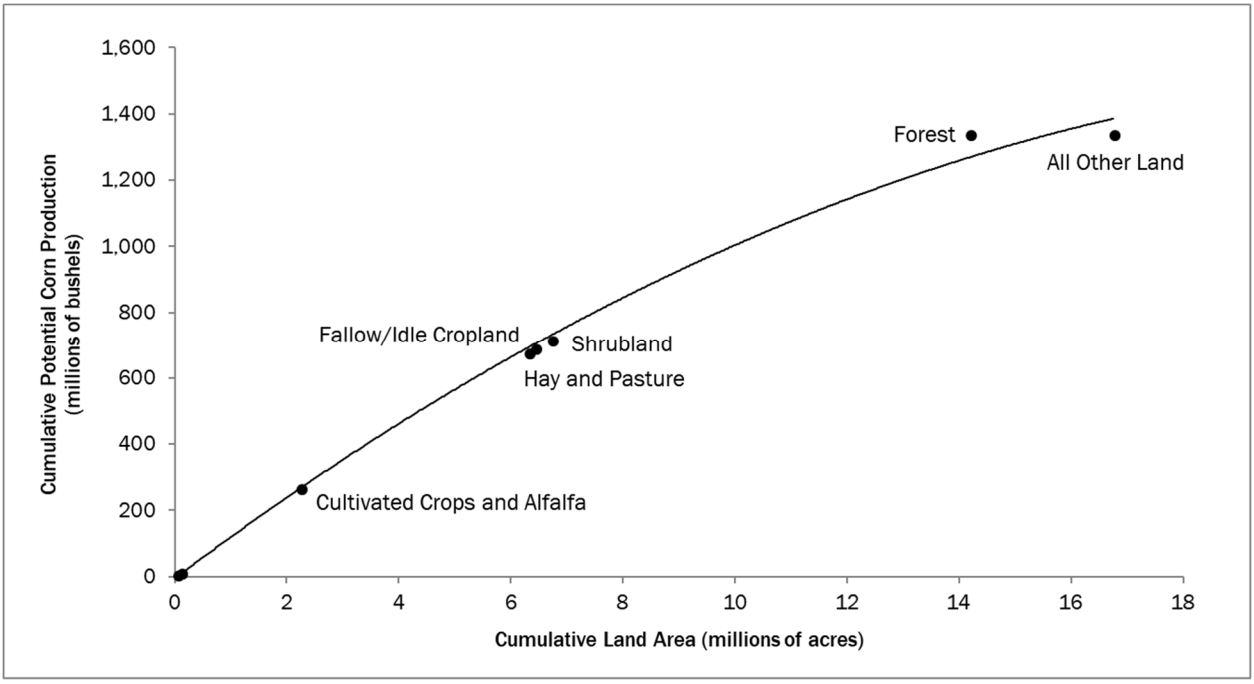
To develop the index, we used the 2014 Cropland Data Layer (CDL) to assign all land in the region to one of eight land cover types: vegetables, melons, and potatoes; berries, grapes, and tree crops; other cultivated crops and alfalfa; non-alfalfa hay and pasture; fallow and idle cropland; shrub and scrubland; forest; and all other land. We used the Gridded Soil Survey Geographic (gSSURGO) database to identify arable land in the region based on land capability classification, and also to obtain National Commodity Crop Productivity Index (NCCPI) values for each unit of land. We then used the NCCPI as a proxy for productivity in the analysis. Using these data and spatial analysis tools, we estimated basic descriptive statistics for the NCCPI values for arable land within each type of land cover; we then quantified the amount of arable land area within each type of land cover. We used these results from the spatial analysis to generate a production function that relates the area of land to product output in the Northeast. The results of this analysis allow us to better understand the relationship between land cover type and productivity as well as the aggregate potential production capacity of the region. The initial results from the analysis demonstrate declining returns to land as more land is brought into agriculture because of a decrease in productivity for each additional unit of land; an example (for New York state) is shown in Figure 8. The production functions generated provide a way to mathematically show this relationship and establish the land cost of bringing less productive land into production. The outcomes of this project will feed into the broader work of the Production and Distribution teams.

Study 6. Scenario: Modeling for Expansion and Climate Change Impacts

Growing conditions vary widely across the Northeast region, encompassing a wide range of soils and climatic conditions. Different scenarios can be evaluated using crop simulation models (CSM) for a specific subset of crops—i.e., those for which robust, validated models are available. The Production Team used CSM for three crops (maize, wheat, and potato) to address questions about potential expansion of land area used for each crop, and also to assess production potential under climate change. Some of the results for potato are used here to illustrate our work.

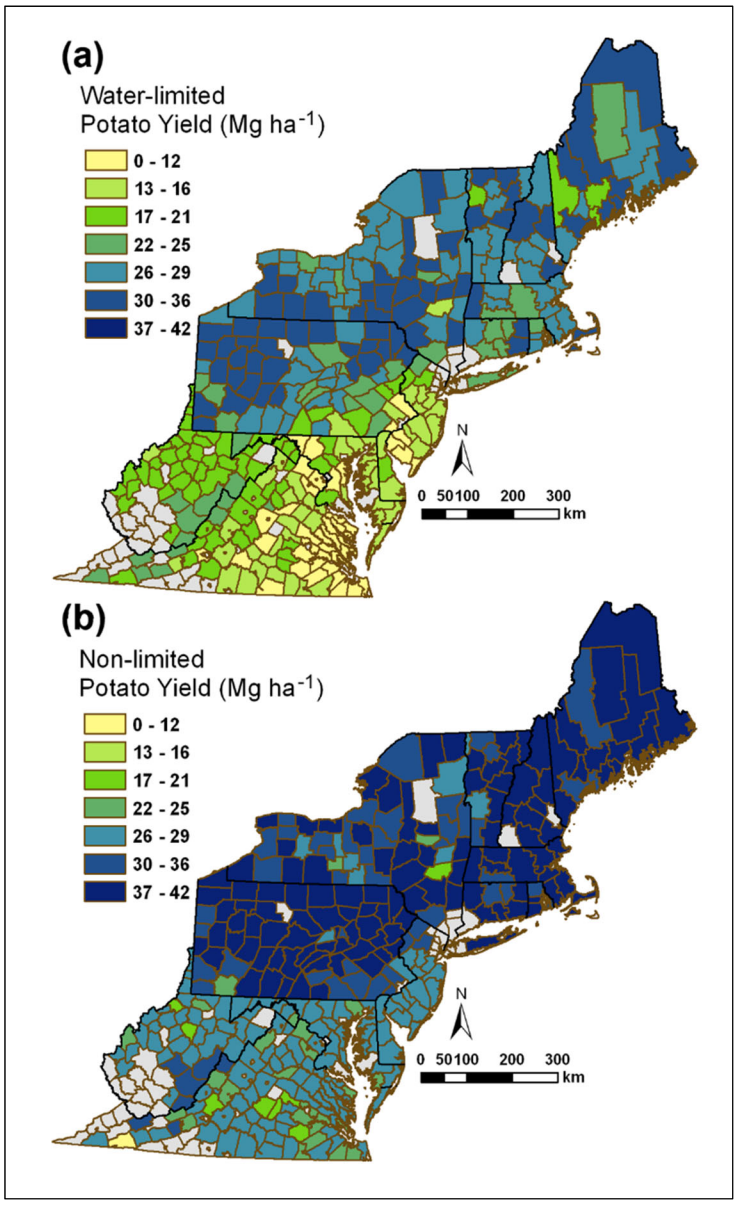
Resop, Fleisher, Timlin, & Reddy (2014) used the well-established potato CSM, SPUDSIM

Figure 8. Production Function for Expanded Agricultural Land Base in New York



(Fleisher, Dathe, Timlin, & Reddy, 2015; Fleisher, Timlin, Yang, & Reddy, 2010), to quantify the impact of soil, climate, and management (irrigation and nitrogen, specifically) on agronomic potato yield. Data presented in Figure 9 confirm that climate factors have a significant impact on the potential yield of potato; there is a pronounced north-south gradient for increased temperature in the region, and the higher temperatures in the southern part of the region depress yield. This can be ameliorated in part by looking at non–water limiting conditions (compare (a) and (b) in Figure 9) because the evaporative demand increases with temperature. The impact of soil properties was notably smaller than that of climatic factors.

Figure 9. Simulated Potato Yield under (a) Water-Limited and (b) Non-Limited Conditions in the Eastern U.S. under Historical Climatic Conditions
Results were spatially aggregated from 16 to 30m resolution



Source: Resop, Fleisher, Timlin, and Reddy 2014.

Because potato is sensitive to high temperature and moisture stress, the implications of climate change are cause for concern. Resop, Fleisher, Mutiibwa, Timlin, and Reddy (2016) used SPUDSIM to simulate the impact of increased temperature and shifting precipitation patterns across the region. Climate change scenarios included temperature increases ranging from 3.6˚F to 7.7˚F (2.0 ºC to 4.3ºC) and changes in annual precipitation ranging from -5% to 16%. They found that yields could be reduced by 50% to 80% *if farmers did not implement adaptation strategies*, which could be as simple as shifting planting dates. This decrease was simulated despite the fertility effect that has been associated with increased carbon dioxide concentration. In the southern part of the region, most of the yield reduction was due to water constraints, along with warmer temperatures. While implementing proven adaptation strategies or practices could reduce the predicted yield impact by half, the consequences would still be substantial. Climate impacts were less severe on maize production, with an average 19% reduction in silage if no adaptation measures were implemented (Resop et al., 2016). In contrast, winter wheat showed a sharp increase in grain yield (by as much as 50% above the current yield levels), depending on location in the region (data not published). This increase was primarily on account of warmer temperatures resulting in a more favorable growth environment. In general, the results suggest that the agricultural land base may need to be

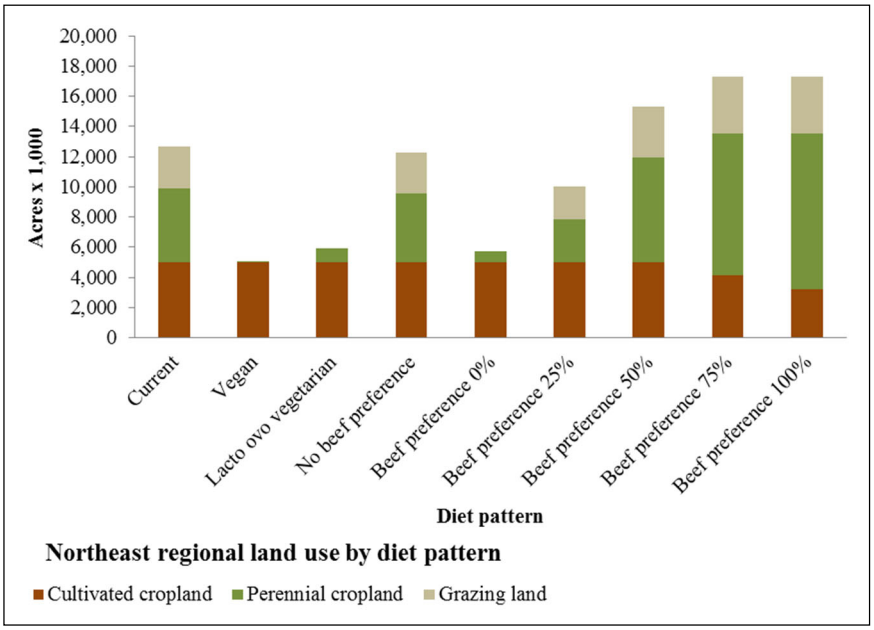
reconfigured by the selection of new crop commodities that are currently not grown in the area, or via an increase in production area for crops that are better adapted to warmer climates.

Study 7. Scenario: Carrying Capacity of the Northeast Region under Different Diet Scenarios

Most of the research described above focuses on individual crops or livestock products. This last study from the Production Team focuses on the capacity of the regional land base to produce complete diets. This was accomplished by modifying the well-documented model from Peters et al. (2007) and Peters et al. (2016) to make it specific to the Northeast region. This spreadsheet-based model uses data on crop yield and animal productivity to estimate the land requirement of specific diets; availability of different foods is estimated using the Loss Adjusted Food Availability dataset from USDA-ERS. In this application, the 10 diets included the current U.S. diet, vegan, lacto-ovo-vegetarian, and six diets that varied in the preference for beef in the diet (i.e., they varied in how non-beef meats were allowed as substitutes for beef). The diets were isocaloric and met the 2010 Dietary Guidelines for Americans.

The land requirements of the various diets vary fourfold (Figure 10). Increasing consumption of beef forces more land to be used for perennial forage production and pasture. At high levels of preference for beef, some of this forage production is on land typically used for annual crop production. It is important to note that the land area devoted to annual crop production varies only slightly across the 10 diet scenarios. The carrying capacity can be estimated based on per-capita dietary demand and regional population; this estimation is related to (but distinct from) the land requirement estimation. As expected, the carrying capacity varies significantly across the diets evaluated (Table 4), but over a smaller range than land requirement. The principle reason for the difference is that there is a substantial land base in the region that is suitable only for perennial forage production (i.e., annual crops would not be suitable for this land base).

Figure 10. Land Requirements of 10 Diet Scenarios for the Northeast U.S.



Discussion

An appraisal of agricultural production at the regional scale should encompass four components. First, as noted by Ruhf and Clancy (2010), it should

Table 4. Carrying Capacity of the Northeast Region as a Function of Diet

Diet pattern	People fed (n x 103)	Population fed (%)
Current	10,864	17
Vegan	15,087	23
Lacto-ovo-vegetarian	18,001	28
No beef preference	12,651	20
Beef preference 0%	12,219	19
Beef preference 25%	12,631	20
Beef preference 50%	13,057	20
Beef preference 75%	11,121	17
Beef preference 100%	8,919	14

recognize that the food system is composed of multiple overlapping and complementary scales. Within each of these scales (local, regional, national, and global), available resources can constrain agricultural production. Second, there is a finite set of mechanisms by which regional production can be increased. These include yield increases for crops and livestock (through efficiency gains, genetic improvement, and the like), crop substitution, and expansion of the land base. The first and last of these mechanisms are generally referred to as *intensification* and *extensification*, respectively. Third, it is important to recognize that the provision of agricultural products to consumers depends on the complex interactions between myriad supply chain businesses. And fourth, there are multiple drivers that either constrain the capacity to increase production or send direct market signals to farms and ranches to alter production. Principle among these drivers are climate change and dietary demand. The research portfolio of the Production Team intentionally tried to capture this range of objectives and associated methodologies.

The two studies that quantify the regional self-reliance (RSR) were referred to as "The Baseline" by the Production Team. These were the first studies to be undertaken by the team and literally established the baseline balance between production and consumption. The RSR presented here is generally aggregated to the level of food categories, although the data are at the resolution of individual crops and livestock. Spatially, the requisite data were at the levels of states in the northeast region. For a few crops (mostly commodity grains and oilseeds), the production data could be developed at the county level, while some livestock categories can only be documented at the level of multiple states (e.g., some animal slaughter data are compiled for the six New England states in aggregate). The results of these two studies are useful in identifying products or categories that have production centers in the region (for example, cabbage is one of the market basket products for EFSNE).

The northeast region has a high population density compared to other regions of the U.S., so much of the farm-level production occurs near cities. There was a clear need to develop a more nuanced picture of where farms and other businesses are located relative to those cities. Of particular interest were peri-urban areas, which anecdotally contain a mosaic of residential, industrial, and rural characteristics. The Production Team developed a protocol to delineate peri-urban zones that initially focused on Baltimore, Maryland, and the surrounding area, but was eventually applied to the other urban EFSNE research sites and then to the entire region. This is a necessary first step to take a more strategic approach to locating food supply chain businesses.

Changes in crop and livestock productivity are not likely to be uniform across the region, and further refinements are needed as we look to the future of the region's food system. As noted earlier, it is possible to expand aggregate production by increasing yield, expanding the land base used for production (recognizing the inherent differences in soil resources and other factors), or both simultaneously. Our analysis of yield trends confirms that (1) the yields of a few commodity grain and oilseed crops, along with milk, have very pronounced positive trends, commensurate with the decades-long public and private investment in the productivity of these products, and (2) some of the crops that occupy the largest agricultural land areas in the region, such as grass, and alfalfa hay, have flat or even negative yields trends over this period. It also should be noted that data availability constrains this type of analysis for many food crops, including most fruits, vegetables, and nuts.

Future production can be simulated at different levels of spatial resolution and in response to different drivers. On the supply side, this includes inherent resource constraints like soil productivity and also the availability of resources and inputs like land, water, and nutrients. Using crop simulation models, the Production Team developed a series of questions around which simulations could be conducted. In general terms, these questions included:

1. What is the regional variability in crop yield (for corn, wheat, and potato specifically) that results from variation in soil productivity and climate?
2. How does productivity change as new land is brought into production?

3. What is the magnitude of the impact of climate change on crop productivity?

Although validated crop simulation models are available for relatively few crops, those that we had access to and experience with represented warm season grain (corn), cool season grain (wheat), and cool season vegetable (potato). Much of this work was done at fine-scale resolution, on the order of 184 ft by 184 ft (56 m by 56 m), and then aggregated upward to the scale of the region. Because of this high resolution, data development, curation, transfer, and processing, and analysis were notable challenges. We also linked demand and supply by quantifying regional carrying capacity as affected by dietary demand. This was important within the context of the EFSNE project, which includes consumption, supply chain, and production realms. It also highlights that demand is a primary driver of production; sustainability outcomes can only be achieved within the context of sustainable consumption (Moomaw, Griffin, Kurczak, & Lomax, 2013).

The coordinated research effort described here represents six years of research and contributions from more than 30 people, including faculty, postdoctoral associates, graduate students, and practitioners and community members; various aspects of this work are described elsewhere (for example, see Clancy et al., 2017; Palmer et al., 2017). Much of the coordination across the investigators was accomplished virtually; the Production Team held biweekly conference calls for more than four years. They also met in person at least once per year, in addition to the annual EFSNE project meeting. Notably, these annual team meetings relied on resources beyond those available from the EFSNE budget. In addition to our research focus, the Production Team actively provided opportunities for graduate students to take leadership roles, in some instances to act as a liaison between different EFSNE teams. All of the studies described here engaged graduate students, and several (e.g., RSR, peri-urban zonation, and productivity index) would not have been possible without student leadership and innovation.

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Salvageable food losses from Vermont farms

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Abstract

For a variety of reasons, farms cannot sell or donate all the food they produce, and some food crops are lost from the food supply. Food lost at the farm level represents a substantial environmental, economic, and nutritional cost to the food system. Few studies have estimated amounts of food lost at the farm level in the U.S. We present a survey-based method for estimating crop loss quantities based on four estimates by farmers: percent available crops that are harvested, percent unharvested crops they would consider edible, percent harvested produce sold, and percent harvested produce donated. We applied the

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method in an online survey administered to 58 Vermont vegetable and berry farms. Within the sample, an estimated 16% of vegetables and 15% of berries were considered lost but salvageable in 2015. If these farms are representative of farms across the state, this would amount to approximately 13,684,000 lbs. (6,207,000 kg) of salvageable vegetables and 589,000 lbs. (267,000 kg) of salvageable berries. This lost produce contains substantial nutrients. For example, the amount of lost fiber is equivalent to the gap between actual and recommended fiber intake for 36,000 adult U.S. women. Most estimates are based on recall. While many farmers reported keeping records of crops harvested (67%) and sold (69%), few had records of other quantities needed for tracking losses. Sixty percent of farmers expressed interest in a state program that would compensate farmers for donations and nearly half expressed interest in one or more strategies to involve community groups in reducing losses. While not all produce that is lost can realistically be provided to consumers in a timely and cost-effective manner, this research highlights a high magnitude of loss and potentially, a considerable nutritional and economic opportunity. Further research is needed to confirm and add depth to these estimates and to evaluate potential solutions.

Keywords
Berry Production; Food Loss; Food Waste; Imperfect Produce; Quantification; Small Farms; Survey; Vegetable Production

Introduction and Literature Review
Farmers in Vermont harvested approximately 3,897 acres (1,577 hectares) of vegetables and 601 acres (243 ha) of berries in 2012 (U.S. Department of Agriculture National Agricultural Statistics Service [USDA NASS], 2012a, 2012b). An unknown but substantial portion of the edible product is lost at the farm level. The Food and Agriculture Organization of the United Nations (FAO) estimates that about 42% of the overall food supply in North America and Oceania goes to waste, with about 33% of that waste occurring at the farm level (Gustavsson, Cederberg, Sonesson, & Emanuelsson, 2013; FAO, 2011). The FAO's estimate represents one of only a few attempts to quantify farm-level food losses in the U.S. The USDA does not collect such data. Additionally, only a few studies have elaborated the nature and determinants of food losses on farms in high-income countries like the U.S. (Berkenkamp, 2016; Davis et al., 2011).

The International Food Loss and Waste Accounting and Reporting Standard (FLW Standard) defines food loss and waste (FLW) as "food and/or associated inedible parts removed from the food supply chain," and uses the terms, "loss" and "waste" interchangeably (World Resources Institute, 2016). We use these definitions and further distinguish "salvageable food loss" as food removed from the food supply chain while still edible. Salvageable food loss includes products indistinguishable from those sold in stores as well as high quality, edible products with cosmetic imperfections such as nonstandard sizes and/or shapes or blemishes. We do not include donated food in our definition of FLW since it remains in the supply chain for human consumption and is thus not considered wasted.

Farm-level FLW represents: a substantial loss of income for food producers, waste of the resource inputs used to produce the food, and loss of nutritious food for consumers. Even when crops are turned under or composted on the farm to nourish the soil, the result is high-input compost that relied on considerable water, energy, labor, and manufactured inputs such as fertilizers. Lower-input methods and inedible organic material can be used to produce compost instead.

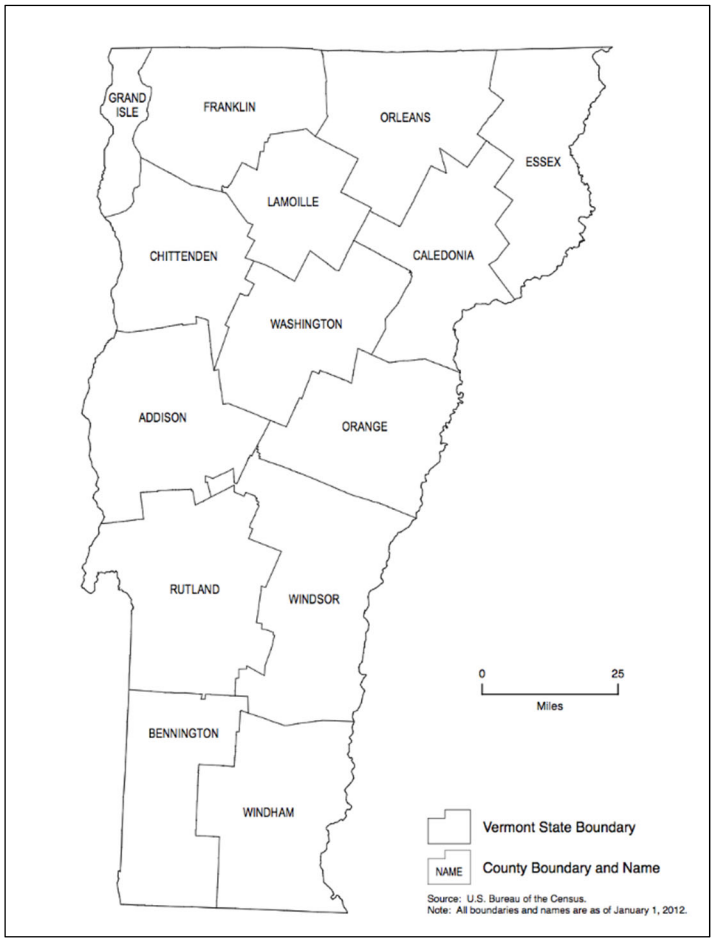
As we will describe, we identified only three prior assessments of multi-crop farm-level losses in the U.S.; Minnesota estimates of produce imperfection rates; British retailer rejections of produce for aesthetic and other reasons; and interviews with California growers and produce packers (FAO, 2011; Milepost Consulting, 2012; ReFED, 2016). Quantifying on-farm losses and assessing reasons is essential for identifying and prioritizing response strategies and interventions, including exploring the amount of loss considered acceptable given realistic tradeoffs and costs involved in food recovery. Data can also

strengthen stakeholder motivation to address the problem, including building support for investment in infrastructure and programs. It is also beneficial for food donation programs to gain further insight into the extent of food that could become available with effective interventions. Lastly, the U.S. has committed to halving waste of food by 2030 (U.S. Environmental Protection Agency [U.S. EPA], n.d.-a), and without baseline or other data on farm-level FLW, it is impossible to track progress toward that goal or to evaluate intervention impacts. Further assessments are greatly needed, covering diverse geographies, crops, and farm sizes, and using diverse methodologies.

Waste of fruits and vegetables leads to vast losses of under-consumed nutrients including, for example, enough calcium for 680.3 million adults and enough fiber across the U.S. to fill the gap between actual and recommended consumption of fiber for 206.6 million adults (Spiker, Hiza, Siddiqi, & Neff, 2017). In Vermont, an estimated 74,600 individuals (11.9% of the population) were food insecure in 2015 (Feeding America, 2017). Studies commonly associate food insecurity with reduced intake of fruits and vegetables (Hanson & Connor, 2014); therefore, strengthened food recovery could enable increased consumption among those in need.

This study provides the first empirical data on farm-level food loss in New England, and among the first farm-level data on the topic nationally. Salvation Farms, a Vermont nonprofit focused on "fostering collaborative, cross-sector partnerships that create efficient management practices for Vermont's farm surplus," initiated and led the project. This manuscript builds on the August 2016 report, *Food Loss in Vermont: Estimating Annual Vegetable & Berry Loss. A Salvation Farm's Analysis* (Snow & Dean, 2016) by providing further literature review and analysis.

Figure 1. Vermont Counties



Source: USDA National Agricultural Statistics Service, 2012b.

Vermont farms are often small and mid-sized, and products are often marketed directly, rather than sold into national markets, meaning the findings from this analysis may have particular value to other states with a preponderance of small farms. Figure 1 depicts the state and its counties.

We developed and administered the Vermont Food Loss Survey in spring 2016, with the aim of estimating the quantity of farm-level FLW among sampled farms, aggregating the estimates to the state level in Vermont, and learning from farmer perspectives on this waste. The research focused on vegetable and berry farms because fruits and vegetables combined are the most frequently wasted agricultural product type and because they are both perishable and nutritious (Buzby, Farah-Wells, & Hyman, 2014).

Applied Research Methods

Our research methods reflect the steps identified in the International FLW

standard, which provides an internationally consistent approach to measurement (World Resources Institute, 2016). The standard was finalized after our data collection was completed, but we reviewed draft versions during development. While the FLW Standard does not cover pre-harvest losses, we extend the approach to include these, given their centrality in understanding farm-level waste.

The FLW Standard includes the following steps: (1) define goals; (2) review accounting and reporting principles; (3) establish scope; (4) decide how to quantify FLW; (5) gather and analyze data; (6) calculate inventory results; (7) assess uncertainty; and (8) report FLW inventory. Table 1 presents our approaches to these steps.

Survey Instrument

We designed the survey instrument based on our research questions, taking into consideration feedback from farmer participants in focus groups and pre-survey interviews, and from experts in wasted food, Vermont agriculture, and survey methods. (See Appendix A for the full instrument.)

Part 1: We began by asking farmers about farm size, specific crops grown and quantities planted and harvested. To estimate the percent of crops lost, we then asked farmers to estimate the following:

Q1: What percent of the vegetables and/or fruits, berries & nuts [henceforth crops]

Table 1. Research Approach in Context of the Requirements in the Food Loss and Waste Standard[a]

FLW Standard Step	Our Approach
Define goals	To quantify FLW in order to contribute to advancing food recovery in Vermont and build an understanding of farm-level FLW in the U.S.
Review accounting and reporting principles	To the extent feasible, our research adheres to the accounting and reporting principles: relevance, completeness, consistency, transparency, and accuracy. Limitations are considered in the Discussion section.
Establish scope	Timeframe: 2015 growing season. Material type: Edible vegetables and berries, as defined by farmers. For some parts of the analysis, we used data from the Vermont agricultural census, which includes melons in the vegetables category. Destination: We collected survey data to identify destinations of lost crops, but the research did not assess percent of crops going to each destination, and we did not assess the extent of valorization. Boundaries: • *Food category*, United Nations Central Product Classification (United Nations, 2015)*:* vegetables (012), edible roots and tubers (015) and berries (0135); • *Lifecycle stage,* United Nations Standard Industrial Classification of All Activities (United Nations, Department of Economic and Social Affairs, & Statistics Division, 2008): Growing of vegetables and melons, roots and tubers (0113); Growing of other tree and bush fruits and nuts (0125). • *Geography:* U.S. state of Vermont. • *Organization:* We surveyed a sample of farms, and extrapolated results to create statewide estimates.
Decide how to quantify FLW	Described below in Methods
Gather and analyze data	Described below in Methods
Calculate inventory results	Described below in Methods
Assess uncertainty	We performed sensitivity analyses to assess possible impacts of differing crop yield percentages and differing amounts of the salvageable loss being redirected to human consumption
Report FLW inventory	Described below in Results

[a] World Resources Institute, 2016.

that grew on those [planted] acres did you harvest?
Q2: What percent of the crops left in the field (i.e., that you did not harvest) were edible?
Q3: What percent of the crops that you harvested did you sell?
Q4: What percent of the crops that you did not sell did you donate?

These questions were selected due to focus group and interview input from farmers regarding what they would reasonably be able to estimate. It is recognized that many of the estimates were based on recall and all are self-reported, potentially leading to limitations in results. However, no other data sources were available at this time.

Part 2: Farmers had the option to participate in additional questions adding depth and context, including listing their three main crops and answering questions about the following:

- Reasons for not harvesting and not selling produce
- The fate of unharvested and unsold items
- Quantities lost during washing, packing, storing, transporting, and at market
- Types of sales venues
- Recordkeeping about planting, harvesting, sales, and losses
- Types and quality of services provided by community groups to the farm, and types of services desired
- Past and planned claims for federal tax deductions for food donations, and level of interest in state-provided financial compensation for farmers for food donations

Survey Sampling

We surveyed farmers online via a Qualtrics survey from April 5–25, 2016. All Vermont farms were eligible to participate if they grew vegetables (n=789) and/or fruit. We received few responses from growers of fruits other than berries, so we limited the analysis to berries (n=535 in state). Some farms grew both vegetables and berries (USDA National Agricultural Statistics Service, 2012a).

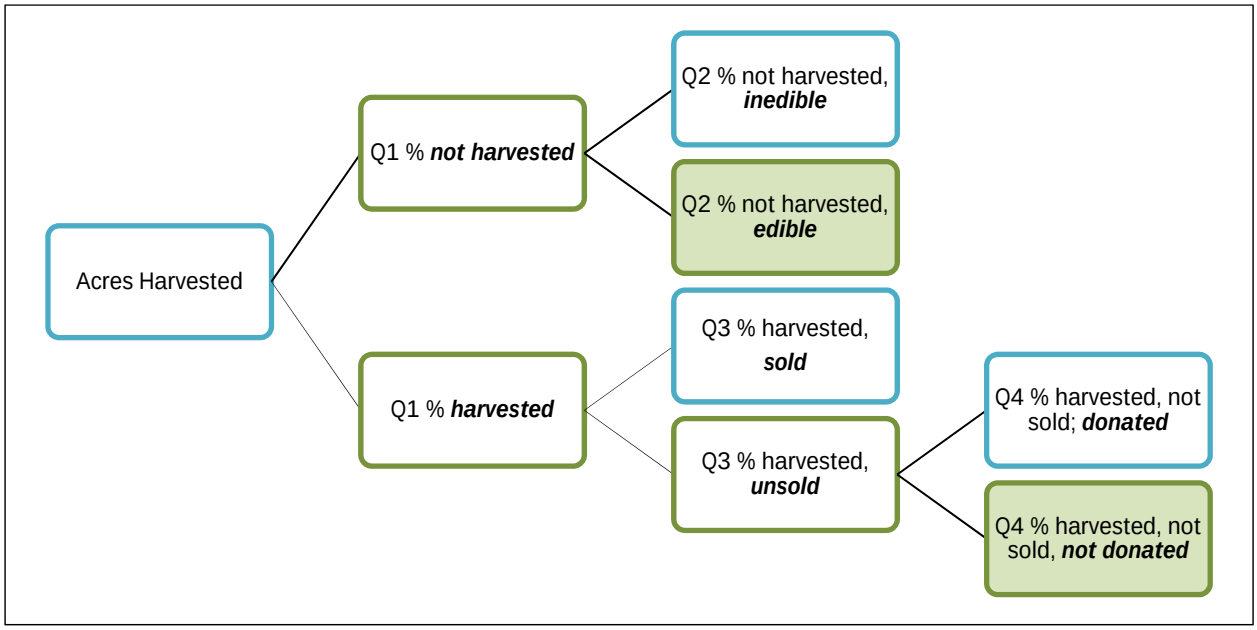
We performed broad outreach and sent follow-up reminders, including through the email lists of Salvation Farms, the Vermont Vegetable and Berry Growers Association, and Vermont Farm to Plate. It is unknown how many farmers received invitations or duplicate requests. Outreach materials indicated that the survey would help Salvation Farms estimate the amount of food loss farmers were experiencing and understand more about the issue from their perspectives. We entered participants in survey Part 1 into a raffle for a US$100 gift certificate, and those in Part 2 for a US$300 gift certificate. We assured participants that only aggregated responses would be reported.

Data Analysis

In addition to performing descriptive analyses of the survey responses, we calculated estimated pounds of salvageable food loss as follows. First, we multiplied provided data on acres harvested by published yield fractions. Specifically, we used the fractions: 0.5 pounds (0.23 kg) of vegetables per square foot, developed by the Rutgers New Jersey Agricultural Experiment Station for small-scale farms that grow a large variety of vegetables, much like the typical Vermont vegetable farm; and 0.15 pounds (0.07 kg) of berries harvested per square foot, an estimate obtained from averaging the expected yields for strawberries, blueberries, and raspberries for New England (Grubinger, 2013; Rabin, Zinati, & Nitzsche, 2012). While obtaining information about each farm's yield estimates rather than using these published numbers would improve specificity, it could also add considerably to subject burden, decrease consistency, and add another source of uncertainty if their estimates were not effective. We chose to use the Rutgers estimate for vegetables, rather than available Vermont-specific yield estimates for 42 vegetable crops, because we did not have acreage data for all of those crops to enable determining how best to derive a single yield fraction from them. A sensitivity analysis was performed using a simple average of those estimates.

We then, as shown in Figure 2, used average survey responses for Q1 (percent of crop

Figure 2. Schematic of Method Applying Survey Responses to Estimate Salvageable Loss



harvested) and census acres available for harvest, to segment the projected harvest into harvested and unharvested. For the unharvested produce, we applied the percent from Q2 to segment into edible and inedible, recognizing that respondent perceptions may differ. For the harvested produce, we applied the percent from Q3 to divide into sold and unsold. Unsold produce was then divided into donated and not donated using the percent from Q4. Salvageable food loss was calculated as the sum of food that was unharvested but edible, and food that was harvested but not sold or donated (see shaded boxes in Figure 2). In other words, salvageable food loss consists of edible food that could be sold to consumers or donated to community organizations, but that is currently lost. The data are depicted in Sankey diagrams in addition to tabular form. We supplemented the presentation of the mean findings with the 25th, 50th, and 75th percentile estimates based on individual responses in order to provide context for the extent of variation in the data.

Our next step was to extrapolate the sample estimates to the state level. We used 2012 Agricultural Census data on acres of vegetables and berries harvested in the state and applied the above yield fractions to estimate the total expected yield. Then we applied the farmer estimates of percent harvested, edible, sold and donated to these amounts.

We performed sensitivity analyses including applying diverse crop yield percentages and subtracting conservative estimates of "lost" food that may have actually been gleaned, eaten directly or processed into value-added crops. Lastly, we estimated vegetable and berry loss by county by applying statewide loss rates to acres planted by county (USDA National Agricultural Statistics Service, 2012b).

Lastly, we provide a descriptive overview of reported record-keeping related to crop loss.

Nutritional Estimates

To estimate the nutritional content of salvageable food losses in the state, we used the previously estimated amounts of vegetables and berries grown in Vermont and pounds of salvageable loss for each of the seven berry types, 37 vegetable types, and an "other" category for each. To obtain data on nutrient composition, we matched each vegetable or berry with a corresponding code, or an average of multiple codes, from the National Nutrient Database for Standard Reference, Release 28 (SR-28) (USDA, Agricultural Research Service, Nutrient Data Laboratory, 2015). We then

calculated the amount of each nutrient in the salvageable loss and summed across food items to arrive at estimates by nutrient. To put the estimates in meaningful terms, we estimated the per capita, per day amount lost for each nutrient in terms of the average gap in dietary intake (national mean current intake minus Recommended Dietary Allowance or Adequate Intake) (Hellwig, Otten, & Meyers, 2006). We presented data for selected nutrients that are underconsumed, and did not include data for highly consumed nutrients, such as calories.

Sensitivity Analyses

Recognizing that crop loss may operate differently on farms of different sizes, our first sensitivity analysis was to weight the Q1–Q4 estimates by farm size. We decided not to treat this weighting as our main analysis, because while farmer estimates of percent harvested, edible, sold and donated seemed to differ by farm size, numbers at each size category were small and most differences were not statistically significant. We stratified estimates of percent salvageable loss by farm size category (vegetables: 0.1 to 4.9 acres [0.04 to 2 ha], 5 to 24.9 acres [2.02 to 10.08 ha], 25 to 99 acres [10.1 to 40.1 ha], 100 acres [40.5 hectares] and larger; berries: 0.1 to 4.9 acres, 5 acres and larger), and multiplied each estimate by the percentage of farms in the state in the relevant size category. State farm size data reflect "vegetables, potatoes and melons" and the berry items in "specified fruits and nuts" for 2012, the most recent year from which data were available (USDA National Agricultural Statistics Service, 2012a). We then summed across the size categories to obtain weighted means. These estimates are heavily influenced by the smaller farm size categories because the state has few larger farms and only a few of them responded to the survey.

We also performed three sensitivity analyses to assess the impacts on these estimates if some of the seemingly wasted food was actually eaten, via: gleaning other than that counted in the donation category; household consumption; and value-added products not otherwise counted. The major gleaning and donation collection operations in Vermont —the Vermont Gleaning Collective (Salvation Farms, 2015) and the Vermont Foodbank Gleaning Program (Vermont Foodbank, n.d.)—gleaned 617,696 lbs. (280,182 kg) in 2015. Based on our knowledge, a high percentage of this produce was picked up after harvest, and thus farmers would categorize it as donations rather than the unharvested category. Additionally, the produce that was "field gleaned" included apples, which are heavier than berries per volume. We nonetheless used 617,696 lbs. as a conservative estimate of vegetables and berries gleaned.

To assess the potential impact of direct consumption, we calculated the amount of produce if each vegetable and berry farm in the state fed a family of four people one pound each a day for four months during the growing season.

The third sensitivity analysis tested the effect of processing edible harvested produce (not sold or donated) into value-added products such as sauces. Two of the 26 surveyed berry farms reported value-added processing, so we estimated the impact if 7.7% (2 of 26) of unsold, undonated berries were processed into value-added products.

Lastly, we recalculated available crops using alternative crop yield estimates published by the University of Vermont Extension. While Rutgers published a single consolidated estimate covering vegetables on small farms (0.5 lb/ft^2 or 2.4 kg/m^2) (Rabin et al., 2012), the Vermont estimate provided "low," "good," and "excellent" estimates for 42 distinct crops. "Good" yields ranged from 2,000 lbs/acre (22,412 kg/ha) (asparagus) to 40,000 lbs/acre (44,834 kg/ha) (onions, pumpkins). Because we did not have information about the crop mixes on included farms, we simply took the mean of all the estimates for "good" yield for vegetables, 0.44 lb/ft^2 (2.15 kg/m^2) (Grubinger, 2013).

Results

Fifty-eight farms, including 53 farms producing vegetables and 26 producing berries, completed the first part of the survey by providing estimates of percent harvested, edible, sold and donated. Fifty completed the full survey. All farms produced multiple products within the vegetable or berry categories, and 22 produced both vegetables and berries. In response to a request to list three of

their main crops (Appendix B), farms listed six berry types—most commonly strawberries and blueberries, and 32 vegetable types—most commonly tomatoes and salad greens (multiple types). The farms represented 13 of 14 counties in Vermont. On average, vegetable farms were 16.4 acres (6.6 ha) (range 1–300), while berry farms were 2.5 acres (1 ha) (range 0.1–17). Compared to statewide figures, vegetable farms in our sample were less likely to be under 4.9 acres (1.98 ha) (54% in our sample vs. 82% statewide) and more likely to be in the larger size categories, 5–24.9 acres (2–10.1 ha) (33% vs. 15%), 25–99.9 acres (10.12–40.43 ha) (9% vs 3%), and 100–249.9 acres (40.47–101.13 ha) (4% vs 1%) (USDA National Agricultural Statistics Service, 2012a). Berry farms in our sample were more likely than farms statewide to be under 5 acres (88% vs. 76%), and less likely to be 5 acres and greater (13% vs. 24%) (USDA National Agricultural Statistics Service, 2012a). The farms represent a convenience sample and are not a randomly selected sample of Vermont farms. Table 2 describes participating farms.

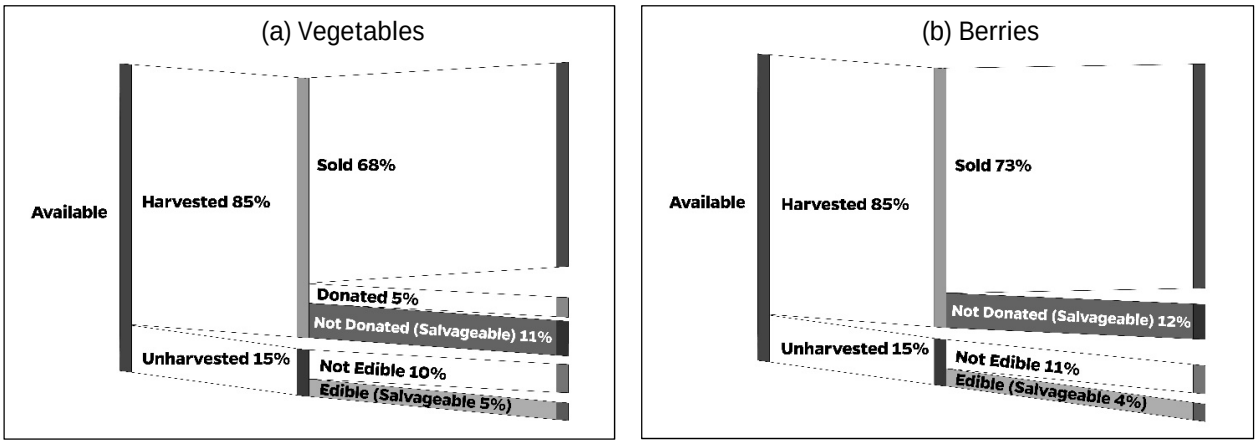
Quantifying Vermont Vegetable and Berry Loss

Figure 3 presents Sankey diagrams depicting farmers' mean estimates of the fate of available vegetables and berries as the available supply is split between harvested and not harvested, and as these are subsequently split into sold, unsold, donated, edible and inedible. As shown in Table 3, farmers estimated that on average, about 85% of available crops were harvested on both vegetable and berry farms (vegetable 25th percentile: 80%, 75th percentile: 93%; berries 25th percentile: 85%, 75th percentile 98%). On vegetable farms, they considered 34% of those unharvested crops edible (25th percentile 5%, 75th percentile 75%), and on berry farms, 25% on average (25th percentile 2%, 75th percentile 36%). Of crops that were harvested, vegetable farmers estimated that about 81% were sold (25th percentile 80%, 75th

Table 2. Characteristics of Participating Farms, Including Acreage, Crops Grown, and Type of Sales, Vermont, 2016

	Vegetable Farms, Mean (SD) (*n*=53)	Berry Farms, Mean (SD) (*n*=26)
Acreage	16.6 (51.4)	2.5 (3.9)
# of types of vegetables/berries grown	34 (26.7)	4.6 (3.1)
Type of sales	% of farms (*n*=50)	
Direct sales to restaurants, retail	75%	
Wholesale in state	61%	
Farmers market	55%	
Farm stand	51%	
CSA	47%	
Wholesale out of state	35%	

Figure 3. Fate of Available (a) Vegetables and (b) Berries, Based on Survey Performed in Vermont, 2016



Note: Percent of berries donated was too small to appear in chart 3(b). Depicted percentages reflect means; Table 3 presents ranges.

percentile 92%), while fruit farmers estimated 86% were sold (25th percentile 95%, 75th percentile 99% [results were skewed]). Vegetable farmers estimated that they donated 33% of the unsold produce on average (25th percentile 5%, 75th percentile 51%), while berry farmers said they donated about four percent on average (25th percentile 0%, 75th percentile 2%). Accordingly, we estimate that within the sample, on average 16% of available vegetables and 15% of berries could be considered salvageable loss (unharvested but edible + harvested but neither sold nor donated). For the average farm in the sample, this loss totaled over an estimated 53,000 lbs. (24,000 kg) of vegetables and 2,440 lbs. (1,107 kg) of berries. Table 3 also presents the median and interquartile ranges, based on farmer responses, for these estimates. As will be discussed, these estimates may be affected by record-keeping limitations.

Farms that responded to Part 2 of the survey also provided additional contextual information. Most farms reported losing "very little" produce at the washing and packaging stage (66% of farms) or in storage (57%), while 60% reported losing no produce during transportation.

We asked farmers about the fate of unharvested and unsold crops, allowing the option to indicate multiple destinations. Results were similar for vegetables and berries and thus are combined here. For unharvested crops, 64% of farms reported turning the crops under the soil, 28% fed them to pasturing animals, and 20% allowed gleaning or food rescue groups to pick them. For unsold crops, 61% of farms indicated that the farmer's family ate some, 59% each donated some to community groups and composted the crops, 47% fed some to animals. Two berry farms (7.7%) reported processing some crops into value-added products.

Table 3. Estimated Salvageable Loss of Vegetables and Berries on Sampled Farms in Vermont, 2016, Based on Estimated Quantities Lost, Sold, and Donated: Mean Weight

	Vegetables		Berries	
	Mean	*N*	Mean	*N*
Acreage	15.1	54	2.5	26
Yield fraction	0.5 lb/ft²		0.15 lb/ft²	
Quantity available for harvest (lb.)	330,794		16,228	
Percent harvested	84.7	53	85.0	26
Percent sold	80.7	53	86.2	25
Percent donated of unsold	33.2	51	3.8	25
Percent edible of unharvested	34.0	53	24.7	25
Quantity harvested (lb.)	280,182		13,800	
Quantity not harvested (lb.)	50,611		2,428	
Quantity not harvested but edible (lb.)	17,208		599	
Quantity sold (lb.)	226,107		11,890	
Quantity not sold (lb.)	54,075		1,910	
Quantity donated (lb.)	17,953		72	
Quantity neither sold nor donated (lb.)	36,122		1,838	
Salvageable Loss	*53,330*		2,437	
% Salvageable Loss	*16%*		15%	
Vegetables + Berries	Mean			
Total available for harvest	347,022			
Total not harvested and edible	17,807			
Total not sold and not donated	37,960			
Total Salvageable Loss	55,767			
% Salvageable Loss	16%			

Notes: Percentiles refer to acreage and farmer percent harvested, sold, donated and edible. Some of the subsequent calculations result in higher quantities of crops in the 25th percentile or median column than in the 75th percentile. In some cases, all three percentile estimates were lower than the mean due to unevenly distributed results. 1 lb= 0.45 kg; 1 acre=43,560 ft²

Reasons for Vegetable and Berry Losses

The top reasons farmers reported for not harvesting edible produce were blemishes (48%) and a lack of confidence that

they could sell the produce (41%), followed by lack of available labor (31%) and lack of affordable labor (10%). Write-in responses included competing harvesting priorities, leaving them with a lack of time to both harvest and prepare produce for market, as well as inadequate storage bins and space to keep the produce.

The top reasons farmers gave for not being able to sell their produce after harvest were a lack of demand (47%), oversaturation of the market (43%), and blemishes on fully edible produce (34%). In some cases, produce became partially or fully inedible before being sold (10%), such as due to lettuce wilting at farmers markets and potatoes deteriorating in storage while seeking wholesale or direct markets.

Interventions to Recover Crops

We asked farmers about their interest in a set of services that could be provided by community groups (Figure 4). Nearly half said they would like community groups to pick up produce from the farm (47%) or purchase their produce (45%).

Figure 4. Services Participating Farmers Would Appreciate from Community Groups, Vermont, 2016

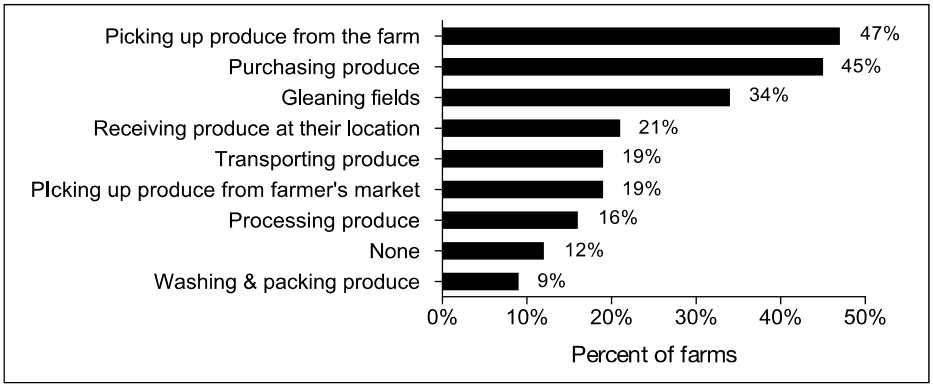


Table 4. Estimated Crops Lost, Sold, and Donated in Vermont in Pounds, Modeled Based on 2016 Survey

	Farms Producing Vegetables, *n*=53	Farms Producing Berries, *n*=26
Total farm acreage	3,897	601
Yield fraction applied	0.5 lb/ft²	0.15 lb/ft²
Total quantity available for harvest (lb)	84,876,660	3,926,934
% Harvested	84.7	85
% Sold	80.7	86.2
% Donated (unsold)	33.2	3.8
% Edible (unharvested)	34	24.7
Harvested (lb)	71,890,531	3,337,894
Sold (lb)	58,015,659	2,877,265
Donated (lb)	4,606,458	17,504
Not sold, not donated (lb)	9,268,415	443,125
Not harvested (lb)	12,986,129	589,040
Not harvested but edible (lb)	4,415,284	145,493
Salvageable loss (lb)	13,683,699	588,618
% of available harvest that was salvageable loss	16.1%	15.0%

Note: 1 lb= 0.45 kg; 1 acre=0.40 ha; 1 lb/ft²= 4.9 kg/m²

The survey explored the use of the federal enhanced tax deduction currently available to farmers for donating food. Of respondents, 92% said they did not claim this deduction for 2015 food donations or were unsure if they had. Only 26% of farms were 'probably' or 'definitely' planning to claim federal tax deductions for food donations in 2016. Additionally, 62% expressed interest in having the state of Vermont develop a program to provide financial compensation for donating food.

Statewide Food Loss Estimates

We extrapolated from the survey data to generate salvageable loss estimates for all of Vermont (Table 4). We estimate that overall,

13,684,000 lbs. (6,207,000 kg) of vegetables and 589,000 lbs. (267,000 kg) of berries may have been lost across Vermont in 2012.

Sensitivity Analyses

The first sensitivity analysis involves statewide weighting estimates by farm size because the farmer estimates related to crop loss appeared to vary by farm size (not statistically significant). We did not incorporate this analysis into the main result because the number of farms is small, so segmenting by crop size creates even smaller cells, leading to reduced confidence in the accuracy of estimates. As shown in Appendix C, table C1, farms lost 16.8% of vegetables (vs. 16.1% unweighted), leading to an estimate of 14,256,000 lbs. (6,466,000 kg) salvageable loss (vs. 13,684,000 lbs. or 6,207,000 kg unweighted). In the weighted estimates, berry farms lost 10.7% of crops by weight (vs. 15.0% unweighted), or an estimated 419,000 lbs. (190,000 kg) (vs. 589,000 lbs. (267,000 kg) unweighted).

It is possible that some of the seemingly wasted food was in fact eaten, via: gleaning that was not counted in the donation category; direct consumption; and value-added products. While we expect that most gleaning would be considered by farmers as donated rather than unharvested, in our sensitivity analysis we subtracted the 2015 quantity gleaned by two major collection operations in the state (Vermont Gleaning Collective and Vermont Foodbank Gleaning Program)—617,696 pounds (280,182 kg)—from the estimated statewide loss.

In the next analysis, we assumed that each vegetable farm (789) and berry farm (535) in the state provided one pound per person per day to a family of four for 120 days during the growing season. The total would be 635,520 lbs. (288,267 kg) of produce. This estimate might be high because some farms are double-counted since they produce both crops, and because consumption levels may be lower than 1 lb (0.45 kg), or it might be low if farmworkers are also consuming the crops directly.

The third sensitivity analysis was based on the fact that some farms may not have included crops they processed into value-added products as "sold" or "donated," meaning these would be counted as a loss. Two of the 26 berry farms in our study reported such processing, so we conservatively estimated the effect of processing 7.7% of unsold, un-donated berries into value-added products. If this happened, 34,086 lbs. (15,461 kg) of berries would be removed from the loss category statewide.

Lastly, we explored alternate estimates of the average yield per acre. The analysis is based on an estimate of 0.5 lb/ft^2 (2.44 kg/m^2) for vegetable yields from Rutgers University (Rabin et al., 2012), based on their similarity to farms in Vermont. As a robustness check, we recalculated based on crop-specific yield estimates published by the University of Vermont Extension—which averaged to 0.44 lb/ft^2 (2.15 kg/m^2) for vegetables (Grubinger, 2013). In the statewide calculation using this value, the estimated salvageable loss for vegetables drops from about 13,684,000 lbs. (6,207,000 kg) to about 12,042,000 lbs. (5,462,000 kg).

Combining the five sensitivity analyses would reduce the estimated salvageable vegetable and berry loss by 13%, or 1,891,500 lbs. (857,970 kg), to 12,381,000 lbs. (5,616,000 kg), as shown in Appendix D.

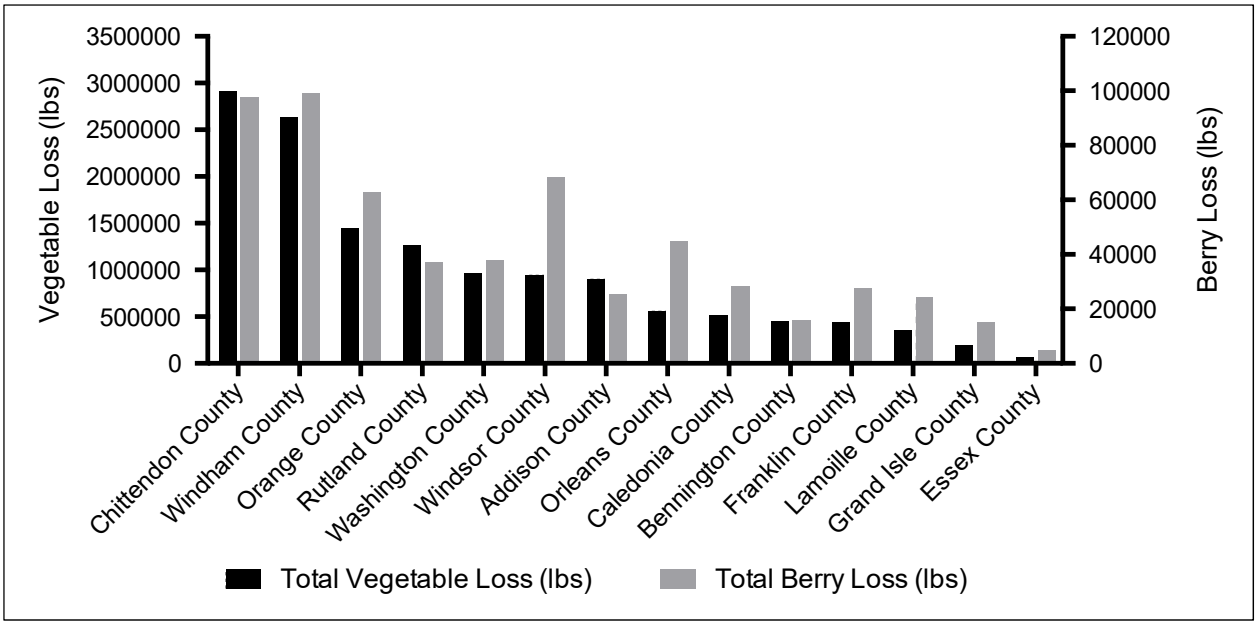
Food Loss Estimates by County

Vegetable and berry production is not evenly distributed across the state of Vermont. For example, 830 acres (336 ha) of vegetables were harvested in Chittenden County, but only 19 acres (7.7 ha) in Essex County. Applying statewide loss rates to acres planted, we estimated vegetable and berry loss by county (Figure 5). Based on their higher production, Chittenden and Windham counties are estimated to have the highest vegetable and berry losses, each exceeding 2.6 million pounds (1,179,000 kg) of vegetable loss and 97,000 lbs. (44,000 kg) of berry loss.

Estimates of Lost Nutrients

We estimated the quantities of lost nutrients statewide. Table 5 displays results for a selection of nutrients classified as under-consumed, meaning that average intakes in the U.S. fall short of recommended amounts, and that are rich in vegetables and berries (U.S. Department of Health and Human Services & U.S. Department of

Figure 5. Vegetable and Berry Loss by Vermont County, Modeled Based on 2016 Survey and County Acres Planted



Data source: USDA National Agricultural Statistics Service, 2012b.

Agriculture, 2015). We focus on the difference between the average amount consumed and recommended (referred to here as the "gap"). This analysis finds that the nutritional content of salvageable vegetables and berries wasted each day in Vermont in 2012 contained an amount of Vitamin A equivalent to the gap between consumption and recommendations for about 221,000 adult women, calcium for 33,000 adult women, iron for 29,000 adult women, potassium for 21,000 adult women, and fiber for 36,000 adult women. Results are also shown for adult men, for whom gaps in dietary intake differ.

Record-keeping

As future efforts to understand farm-level crop

Table 5. Nutritional Content of Salvageable Vegetable and Berry Losses in Vermont (Modeled), for Selected Nutrients

Nutrient	Nutritional content of salvageable loss of vegetables and berries (average per capita per day)	Average gap in dietary intake for adult women: National mean current intake minus Recommended Dietary Allowance or Adequate Intake	Equivalent number of gaps in dietary intake for adult women from salvageable loss statewide	Average gap in dietary intake for adult men: National mean current intake minus Recommended Dietary Allowance or Adequate Intake	Equivalent number of gaps in dietary intake for adult men from salvageable loss statewide
Vitamin A	34.2 mcg	–97 mcg	220,740 adults	–151 mcg	141,800 adults
Vitamin E	0.12 mg	–7.3 mg	10,073 adults	–4.7 mg	15,646 adults
Calcium	6.9 mg	–132 mg	32,745 adults	+116 mg	N/A
Iron	0.2 mg	–4.4 mg	28,708 adults	+10.1 mg	N/A
Magnesium	6.3 mg	–36 mg	109,315 adults	–44 mg	89,439 adults
Potassium	78.4 mg	–2288 mg	21,459 adults	–1505 mg	32,623 adults
Dietary Fiber	0.5 g	–8.9 g	36,075 adults	–17.7 g	18,139 adults

Source: Nutritional data from USDA, and RDA/AI data from Hellwig, Otten, & Myers, 2006..

losses proceed, it is valuable to understand the extent to which farmers currently keep records of quantities relevant for this assessment. In our survey, most participating farmers reported recording the amount of crops planted (74%), harvested (67%) and sold (69%). Few, however, kept records of other quantities important for tracking food losses, including amount not harvested (3%), amount damaged during washing and packaging or during storage (2% each), and amount damaged during transportation (0%). Farmers most commonly recorded information on paper, closely seconded by computer (commonly Excel or Quickbooks). Many used both paper and computer. Few recorded data on smartphone applications.

Discussion

This research provides the first survey-generated estimate of farm-level food losses in Vermont and contributes estimates and a methodology to the small body of largely non–peer-reviewed literature on farm-level food loss in the U.S. These findings for Vermont may shed light on quantities of farm-level food loss elsewhere, primarily on farms that are small and selling via direct markets, and particularly those with similar planting conditions.

Previous Estimates of On-Farm Crop Loss in the U.S.

Our estimate of 14.3 million pounds (6,500,000 kg) of vegetable and berry loss far exceeds Salvation Farms' previous Vermont estimate of 2 million pounds (907,000 kg) across all crop types (developed based on observation of farming and crop rescue in the state). Even with sensitivity analyses, the estimate would only drop to 12.4 million pounds (5,625,000 kg). Nonetheless, our estimate that 16.1% of vegetables and 15.0% of salvageable berries were lost does fall within the range of the three other estimates of U.S. farm-level crop losses we identified.

First, the FAO estimates that 20% by weight each of fruits, vegetables, and tubers are lost annually during production (Gustavsson et al., 2013). The fruit and vegetable estimates are based on a study including carrots, onions, and tomatoes from two to three large farms per product in Sweden. That study does not provide its methods of estimating loss percentage but does state that there is large variation in FLW between crops (Davis et al., 2011). The FAO estimates for North America are further shaped by a U.K. estimate that 25-40% of most fruit and vegetable crops are rejected by supermarkets (Gustavsson et al., 2013).

The second identified estimate of U.S. farm-level crop loss comes from the ReFED collaborative of wasted food stakeholders, which estimates conservatively that 13.1% of crops are lost at the farm level (10.1 million tons [9.2 metric tons]), based only on cosmetic imperfection rates found in one survey in Minnesota. For comparison to Vermont, they identified an imperfection rate of 10% for berries, an average of 13% for multiple vegetables, and 15% for potatoes in Minnesota (Berkenkamp, 2016). ReFED estimated that less than 5% of the loss was recovered for human consumption, primarily through farm-to-food-bank programs (ReFED, 2016).

Finally, a study commissioned by the Natural Resources Defense Council estimates farm-level fruit losses ranging from 3% (low-end estimate, cherries) to 60% (high end, plums); and vegetable losses from 5% (low end, lettuce) to 22% (high end, broccoli) (Milepost Consulting, 2012). These estimates were based on interviews with large commercial produce growers and shippers in California.

While methodological differences partly shape the differences in these estimates, we emphasize that farm-level food waste will vary considerably by crop, geographic factors, farm size and more.

Reasons for Loss

This survey identified a set of proximal reasons for crop loss which were generally consistent with findings described in other studies: aesthetics, challenges in selling the produce due to demand fluctuations and market saturation, and labor availability and costs. We note that underlying each of these reasons is a set of deeper reasons. For example, aesthetics challenges arise from factors including weather and pests; consumer demand; purchaser expectations; and produce standards. Moreover, market saturation can be linked partly to the fact that it is economically beneficial to overproduce crops to insure against potential

losses. Demand fluctuations are affected by many factors including the contracts made with purchasers and even changes in weather that affect consumer consumption patterns. Labor availability may be traced in part to immigration policy and to relatively low produce costs that can make it difficult to pay a living wage. Also, because farms are vulnerable to weather and other conditions, and many smaller produce farms do not have crop insurance, overplanting is commonly practiced to increase the likelihood of having a profitable season. Another norm affecting farm-level waste is the fact that prices for a product typically drop over the course of a season, and plants may become damaged over time, reducing the amount of quality produce that can be harvested. Accordingly, it can become economically unwise to continue harvesting even as crops remain unpicked (Creamer, 2017).

We also emphasize that farm-level food waste is heavily linked with waste at other stages of the supply chain. For example, decisions regarding whether to harvest crops and the ability to sell some crops are shaped by retailer preferences, which to an extent are shaped by consumer preferences. Practices on the farm, from harvest timing to storage to packaging, also have important impacts on losses further up the food chain that may ordinarily be attributed to consumers or retailers.

Addressing Vermont Food Losses

There is no silver bullet intervention to address farm-level food losses. Strategies must be tailored, and it will be necessary to address the problem from multiple levels at once.

The U.S. EPA's Food Recovery Hierarchy indicates that the priority in addressing food loss and waste should be prevention, or reducing excesses at the source (U.S. EPA, n.d.-b). Addressing the aforementioned reasons for loss requires strategically selected approaches aimed at either preventing the risk factor for loss (e.g., improving strategies for crop protection from weather or pests), or finding ways to manage it (e.g., identifying good markets for all grades of produce and determining how best to connect farmers to them). Infrastructure, technology, staffing levels, financing, experience, and luck all play roles.

The second priority in the hierarchy is recovering food for people to eat. Farmers indicated that they already donated about 32% of unsold produce from vegetable farms and 4% from berry farms. The latter was presumably lower due to the fragility and perishability of berries. Farms identified a variety of services they would consider helpful in this regard. To help address food insecurity, over 60% expressed interest in a state program that would compensate farmers for donations. A federal tax deduction was extended to all farms in December 2015. As farmers and farm service agents become more informed of this change, farms may increasingly take advantage of this resource for their eligible food donations.

Lower priorities in the EPA Food Waste Recovery hierarchy include feeding the crops to animals and composting them or sending for anaerobic digestion to produce energy. While these are usually not optimal, especially for high-quality crops, they are efficient and economical on-farm practices that have value for a farm. Half or more of surveyed farmers reported these approaches. Tradeoffs exist in cost, time, and environmental impact, and it is not always preferable to perform the extra work to reduce the last small quantities of loss, especially when alternate benefits can be obtained from the materials.

Record-Keeping

The research revealed that few farmers were keeping records needed to enable them to track their own losses. Providing easy to use tools may be valuable for advancing this practice. Maintaining such records is beneficial not only for broader tracking efforts, but also because it helps to build motivation for action to reduce losses, to shape targeted responses to key risk factors, and to enable farmers to track progress toward reducing loss. Such records could also aid in assessing potentially available fruits and vegetables for donations or processing.

Strengths and Limitations

This research presents an innovative survey-based approach for estimating food losses at the farm level, contributing to addressing an important

research gap. It complements farmer estimates of waste quantities with multiple types of contextual information. The research goes beyond the direct findings to model results at the state and county level. It also provides the first estimates of nutrient content of crop losses at the state level.

The food loss estimate has several limitations. First, the calculations are based on small numbers of farms (53 vegetable and 26 berry farms), and they were recruited through convenience sampling, so participants may have been particularly interested in crop losses. Selection bias could lead to increased waste estimates if participants have a higher awareness of their farm's discards, or to decreased waste estimates if participants are already active in waste-reduction. Second, findings were based on post-season estimates of percent harvested, sold, edible, and donated. Most farmers did not maintain the records needed to quantify these figures definitively. Self-reported estimates are subject to recall bias, use of heuristics to simplify the task of developing estimates, aspiration bias, and social desirability bias—with the likelihood of the latter increased by the request to include the farm name. Third, the estimates of pounds wasted are shaped by the volume of crops available for harvest, which in turn are shaped by the selected estimates for crop yield per acre. The sensitivity analysis using a different crop yield estimate yielded a result about 12% lower. Fourth, there may have been diverse understandings among the farmers of terms, including "edible" and "inedible"; "sold" (whether to include value-added crops); and "donated" (whether to include gleaned crops). Question 1 regarding percent of crops harvested did not specify that we intended the denominator to be crops that grew successfully rather than the entire initial planting, as we perceived that to be implicit.

We performed additional sensitivity analyses for other potential sources of error. These assessments mostly used conservative assumptions that likely overstated impact, and combined they would have reduced estimated salvageable statewide losses by 13%, to 12,389,000 lbs. (5,620,000 kg).

We also note that statewide data come from the 2012 Agricultural Census, whereas our survey took place in 2016, generating estimates for the 2015 growing and harvest season. We do not believe substantial changes in farm size and production have taken place in that time.

Future Research

We identify multiple research needs to improve estimates of farm-level food waste. First, it would be valuable for future studies to survey larger, randomly collected samples of farmers and to collect data directly rather than relying on recall and estimation. Research should also focus more specifically on widely grown crop items, particularly fruits, which may represent a valuable opportunity for gleaning, donations, and new market development. It would also be valuable to measure the amounts of vegetables and berries lost during washing, packaging, storage, and transportation. While no farmers in the Vermont Food Loss Survey said that they lost "a lot" of produce during any of these stages, a few did say they lost a "moderate amount." Further exploration is needed to understand better how farmers interpret these quantities, both quantitatively and qualitatively. Another research gap in the quantification of farm-level waste is understanding how much unsold, undonated produce goes to direct consumption, value-added products, animal feed, compost, anaerobic digestion, and other destinations.

This study also highlights research needed to improve responses to farm-level losses. First, there is a need for evaluations to understand the impacts of diverse strategies aimed at reducing the amount of food loss in Vermont, including new market development. A particular question is the extent to which the federal tax deduction is functioning as an incentive to increase donations or a benefit for those who would donate regardless—and what the Vermont financial compensation should look like in order to best support farmers and further reduce food loss. Lastly, additional research is necessary to understand how farmers can better partner with gleaning, food rescue, and farm surplus management organizations to reduce food loss and address food insecurity in Vermont, and how these operations can be better supported to advance their operations and enable properly valuing these public services that today are often performed by volunteers.

Conclusions

An estimated 14.3 million pounds (6,500,000 kg) of edible vegetables and berries may be lost each year in Vermont. This food is either left unpicked in the fields or is picked but neither sold nor donated. Improved record-keeping is needed to strengthen these estimates. This research can undergird future efforts to assess the potential for preventing losses and recovering food for human consumption, and to examine tradeoffs in cost and environmental impacts. It may not be feasible or preferable to recover *all* crops that are lost, given challenges in logistics, perishability, and the disproportionate effort needed to reduce the last bits of waste. Nonetheless, the quantities of farm-level loss suggested in this research indicate there might be great potential to prevent crop losses and to scale up food recovery efforts from farms.

In order to capture more of this large amount of food loss, a robust food loss management plan would be beneficial in Vermont, with farmers at the core. This plan should advance food loss prevention interventions; expand market opportunities for farmers; compensate farmers for donating the foods they produce that are not sold or eaten; and support larger-scale, professionalized gleaning, food rescue, and farm surplus management operations that strengthen farms and the regional food system and increase availability of produce for those in need. It should also provide farmers with tools to assist in quantifying losses and decision tools to assist them in determining when to expend the effort in recovering them. In each of these ways, farmers will benefit and more food will enter the local food system. From farmers to gleaners, food rescuers to policymakers, and consumers to purchasers, everyone can play a role in right-sizing production and in capturing more of this healthy food that otherwise is lost.

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We extend our thanks to the dozens of farmers who lent us their time and insights by filling out the Vermont Food Loss Survey. We are very grateful to the many farmers we interviewed from across the state during the survey development stage, as well. We could not have obtained such a great response from farmers without the support of the many partners who distributed the Vermont Food Loss Survey to their farmer network. This includes the Vermont Vegetable and Berry Growers Association, NOFA-Vermont, the Vermont Foodbank, and the Vermont Gleaning Collective members (RAFFL, HOPE, the Intervale Center, Community Harvest of Central Vermont, and the Northwest Vermont Healthy Roots Collaborative).

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Appendix A. Survey Instrument (following pages)

Default Question Block

Thank you for taking part in Salvation Farms' Vermont Food Loss Survey!

If you complete Part One of this survey, you will be entered into a raffle to win a **$100 gift certificate** to a location of your choosing. Part One will take you no more than **5 minutes** to complete.

At the end of Part One, we will ask you if you want to continue on to answer Part Two of this survey, where you would then be eligible to win a **$300 gift certificate** to a location of your choosing. Part Two will take you no more than **10 minutes** to complete.

Before starting, we want to remind you that all information provided in this survey will remain **confidential**. Only aggregated responses will be reported.

Part One

What is the name of your farm?

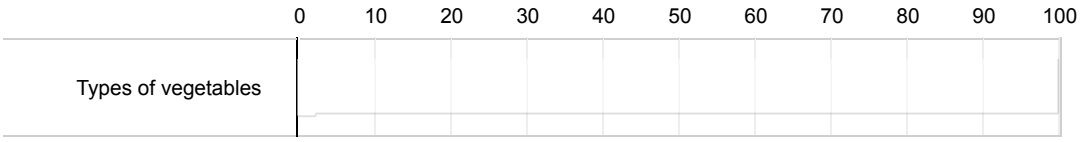
What county is your farm located in?

In 2015, what types of produce did you grow?

Please select all that apply

- [ ] Vegetables
- [ ] Fruits, Berries, & Tree Nuts

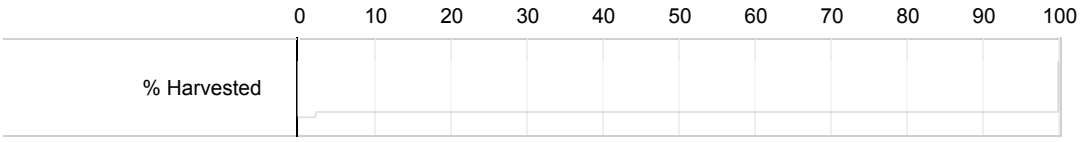
In 2015, how many types of vegetables did you grow?



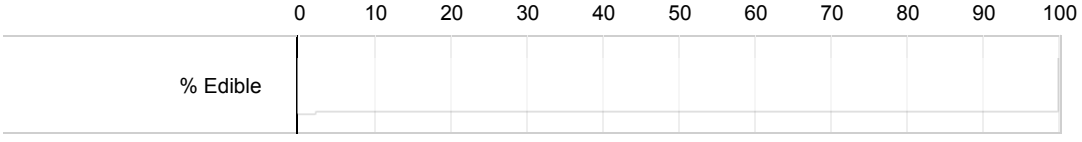
In 2015, how many acres of vegetables did you plant?

Of the ${q://QID227/ChoiceTextEntryValue} acres of vegetables that you planted, how many acres did you harvest?

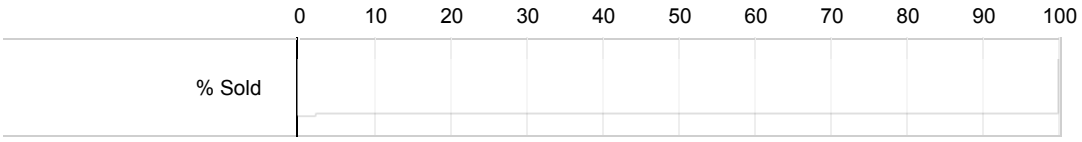
What percent of the vegetables that grew on those ${q://QID228/ChoiceTextEntryValue} acres did you harvest?



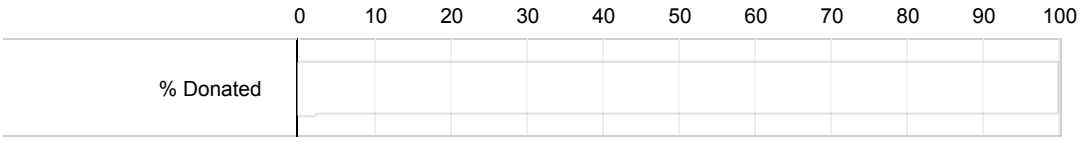
What percent of the vegetables left in the field (i.e. that you did not harvest) were edible?



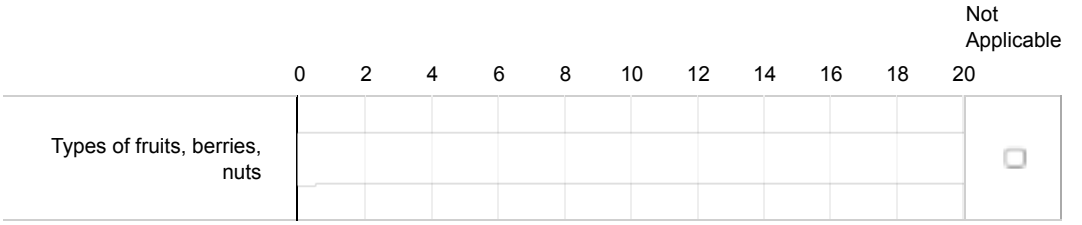
What percent of the vegetables that you harvested did you sell?



What percent of the vegetables that you did not sell did you donate?

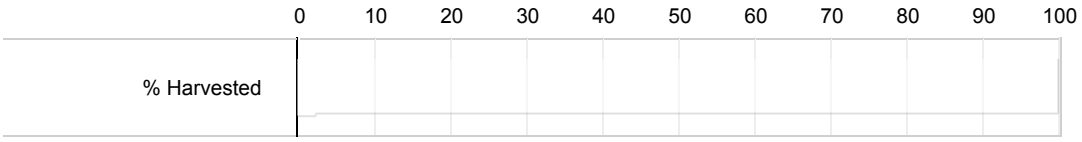


In 2015, how many types of fruits, berries, and nuts did you grow?

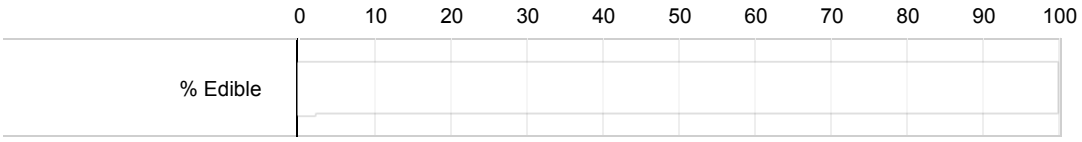


In 2015, how many acres of mature fruit trees, berry bushes, and nut trees did you have?

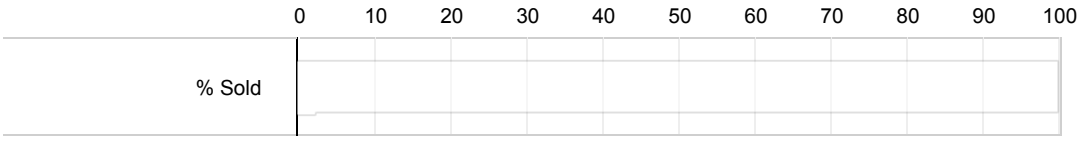
What percent of the fruits, berries, and nuts that grew did you harvest?



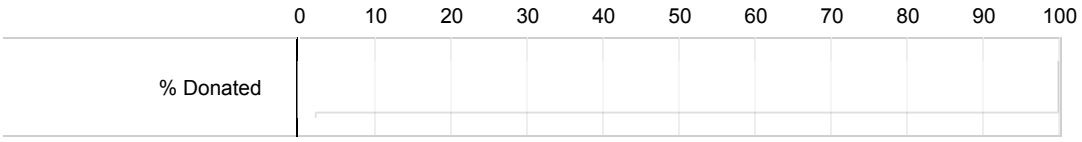
Of the fruits, berries, and nuts left on the trees/bushes (i.e. unpicked), what percent were edible?



What percent of the fruits, berries, and nuts that you harvested did you sell?



What percent of the fruits, berries, and nuts that you did not sell did you donate?



Thank you for completing Part One of this survey. You have been entered into a raffle to win a $100 gift certificate.

If you continue onto Part Two of this survey, you will be entered into a raffle to win a **$300 gift certificate** to a location of your choosing. Part Two will take you no more than **10 minutes** to complete.

- ○ I would like to continue to Part Two
- ○ I would like to end

Part Two

What were the reasons you did not harvest some of your produce?

- ☐ Lack of affordable labor
- ☐ Lack of available labor
- ☐ The produce - while completely edible - had blemishes
- ☐ The produce was inedible
- ☐ Not confident would be able to sell
- ☐ N/A - We harvested all edible produce
- ☐ Other

What happened to the crops that you did not harvest?

- ☐ Fed to pasturing animals
- ☐ Turned under
- ☐ Allowed gleaning/food rescue groups to pick
- ☐ Other

How much of your produce did you lose during the following stages?

	None	Very little	A moderate amount	A lot	N/A
Washing & Packing	○	○	○	○	○
Storing	○	○	○	○	○
Transporting	○	○	○	○	○
At market	○	○	○	○	○

What were the reasons that you were not able to sell some of your produce?

- ☐ General lack of demand for the item
- ☐ Oversaturation of the market with the item
- ☐ The produce - while completely edible - had blemishes
- ☐ The produce was only partially edible
- ☐ Other

What happened to the produce that you did not sell?

- ☐ Fed to animals
- ☐ Used for compost
- ☐ Eaten by farmers
- ☐ Donated to community groups
- ☐ Other

What were three of your main crops in 2015?

i.e. Kale, Sweet Potatoes, Corn

Crop 1 Name	
Crop 2 Name	
Crop 3 Name	

In 2015, how many acres did you plant?

0 Acres of » Crop 1 Name

0 Acres of » Crop 2 Name

0 Acres of » Crop 3 Name

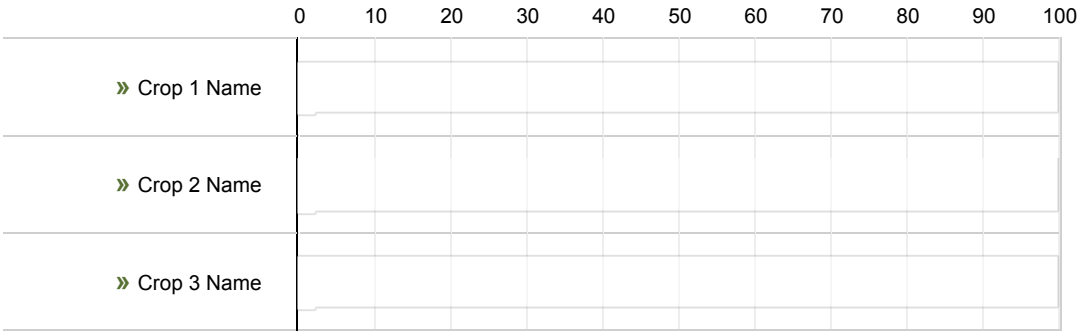
In 2015, how many acres did you harvest?

0 Acres Harvested of » Crop 1 Name

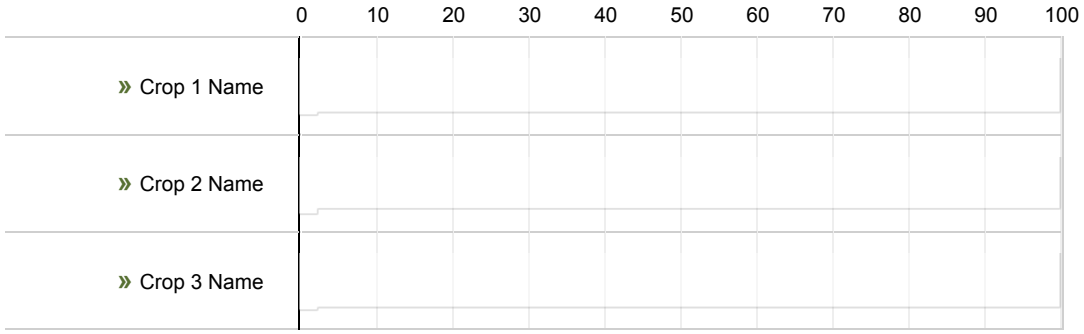
0 Acres Harvested of » Crop 2 Name

0 Acres Harvested of » Crop 3 Name

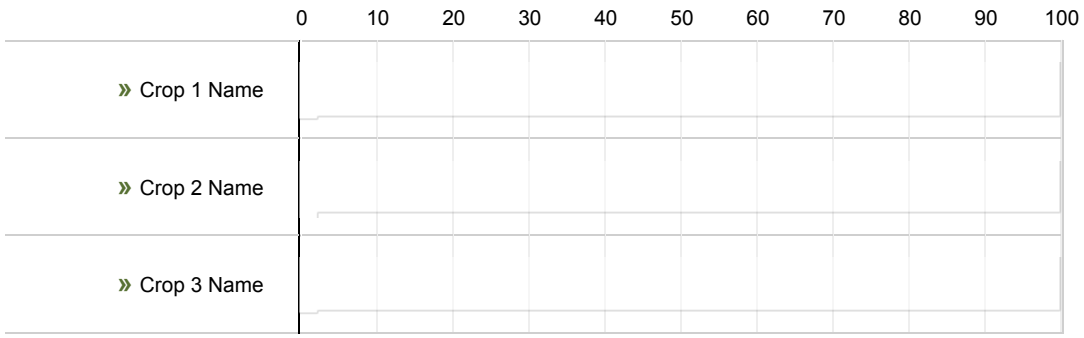
What percent of each crop did you harvest?



What percent of what you harvested were you able to sell?



What percent of what you left unharvested (i.e. in the field or on the trees) was edible?



In 2015, where did you sell your produce?

- ☐ CSA
- ☐ Farmer's market
- ☐ Farm stand
- ☐ Direct sales to restaurants, grocery stores, etc.
- ☐ Wholesale (in-state)
- ☐ Wholesale (out-of-state)
- ☐ Other

Do you keep an inventory of produce sold through your CSA?

- Yes, for all crops
- Yes, for some crops
- No

Do you keep an inventory of produce sold at farm stands?

- Yes, for all crops
- Yes, for some crops
- No

Do you keep an inventory of produce sold at the farmer's markets?

- Yes, for all crops
- Yes, for some crops
- No

Do you keep invoices for produce sold in direct sales?

- Yes, for all crops
- Yes, for some crops
- No

Do you keep invoices for produce sold to wholesale markets?

- Yes, for all crops
- Yes, for some crops
- No

Do you keep a physical record of what you plant and/or harvest each year?

(This is sometimes referred to as a "crop record" or "crop log")

- ○ Yes, for all crops
- ○ Yes, for some crops
- ○ No

Which of the following do you record?

- ☐ Amount of crop planted
- ☐ Amount of crop harvested
- ☐ Amount of crop not harvested
- ☐ Amount of produce damaged during washing & packing
- ☐ Amount of produce damaged during storage
- ☐ Amount of produce damaged during transportation
- ☐ Amount of produce sold

Where do you record the following information?

	On Paper	On Computer	On Smartphone App	N/A
» Amount of crop planted	☐	☐	☐	☐
» Amount of crop harvested	☐	☐	☐	☐
» Amount of crop not harvested	☐	☐	☐	☐
» Amount of produce damaged during washing & packing	☐	☐	☐	☐
» Amount of produce damaged during storage	☐	☐	☐	☐
» Amount of produce damaged during transportation	☐	☐	☐	☐
» Amount of produce sold	☐	☐	☐	☐

What is the name of the tracking system that you used (if there is one)?

In 2015, what services did community groups provide to your farm?

- [ ] Gleaned fields
- [ ] Picked up produce from the farm
- [ ] Picked up produce from the farmer's market
- [ ] Purchased produce
- [ ] Received produce at their location
- [ ] Other
- [ ] None

How would you rate the community groups you worked with in 2015?

Overall communication	
Overall service	
Management of volunteer crews	
Consistency of service	
Showing up when scheduled	
Responsiveness to farmer needs	
Responsiveness to farmer instructions	
Respect for farm operations	
Respect for farmer's time	

What services would you like community groups to provide to your farm this coming year?

- [ ] Gleaning fields
- [ ] Washing & Packing produce
- [ ] Transporting produce
- [ ] Picking up produce from the farm
- [ ] Picking up produce from the farmer's market
- [ ] Purchasing produce
- [ ] Receiving produce at their location
- [ ] Processing produce
- [ ] None

Did you claim any federal tax deductions for food donations that you made in 2015?

- [ ] Yes
- [ ] No
- [ ] Not sure

Are you planning on claiming a federal tax deduction for food donations that you will make in 2016?

- ○ Definitely yes
- ○ Probably yes
- ○ Might or might not
- ○ Probably not
- ○ Definitely not

Would you be interested in the state of Vermont providing financial compensation to farmers for their food donations?

- Definitely yes
- Probably yes
- Might or might not
- Probably not
- Definitely not

Appendix B. Vegetables and Berries Grown on Farms in Survey Sample

Survey part 2 respondents were asked the open-ended question, "What were three of your main crops in 2015?" Forty-eight farms listed three crops, two provided two crops, and three provided one. If the row for the item type (bold) has a number, e.g., brassica, it means some respondents listed the category rather than a specific item.

ITEM	# Farms
Berries	
Apples	2
Blueberries	5
Plums	1
Quince	1
Raspberries	3
Strawberries	6
Brassica	1
Broccoli	1
Brussels sprouts	1
Cabbage	4
Greens	5
Dandelion greens	1
Kale	7
Lettuce/salad greens/mesclun [multiple types]	17
Swiss chard	1
Tatsoi	1
Herbs	**1**
Parsley	1
Roots, other than potato	
Beets	5
Carrot	5
Celeriac	1
Garlic	8
Onions	4
Roots	1
Sweet potato	1

ITEM	# Farms
Solanaceae	
Eggplant	1
Peppers	5
Potato	11
Tomatillos	1
Tomatoes	18
Squash	
Buttercup squash	1
Pumpkin	2
Winter squash	5
Other	
Asparagus	1
Beans	4
Corn	6
Cucumbers	4
Peas	1

Appendix C.

Table C1. Statewide Estimates Weighted by Farm Size

	Farms Producing Vegetables, *n*=53: WEIGHTED	Farms Producing Vegetables, *n*=53: Unweighted	Farms Producing Berries, *n*=26: WEIGHTED	Farms Producing Berries, *n*=26: Unweighted
Total farm acreage	3,897		601	
Yield fraction applied	0.5 lb/ft^2		0.15 lb/ft^2	
Total quantity available for harvest (lb.)	84,876,660		3,926,934	
% Harvested	87.9	84.7	90.9	85
% Sold	78.0	80.7	90.4	86.2
% Donated of Unsold	32.4	33.2	1.6	3.8
% Edible of Unharvested	30.7	34	23.0	24.7
Harvested (lb.)	74,609,021	71,890,531	3,571,154	3,337,894
Sold (lb.)	58,196,002	58,015,659	3,228,680	2,877,265
Donated (lb.)	5,312,241	4,606,458	5,542	17,504
Not sold, not donated (lb.)	11,100,778	9,268,415	336,931	443,125
Not harvested (lb.)	10,267,639	12,986,129	355,780	589,040
Not harvested but edible (lb.)	3,155,387	4,415,284	81,918	145,493
Salvageable loss (lb.)	14,256,166	13,683,699	418,850	588,618
% of available harvest that was salvageable loss	16.8%	16.1%	10.7%	15.0%

Note: 1 lb.= 0.45 kg.

Table C2. Weighting Calculation

	Vegetables					Berries		
	.1–4.9 Acres	5–24.9 Acres	25–99 Acres	100 Acres and Larger		.1–4.9 Acres	5 Acres and Larger	
Percent Harvested	*88.8*	*78.8*	*78.8*	*90.5*		*88.5*	*98.7*	
Percent Sold	*75.0*	*85.2*	*92.2*	*95.0*		*90.8*	*89.3*	
Percent Donated of Unsold	*31.0*	*38.1*	*31.6*	*25.0*		*1.7*	*1.3*	
Percent Edible of Unharvested	*27.7*	*43.5*	*38.4*	*32.5*		*29.9*	*1.3*	
% Farms in State	*0.82*	*0.15*	*0.03*	*0.01*		*0.76*	*0.24*	
	0.3	0.2	0.1	0.1		0.1	0.1	
Weighted means					Sum of Vegetables			Sum of Berries
Percent Harvested	72.8	11.8	2.4	0.9	87.9	67.3	23.7	90.9
Percent Sold	61.5	12.8	2.8	1.0	78.0	69.0	21.4	90.4
Percent Donated of Unsold	25.5	5.7	0.9	0.3	32.4	1.3	0.3	1.6
Percent Edible of Unharvested	22.7	6.5	1.2	0.3	30.7	22.7	0.3	23.0
	11.31	-0.96	0.98	0.99	12.3	0.31	0.79	1.1

Note: 1 acre=0.4 ha

Appendix D. Sensitivity Analysis Summary

	Vegetables	Fruits	Vegetables + Fruits	All (Vegetables only; fruits only; vegetables + fruits)
Original Estimates	*13,683,699*	*589,000*	*14,272,699*	
1. Weighting by farm size	14,256,166	418,850		
Difference from original	*+572,467*	*–170,150*		
2. Gleaning			13,655,003	
Difference from original			*-617,696*	
3. Home consumption		563,056		
Difference from original		*–34,086*		
4. Alternative yield fraction	12,041,655			
Difference from original	*1,642,044*			
SUM of differences from original–all sensitivity analyses	*–1,069,577*	*–204,236*	*–617,696*	1,891,509
New estimate incorporating all sensitivity analyses				12,381,190
% Change				13%

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Do affluent urban consumers drive direct food sales in the Northeast United States? A three-part analysis

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Abstract

The last century has seen steady decline in the number of farms and ever-worsening concentration of economic power in the food system. In more recent decades, agricultural sales directly to consumers have grown, raising questions about the role of economic privilege and its spatial distribution in supporting direct marketing. We address this question in a three-part analysis of 216 counties in nine Northeast states. First, we compare four direct-sales indicators and their common covariates among county types defined by metropolitan status and adjacency to metro/nonmetro borders. Second, we map four direct-sales variables over these county types. Third, we construct panel regression models with county as a fixed-effect in order to examine the influence of county-level household income on direct agricultural sales while controlling for other county-level variables shown to have an influence: population, vegetable production, farm size, and number of farms. Together, these three perspectives—bivariate, spatial, and multivariate—show that economic privilege is a

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factor in direct food sales, but not necessarily a driver. The variability across the region and the different patterns associated with different direct-marketing variables indicate that both researchers and practitioners would benefit from strategies sensitive to context, contingency, and change over time.

Keywords
Local Food Systems; Direct Marketing; Spatial Analysis; GIS, Panel Regression

Introduction
The twentieth and twenty-first centuries have seen a steady decline in the number of U.S. farms as economic power has become more concentrated in all stages of the food system (Constance, Hendrickson, Howard, & Heffernan, 2014). In 1910, there were more than 6 million farms across the United States, but the 2012 Census of Agriculture counts only about 2 million farms, fewer than half of which sell more than US$10,000 in agricultural products per year (U.S. Department of Agriculture National Agricultural Statistics Service [USDA NASS], 2012). Furthermore, the top four percent of farms, with agricultural sales of US$1 million or more, account for over two-thirds of all agricultural sales (USDA NASS, 2012). As Constance et al. (2014) note, concentration in agriculture aligns with continuing concentration in the food system as a whole, as fewer and fewer agrifood corporations come to dominate the market both within and across agricultural sectors, a process that has unfolded globally as well as within the U.S. More and more producers find themselves unable to sustain a viable agricultural livelihood at all. As a *New York Times* op-ed highlighted (Smith, 2014), over 90% of farmers rely on off-farm income (Brown & Weber, 2013), which is unsurprising as the median farm income recorded in the 2012 census is actually negative: –US$1,453 (USDA Economic Research Service [USDA ERS], 2014).

Among many responses to this deepening crisis is the burgeoning growth of direct agricultural sales through farmers' markets, roadside stands, CSAs, and other direct-to-consumer channels. U.S. direct agricultural sales grew to over US$1.2 billion by 2007 (up from US$404 million in 1992) and increased another 8 percent between 2007 and 2012 (USDA NASS, 2012). In addition, the USDA reports that the number of farmers' markets nationwide has increased by more than 75% between 1994 and 2012, with a 9.6% increase from 2011 to 2012 alone (USDA, 2012), and CSAs are now found on over 12,000 farms nationwide (USDA-NASS, 2012).

Direct-to-consumer marketing cannot, by itself, resolve the ongoing livelihood crisis in American agriculture (Guptill & Welsh, 2014; Stevenson et al., 2011). It still represents less than 1 percent of all agricultural sales, and the growth of these sales seems to have plateaued (Vogel & Low, 2015). Locally focused farms are also selling to intermediators, such as stores, restaurants, institutional food services and food hubs; these sales are now more than three times the value of direct-to-consumer agricultural sales (Vogel & Low, 2015). However, over 85% of local-food farms (those selling directly to consumers or to intermediaries) sell at least some food direct to consumers, and 70% sell only to consumers (Vogel & Low, 2015). Selling direct-to-consumers is an important option for beginning farmers as well as commodity-focused farmers seeking to diversify. Thus it is important to understand what role direct marketing can play in changing the food system.

One central factor shaping the role and relevance of direct marketing is whether it is largely a boutique phenomenon catering to well-off consumers in urban and suburban areas. Research on participation in and practices associated with farmers markets, community supported agriculture operations (CSAs), and other direct-marketing channels shows that they do not escape the troublesome social inequalities in which they are embedded (Alkon & McCullen, 2010; Lyson, M. C., 2014). While findings about consumers confirm that almost everyone values fresh, healthful food and would like to support local and regional agriculture (Colasanti, Conner, & Smalley, 2010; Stephenson & Lev, 2004), not all can play the consumer role in these practices. Spatial inequality influences whether one even has buying opportunities close by (Byker, Shanks, Misyak, & Serrano, 2012; Colasanti et al., 2010; Stephenson, Lev, & Brewer, 2008). Also, the physical practices

of procuring food directly from farms further restricts access to people who have the transportation, time, food budgets, and physical ability needed to participate. Consequently, consumers participating in direct marketing tend to have above-average socio-economic status, including higher levels of formal education: at least, a bachelor's degree (Byker et al., 2012). These consumers also tend to live closer to urban areas than rural regions and to have above-average family incomes (Brown, Gandee, & D'Souza, 2006; Thilmany, Bond, & Bond, 2008).

Similarly, not all producers are well placed to incorporate direct marketing or other alternative strategies into their operations (Hardesty & Leff, 2010; LeRoux, Schmit, Roth, & Streeter, 2010). Direct agricultural sales tend to be higher in the agriculturally active areas near cities where producers encounter both high land prices—which incentivizes more intensive farming and higher cash gains per acre—and proximate pools of potential customers with higher than average income (Inwood & Clark, 2013; Lyson, T. A., & Guptill, 2004; Pfeffer & Lapping, 1995). Other studies show that direct-selling farms tend to be smaller and sell fruits and vegetables and other high-value crops (Lyson, T. A., & Guptill, 2004; Monson, Mainville, & Kuminoff, 2008; Thomas & Howell, 2003). They are also more likely than other farms to use organic practices and internet marketing (Detre, Mark, Mishra, & Adhikari, 2011). While most farmers and ranchers value environmental stewardship, social connections, and product quality (Guptill, 2009; Ross, 2006; Selfa & Qazi, 2005), producers, like consumers, face varying social and economic constraints in pursuing these priorities.

Prior research leads us to a paradox. The values that consumers associate with locally produced foods are widely shared across income categories (Colasanti et al., 2010; Stephenson & Lev, 2004), but there is a persistent statistical association between economic privilege and participation in direct marketing (Byker et al., 2012). To what extent, then, does economic privilege drive direct agricultural sales? We take a spatial approach to addressing this question by analyzing 216 counties in nine Northeast states: Connecticut (CT), Maine (ME), Massachusetts (MA), New Hampshire (NH), New Jersey (NJ), New York (NY), Pennsylvania (PA), Rhode Island (RI), and Vermont (VT). The Northeast is the most densely populated region of the U.S., and has the most local food sales (Low et al., 2015). Understanding the dynamics in the Northeast region can help explain the role direct sales can play in promoting positive change in the changing food system, as the rapid growth in direct sales early in the 2000s seems to have plateaued (Vogel & Low, 2015).

We analyze data from the most recent Censuses of Agriculture and American Community Surveys in three ways. First, we examine four direct-sales indicators and common covariates among counties defined by four types of metropolitan status and adjacency to counties with the opposite metropolitan status. Second, we map four direct-sales indicators over county type. Third, we construct a fixed-time effects regression model in order to examine the influence of consumer household income on direct agricultural sales while controlling for other county-level variables shown to have an influence: population, vegetable production, farm size, and number of farms. Fixed effects (panel data) models examine drivers of change by regressing the difference in the outcome variable across at least two time points on the differences in the predictor variables. In the context of prior research, our place-based analysis would initially suggest that household income is related to direct agricultural sales but is not the sole driver of the phenomenon.

Spatial Patterns of Direct Agricultural Sales

Most studies of direct agricultural marketing have focused on consumers or farms as the units of analysis (for example, Byker et al., 2012; Colasanti et al., 2010; Inwood & Clark, 2013; Monson et al., 2008). Studies of consumers show that direct-marketing consumers tend to have higher incomes, more years of formal education, and reside closer to or within urban areas (Byker et al., 2012; Thilmany et al., 2008). At the same time, enthusiasm for locally produced foods is widespread among consumers (Colasanti et al., 2010; Stephenson & Lev, 2004). Farm studies show that

farm size, crop mix, and other structural variables are associated with the probability of selling agricultural products directly to consumers (Lyson, T. A., & Guptill, 2004; Monson et al., 2008), as are the backgrounds and motivations of farmers themselves (Inwood & Clark, 2013; Jarosz, 2011). Income—for both consumers and producers—matters, but it clearly is not the only driving force in direct marketing.

Spatially informed analyses can help to gauge the importance of economic privilege in setting the stage for direct agricultural marketing. As Clark, Inwood, and Sharp (2012) argue, spatial patterns in food systems are dynamic, reflecting both structural factors, like development pressures, as well as the varying values and motivations of producers and consumers in the systems. In one of the first spatial analyses of local and direct food marketing, Brown, Gandee, and D'Souza (2006) constructed a linear regression model of the volume of direct sales (in dollars) in the 55 counties of West Virginia. They found that higher direct sales in 2002 are associated with "higher median housing value, increased population density, a younger population, a greater number of direct market farms, more diversity of fruit and vegetable production and closer proximity to Washington, DC" (Brown et al., 2006, p. 575). In contrast to consumer-level studies, their analysis indicated that counties with a higher percentage of the population holding bachelor's degrees had lower dollar-values of direct sales, suggesting that counties with high direct sales might be selling to out-of-county consumers. They also note that previous studies had "mostly studied urban markets, and those findings may not be applicable to rural areas where residents with lower education levels may have a relatively higher demand for locally grown produce" (Brown et al., 2006, p. 580).

Subsequently, two analyses using 2007 Census of Agriculture data provide additional insights. Timmons and Wang (2010) analyzed state- and county-level data from across the U.S. To account for the vast differences in county size, they used as their dependent variable the natural logarithm of the dollar value of sales per square mile. Like Brown et al. (2006), their independent variables included population density, percentage of land in farming, and an indicator of vegetable production. In contrast to Brown et al. (2006), they measured socio-economic status with median household income, rather than housing values and education, and they did not include age structure, proximity to metropolitan areas, or indicators of farm-level direct sales. Altogether, Timmons and Wang (2010) found that five variables—farm size, population density, percentage of land in farming, percentage of farms growing vegetables, and median income—along with region, accounted for 64 percent of the county-level variance in direct marketing.

Cheng, Bills, and Uva (2011) performed an analysis similar to Timmons and Wang but focused on eleven Northeast states, the same nine that we use (CT, ME, MA, NH, NJ, NY, PA, RI, and VT) as well as Delaware and Maryland. They used the same dependent variable as Timmons and Wang—the natural log of the dollar value of direct sales per square mile—and some of the same independent variables: average farm size, percentage of land in farming, percentage of farms growing vegetables, and median household income. They also included population (rather than population density), percentage of farms raising cattle, percentage of farms growing fruit, county metropolitan status, and three indicators of marketing channels present in the county: number of farmers markets per 1000 population, ratio of farms marketing through CSAs, and the presence or absence of a farm-to-school program. With the exception of fruit production and metropolitan status, all of the variables were significant with coefficients in the predicted directions.

More recently, O'Hara and Low (2016) have analyzed changing direct sales on a county level between 1992 and 2012, and find that increasing per capita incomes in metropolitan areas within 100 or 150 miles of a county is associated with a striking increase in the county's direct-to-consumer sales. That is, an increase in per capita income of US$1000 in a metropolitan statistical area is associated with a US$70,900 increase in the annual direct sales of counties within 100 miles (161 km) and a US$57,200 increase in direct sales in counties within 150 miles (241 km). They control for changes in demographics in nearby metropolitan

statistical areas (MSAs): total MSA population, percent population Hispanic and non-Hispanic white, and percentage of population in three adult age groups. They also control for metropolitan status and adjacency to metropolitan areas. They calculated a model using local county-level socio-economic and demographic variables, eliminating those counties, generally in the largest cities, that do not report direct-to-consumer sales. An in-county increase in per capita income of US$1,000 was associated with an increase in direct sales of US$38,600. Population growth within a county had a positive effect on direct sales, but population growth in nearby MSAs did not. They conclude that demand for direct-to-consumer agricultural products has a high income elasticity.

We see a need for further study in this area for two reasons. First, while dollar value of direct sales, either absolute or per square mile, is a meaningful outcome, it is also important to explore how explanatory variables might change with other measures of direct marketing activity. If direct agricultural sales are framed solely as economic activities, then economic volume is the most important outcome variable. However, if one views direct sales as part of a broader food movement, as we do, then the numbers and proportions of farms participating, as well as the proportion of agricultural sales that are direct-to-consumer are also important. A second contribution we make is to examine these questions with a fixed-time effects model that can account for hidden time-invariant spatial variables. O'Hara and Low (2015) demonstrate the importance of market areas beyond county boundaries and change over time, but they also exclude from their analysis counties whose population centroid are not within 100 miles (in one model) or 150 miles (in the other model) of the population centroid of an MSA. Our study also accounts for change over time, but in a way that includes even the most rural counties in the region as well as supply-side factors shown to make a difference in prior studies (Brown et al., 2006; Cheng et al., 2011; Timmons & Wang, 2010).

Data and Methods

From the 2007 and 2012 Censuses of Agriculture we draw four outcome variables: the number of direct-selling farms, the percentage of farms selling directly to consumers, the total dollar value of direct sales, and the percentage of all agricultural sales that are direct to consumer. For the USDA National Agricultural Statistics Service, direct sales are defined as "products that were sold directly to individual consumers for human consumption" (USDA NASS, 2012, p. 54). Sales directly to restaurants or retailers are instead called intermediate sales; the 2012 Census of Agriculture measured them for the first time. In addition to the outcome variables, we also draw from the Census of Agriculture independent variables for the number of farms, land area, median farm size and acres of vegetable production, all shown in prior research to be predictors of direct sales. The county is our unit of analysis, and we include the 216 counties in nine Northeast U.S. states (CT, ME, MA, NH, NJ, NY, PA, RI, VT).

In addition to the four outcome variables, we draw four agricultural control variables from the 2007 and 2012 censuses: number of farms, median farm size, number of farms producing vegetables, and acres in vegetable production. We also gather the five-year estimates of median household income (our independent variable) and population (a control variable) from the American Community Survey for 2009 and 2012; 2009 is the closest year to 2007 in which these data are available for all counties in the Northeast. These control variables were included in prior studies and reflect recent findings about direct sales (Cheng et al., 2011; Timmons & Wang, 2010).

For the bivariate analysis and spatial visualization, we constructed a metropolitan adjacency variable drawing on metropolitan status as defined by the Office of Management and Budget in 2013. Metropolitan counties are those that include urbanized areas with a population of 50,000 or more as well as the outlying counties from which 25 percent or more of workers commute. Any other counties are considered non-metropolitan. With that definition and the tools of ArcGIS, we created a metropolitan-adjacency variable with four categories: (1) nonmetropolitan counties not adjacent to any metropolitan county, (2) nonmetropolitan county adjacent to at least one metropolitan county, (3) metropolitan county adjacent to at least one

nonmetropolitan county, (4) metropolitan county not adjacent to any nonmetropolitan counties.

Table 1 shows basic descriptive statistics for all variables included in the analyses for both 2007–2009 and 2012 values. It shows that while direct sales have plateaued nationally the means of all four indicators of direct marketing have grown between 2007 and 2012 in the Northeast: the number and percentage of farms selling direct, the dollar value of direct sales, and the percentage of sales that are direct. Median household income and population have also increased, while the mean number of farms, median farm size, number of vegetable farms and acres in vegetables have fallen.

We conducted a three-part analysis. First, we examined bivariate patterns by metropolitan adjacency (Table 2); second, we mapped outcome variables by metropolitan adjacency to visualize spatial patterns. Third, to clarify the impacts of income, we entered these variables into panel regression models with county as a fixed effect (one for each of the four outcome variables) as demonstrated by the following equation:

$$Y_{it} = \beta X_{it} + \alpha_i + \varepsilon_{it}.$$

This approach regresses the change in the outcome variable (Y_{it}) from time 1 (2007) to time 2 (2012) on the change in predictor variables (βX_{it}) over the same time period after accounting for unchanging characteristics of each county (α_i), which are the fixed panel effects. One significant advantage of a fixed-effects panel model is that it accounts for any confounding variables that are constants through time, such as proximity to major population centers and transportation corridors (Brown et al., 2006; O'Hara & Low, 2016). Thus, our metropolitan adjacency variable is not included in the fixed-effects model, as it does not vary between time 1 and time 2.

Table 1. Descriptive Statistics

		2007/2009		2012		Difference in means 2012–2007
Variable	Source	Mean	Standard deviation	Mean	Standard deviation	
DEPENDENT VARIABLES						
Number of farms selling direct	USDA-NASS Census of Agriculture	103.2	76.1	119.4	85.1	16.2
Percent of farms selling direct	USDA-NASS Census of Agriculture	17.5%	8.6%	21.0%	9.3%	3.5%
Direct sales (US$1,000 current dollars)	USDA-NASS Census of Agriculture	$1,547	$1,634	$1,804	$1,811	$257
Percentage of sales direct	USDA-NASS Census of Agriculture	4.29%	4.56%	5.36%	6.49%	1.07%
INDEPENDENT VARIABLE						
Median household income (US$)	ACS, 5-year estimates	$52,840	$13,957	$55,140	$13,858	$2,300
CONTROL VARIABLES						
Population	ACS, 5-year estimates	248,401	102,100	250,697	102,200	2,296
Total number of farms	USDA-NASS Census of Agriculture	665	539	646	531	–19
Median farm size (acres)	USDA-NASS Census of Agriculture	62	39	63	37	1
Number of farms producing vegetables	USDA-NASS Census of Agriculture	65	69	59	61	–6
Acres in vegetable production	USDA-NASS Census of Agriculture	1,720	4,887	1,594	4,942	–126

Note: 1 acre=0.4 hectare

Results

Bivariate Results

Table 2 compares the means of variables in the model by metropolitan-adjacency category: nonmetro, nonborder; nonmetro, border; metro, border; metro, nonborder. The table shows that metropolitan-adjacent counties—either metropolitan or nonmetropolitan—have more farms selling direct than nonmetropolitan-adjacent counties (116 and 137 versus 93 and 103). However, metropolitan-adjacent counties have smaller proportions of farms selling direct (roughly one in five versus one in four) and smaller percentages of sales that are direct than non-adjacent counties (4 and 5 percent versus about 7.5 percent). The mean dollar value of direct sales, in contrast, rises from the most rural counties to the most urban ones: US$917,000 per year in nonmetropolitan, nonmetropolitan-adjacent counties, to US$2,432,000 in metropolitan, nonmetropolitan-adjacent counties, a 2.6-fold increase. Household income and population both, predictably, also increase from more rural counties to more urban ones. Metropolitan-adjacent counties, both metropolitan and nonmetropolitan, have more farms than nonmetropolitan-adjacent counties, while nonmetropolitan counties tend to have larger farms and fewer farms producing vegetables. Mean acres in *vegetables* is largest in nonmetropolitan counties adjacent to metropolitan ones, but it only slightly exceeds that of metropolitan, nonmetropolitan-adjacent counties.

Overall, these bivariate results indicate that the narrative of urban-fringe locations being prime opportunities for direct sales is somewhat oversimplified. Rural-urban adjacent counties have higher absolute numbers of direct-selling farms, but the largest volume of direct agricultural sales are among farms in metropolitan counties (metropolitan-adjacent or not). With slightly higher median incomes and much higher populations, it is clear why absolute values would be higher in metropolitan counties. On the other hand, the relative measures—the percentage of farms selling direct and percentage of sales that are direct—are notably higher in nonmetropolitan-adjacent counties (both nonmetropolitan and metropolitan). Contrary to common assumptions, direct sales are smaller parts of the agricultural economies of adjacent rural-urban counties.

Table 2. Means by Metropolitan-Adjacency Category

Variable	Nonmetro, nonborder	Nonmetro, border	Metro, border	Metro, nonborder	Overall
	n=14	*n*=80	*n*=78	*n*=44	*N*=216
DEPENDENT VARIABLES					
Number of farms selling direct	93	116	137	103	119
Percent of farms selling direct	24.5%	19.3%	19.7%	23.8%	20.7%
Direct sales (US$1,000 current dollars)	$917	$1,241	$2,221	$2,432	$1,804
Percentage of sales direct	7.5%	4.0%	4.9%	7.4%	5.4%
INDEPENDENT VARIABLE					
Median household income (US$)	$44,983	$47,832	$55,738	$69,621	$55,140
CONTROL VARIABLES					
Population	33,752	61,536	242,021	679,033	250,697
Total number of farms	398	657	721	538	646
Median farm size in acres	79	84	59	20	63
Number of farms producing vegetables	43	56	74	74	59
Acres in vegetable production	263	1,828	1,475	1,804	1,594

Note: 1 acre=0.4 hectare

Spatial Visualization

Figures 1 through 4 overlay the four outcome variables on the metropolitan adjacency categories shown in Table 2. Figure 1 shows that direct-selling farms are found in almost all counties, regardless of their metropolitan status or adjacency to the metro/nonmetro border. Some concentration of farms around major metropolitan areas is visible, and Vermont stands out as home to many direct-selling farms. Figure 2 shows that the highest percentages of farms selling direct to consumers are not necessarily proximate to all major metropolitan areas, but are, rather, found primarily in northern New England and central Massachusetts. Figure 3 also illustrates the pattern shown in Table 2, that metropolitan counties, bordering or not, see the highest volume of direct agricultural sales. Vermont, again, stands out with a noticeable concentration of sales. Figure 4 shows that the highest percentages of direct-to-consumer sales are not in the same array of counties with the highest percentages of direct-selling farms. Fewer northern New England counties

Figure 1. Number of Direct-selling Farms and Metropolitan Adjacency

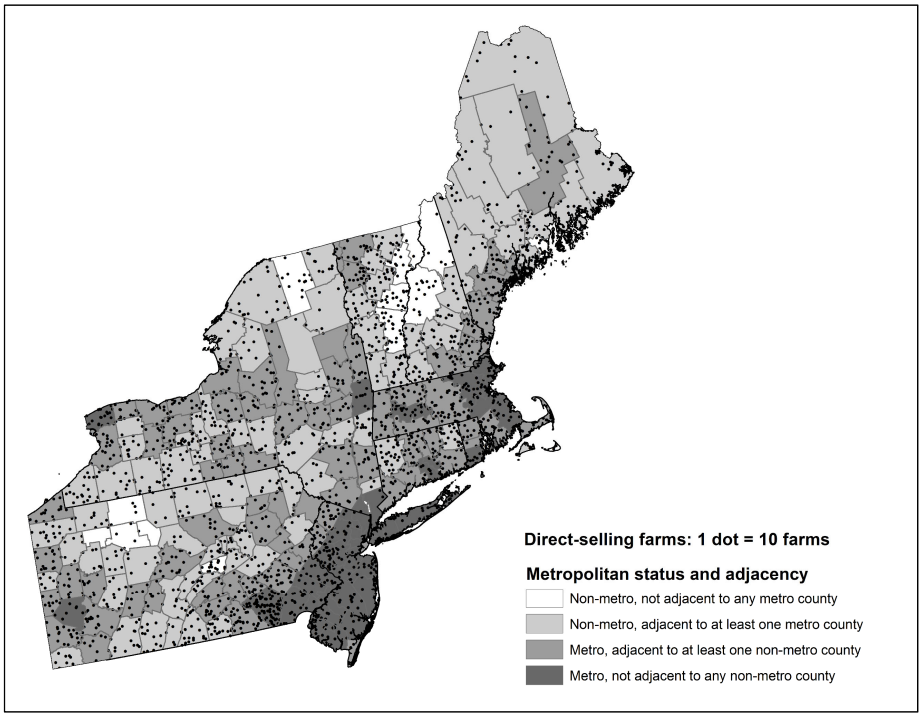


Figure 2. Top-quartile of Percent of Farms Selling Direct and Metropolitan Adjacency

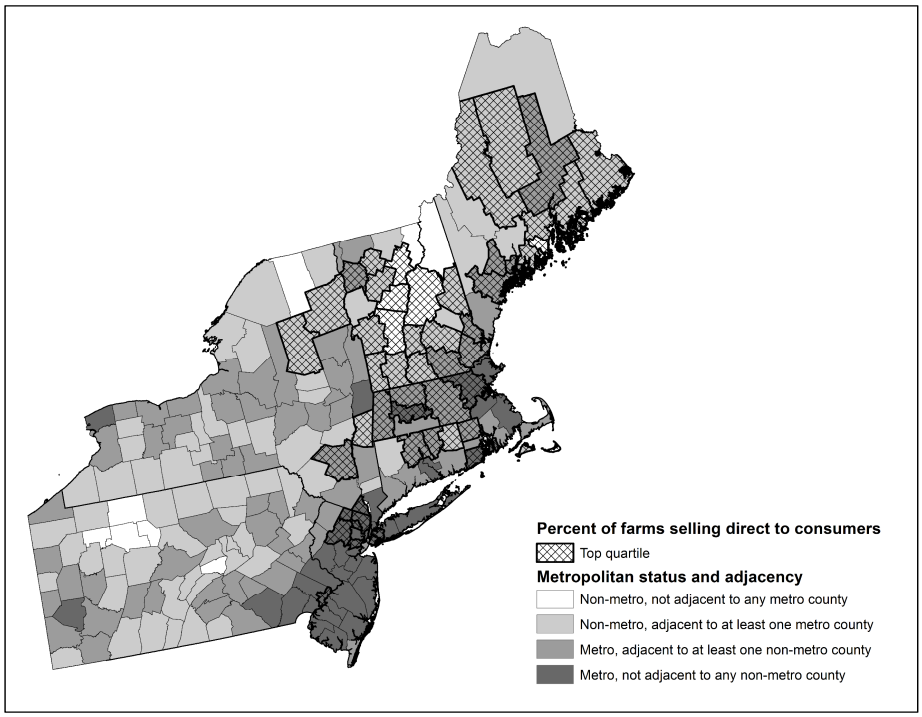


Figure 3. Volume of Direct Sales and Metropolitan Adjacency

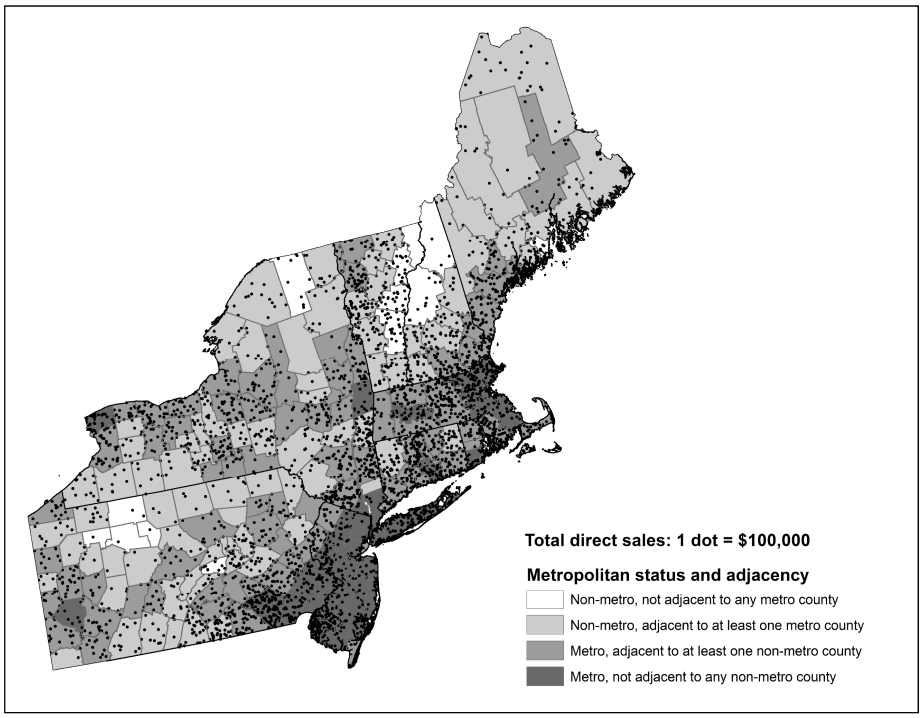
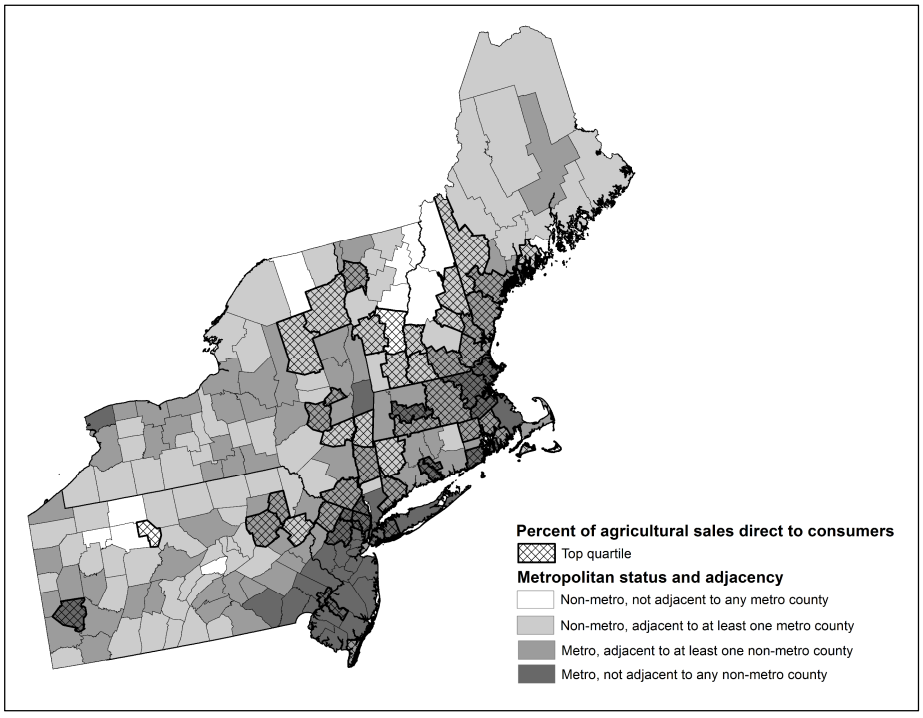


Figure 4. Top-quartile of Percent of Sales Direct to Consumer and Metropolitan Adjacency



are in the top quartile. Instead, the highest proportions of direct sales seem to occur in counties along interstate routes to Boston and New York City.

Together, the descriptive statistics and spatial visualizations show complex patterns, not necessarily driven by household income. Notably, the patterns change depending on how direct marketing is measured. To examine these patterns in a multivariate context, we entered our data into a series of fixed-time effect regression models.

Fixed-time Effect Regression Results

Table 3 summarizes standardized fixed-time effect regression results to isolate how changes in median household income and each control variable are associated with changes in the direct-sales variables between 2007 and 2014. Controlling for other variables, the change in the number of farms (Model 1) selling direct between 2007 and 2012 can be partly explained by most variables in the model. Increase in household income has a positive relationship to growth in number of farms selling direct, as does the total number of

farms, growing median farm size, and growing number of farms producing vegetables. Increasing population has a significant negative relationship to the number of farms selling direct, and acres in vegetables is negatively related to the number of direct-selling farms, though the effect is not significant. The overall R^2 for the model is 0.48.

Interestingly, household income is not a significant predictor for growth in the percentage of farms selling direct (Model 2). Population and the number of vegetable farms are positively related to percentage of farms selling direct, while the total number of farms and acres in vegetables are negatively related. Median farm size is unrelated. It is a slightly less powerful model, with an overall R^2 of 0.41. The beta coefficients for volume of direct sales (Model 3) shows yet another pattern, with income and number of vegetable farms significant and positive in the model, while the total number of farms is significant and negative. This is the least predictive model of the four, with an overall R^2 of 0.37. Finally, changes in the percentage of direct-to-consumer sales (Model 4) are also distinct, with the number of vegetable farms positively related and the total number of farms, median farm size, and acres in vegetables negatively related to direct sales. Income and population are unrelated. The overall R^2 for Model 4 is 0.44.

To summarize the role of income, it seems to have a positive relationship to the number of farms selling direct (Model 1) and the volume of direct sales (Model 3), but is unrelated to the percentage of farms selling direct (Model 2) and the percentage of direct sales (Model 4). Population, in contrast, is negatively related to the number of farms selling direct (Model 1), positively related to the percentage of farms selling direct (Model 2), but unrelated to the volume of direct sales (Model 3) or the percentage of sales that are direct (Model 4). Direct agricultural sales appear to be more complex in the Northeast than simply a high-income, peri-urban phenomenon.

Implications

Examining the role of household income and metropolitan adjacency in promoting direct agricultural marketing from three perspectives—bivariate, spatial, and multivariate—reveals that income and location in terms of metropolitan areas matter to some measures of direct sales. It is inaccurate, however, to dismiss direct marketing as a boutique phenomenon catering to privileged consumers in the suburbs. The strength and the direction of the statistical link between income and direct marketing varies by whether one uses an absolute (farms, sales volume) or relative

Table 3. Fixed-effects Results

	Model 1		Model 2		Model 3		Model 4	
	Number of farms selling direct		Percentage of farms selling direct		Direct sales (US$1,000 current dollars)		Percentage of direct sales	
	Beta	Standard error	Beta	Standard error	Beta	Standard error	Beta	Standard error
Household income	0.26***	0.05	0.10	0.06	0.44***	0.07	0.15	0.06
Population	–0.35***	0.05	0.13**	0.06	0.12	0.07	0.06	0.07
Total farms	0.34***	0.07	–0.96***	0.08	–0.29***	0.09	–0.55***	0.08
Median farm size	0.14**	0.05	0.04	0.07	–0.01	0.07	–0.21***	0.07
Vegetable farms	0.33***	0.06	0.83***	0.08	0.23**	0.08	0.35***	0.07
Acres in vegetables	–0.03	0.05	–0.23***	0.05	0.06	0.06	–0.18***	0.05
R^2 within	.25		.21		.00		.01	
R^2 between	.51		.45		.40		.46	
R^2 overall	.48		.41		.37		.44	

* $p<0.01$; ** $p<0.005$, *** $p<0.001$

(percentage of farms, percentage of sales) outcome measure. O'Hara and Low (2016) usefully demonstrate the income elasticity of demand for direct-marketed agricultural products, but our study, and others, emphasize contributions of other factors that can lead to a positive change in the structure of the food system: wealth of farm resources, types of agricultural products, and spatial considerations such as proximity to major cities and transportation corridors (Brown et al., 2006; Cheng et al., 2011; Clark, Inwood, & Sharp, 2012; Selfa & Qazi, 2005).

Understanding affluence as a factor in (but not a driver of) direct agricultural sales is important for at least two reasons:

1. Most analyses treat the Northeast U.S. as one relatively homogenous region, characterized by dense settlement patterns and relative social privilege, when considering direct marketing in agriculture (e.g., Lyson, T. A., 2004; Timmons & Wang, 2010). Our analyses, however, show considerable variation in socioeconomic and ecological contexts within the Northeast. This variation is important for food system work, as each locale is best understood as a unique configuration of broader spatial and economic patterns.

2. The increase in direct markets is often attributed to the presence of higher-income people living in urban and peri-urban areas. Although there is significant association between direct-sales outcomes and access to high-income markets, our models indicate that the total picture is more complex. Therefore, specific strategies to promote direct markets for areas with more modest incomes and less dense populations could prove fruitful. For example, regional food-system efforts might be more effective than local ones in serving less privileged places (Brekken, Parks, & Lundgren, 2017)

Direct marketing can take a variety of forms, which have discrete drivers depending on the context. Therefore, policy aimed at promoting or enabling shorter supply chains and direct markets should take this heterogeneity into account.

We also note that the visually striking way that Vermont stands out also indicates that current levels of direct marketing are not circumscribed by household income. The regression model constructed by Timmons and Wang (2010) predicted direct sales for Vermont of US$10.5 million when the observed volume of direct sales in the 2007 Census of Agriculture was over twice that at US$22.9 million. Conner, Dewitt, Inwood, and Archer (2015) highlight the role of Vermont's 2009 "Farm to Plate" legislation, which created a 10-year plan for promoting economic development, employment, and public health through a more sustainable food system. This statewide commitment supports the efforts of socially responsible food and agricultural businesses in the state and has yielded growth in both the number of food businesses and the number of jobs in the food sector. It is unlikely that another state or region can walk exactly in Vermont's footsteps, given the state's compelling brand in the minds of many consumers,[1] but in the broader context of our analysis, the Vermont case illustrates the rich possibilities of strategic food systems work and policy advocacy.

Conclusions

Our research reinforces the notion that researchers and policy-makers interested in direct marketing activities in agriculture should view local food systems as potentially complex phenomena nested in broader contexts. In-depth case studies together with broader quantitative analyses can better explicate the ideal types of direct markets we have measured here. In this way, we can avoid idealizing or dismissing direct food markets as panaceas or as irrelevant, respectively, for rural development when not appropriate. While our work reveals some insights about the limited and contextual role of economic privilege in direct food marketing, it has several notable limits.

First, direct-to-consumer sales are only part of the local food picture. Future analyses of the role

[1] We are indebted to an anonymous reviewer for this point.

of economic privilege in facilitating local food systems will likely focus on newer data on intermediate marketing channels. The 2012 Census of Agriculture for the first time collected data on farm sales direct to retailers (restaurants, stores, institutional kitchens) and aggregators serving local markets (food hubs and local distributors). Intermediated sales in 2012, at US$4.8 billion, are more than three times the volume of direct-to-consumer sales (Vogel & Low, 2015); the sharply reduced growth of direct-to-consumer sales between 2007 and 2012 may be explained by these expanded marketing opportunities for locally focused farmers. Also, intermediated sales may be more profitable avenues for some farms (Uematsu & Mishra, 2011). Direct-to-consumer and intermediated sales are two interacting parts of a broader local food system. While our data are only a few years old, the emergence of food hubs and other locally and regionally focused efforts may make our findings quickly out-of-date.

Second, while our fixed-effects model demonstrates the usefulness of considering change over time, it does not, by itself, provide a rich narrative of how change is created at the local and regional levels. For example, Hoey, Colasanti, Pirog, and Fink Shapiro (2017), reflecting on food-system work in Michigan, emphasize the critical importance of trust among social-change stakeholders to create processes that can lead to effective change in policies and practices. Similarly, Godette, Beratan, and Nowell (2015) show that uniform strategies for local food system development are often poorly aligned with contingent local conditions, such as the attitudes and policies of institutional food buyers. Trust, relationships, attitudes, and even policies are dimensions of food-system contexts that are invisible to the Census of Agriculture.

Third, our model is limited by data availability. It is based on 2007 and 2012 data from the Census of Agriculture and corresponding years of the American Community Survey. While the agricultural data are the most recent available, they are still somewhat out of date. Similarly, with R^2 values ranging from 0.37 to 0.48, more than half the variance in direct sales is due to unexplained factors. While the fixed-effects panel model accounts for variables that are constant through time (such as proximity to major urban areas), there are clearly other variables that changed between 2007 and 2012 that help shape direct sales outcomes.

As researchers pursue varied projects emphasizing diverse dimensions of the food system, our results suggest that future analyses would be enriched in two ways. First, including multiple measures of local-food activity enables research to capture both economic flows and promising structural change. Second, modeling techniques like fixed-time effects regression are effective in accounting for unmeasured time-constant variables and, in that way, representing some of the subtle complexities of broad food-system change.

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The SNAP Challenge: Communicating food security capabilities through anti-hunger advocacy

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Abstract

This research brief reports preliminary findings related to the SNAP Challenge (SC), an anti-hunger initiative in which participants purchase their household groceries using the average food stamp budget benefit for one week. By simulating a SNAP budget, SC participants encounter food insecurity directly, recognizing how the food they are able to consume connects to income, nutrition needs, and other factors that contribute to quality of life, all of which can be considered capabilities of food security. Linking the experience of food hardship to conditions of poverty can address not only immediate food needs but also the interconnected material opportunities and disparities that constitute food (in)security. In this way, I suggest, a capability approach to food security can better align anti-hunger advocacy and food system policy. This initial study supports ongoing research related to anti-hunger advocacy communication, food security discourse, and capability-based approaches to food system reform.

Keywords

Food Security; SNAP Challenge; SNAP; Capability Approach; Anti-Hunger Advocacy; Food Stamps

Introduction

Threats of cuts to federal nutrition programs such as SNAP[1] foment debates about the function of the social safety net and the role of public policy in household food security. Although individual SNAP benefits average US$132 per month, they allow "families to maintain food as a spending

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[1] The food assistance program formerly known as food stamps was renamed the Supplemental Nutrition Assistance Program (SNAP) in 2008.

priority…while not falling as far behind in meeting their other obligations—rent, utilities, transportation, and educational or medical debt—as they otherwise might" (U.S. Department of Agriculture, Food and Nutrition Service [USDA FNS], 2013, p. 15). In other words, SNAP benefits fulfill a critical need that extends beyond supply-side hunger relief. The SNAP Challenge (SC) is an anti-hunger advocacy initiative aimed at illustrating the "the important role SNAP plays in mitigating hunger *and* poverty" (emphasis added, Food Research & Action Center [FRAC], n.d.-a, para. 2). Participation in this week-long campaign requires purchasing one's household groceries based on the average SNAP benefit, an experience that may provide "a new perspective and greater understanding" of not only what food hardship looks like, but also the structural conditions that constitute food (in)security (FRAC, n.d.-a, para. 1). Although the SC has garnered attention in media reports (Doran, 2013; Livingston, n.d.) and academic investigations (Robb, 2016; Schoettler, Lee, Ireland, & Lenders, 2015), the focus has largely tended to emphasize the former; this primary study takes up the latter.

While seeking to reduce hunger, anti-hunger advocacy often also articulates the amelioration of poverty, underemployment and low wages, and health disparities as interconnected facets of food (in)security (Bellows & Hamm, 2002). However, the prevailing commodity-based approach to food security relies on supply-side criteria for assessing food provisioning, which narrowly focuses on redistributing resources to those in need. Instead, initiatives like the SC can reveal how food access and consumption are contextualized within a web of "cultural, social, and economic…practices, habits and desires" (Alkon, Block, Moore, Gillis, DiNuccio, & Chavez, 2013, p. 126). Linking the experience of hunger to conditions of poverty can thus address not only immediate food needs but also the interconnected material opportunities and disparities that constitute food (in)security.

The current study explores how the SC connects the experience of food hardship to what may be considered *capabilities* that produce or inhibit the achievement of food security (Sen, 1999, 2003). These capabilities are indicated by a variety of factors, such as income, nutrition needs, and health, which contribute to quality of life. I argue that by simulating SNAP usage, SC participants confront their typical consumption choices and habits and in doing so can reflect on how the food they are able to consume connects to economic and physiological capabilities.

The following research brief reports on preliminary findings from an SC campaign facilitated in Salt Lake City, Utah. This initial study supports ongoing research related to anti-hunger advocacy communication, food security discourse, and capability-based approaches to food system reform.

The SNAP Challenge

Popularized by celebrities like Chef Mario Batali and Gwyneth Paltrow (Bever, 2015; Italie, 2012) and elected representatives such as former Newark Mayor Cory Booker (Memmott, 2012), the SC is structured strategically to highlight "how difficult it is for families living on SNAP to simultaneously avoid hunger, afford nutritious foods, and stay healthy with limited resources" (FRAC, 2016, p. 1). The SNAP Challenge Toolkit, a downloadable resource packet provided by FRAC (2016), outlines the parameters for participation: use only a food budget equivalent to the average weekly food stamp benefit; all food consumed during the Challenge week is purchased from the simulated SNAP budget; no food (including condiments and spices) already owned or obtained for free can be consumed during the Challenge week; spending and items purchased should be logged. Thus to complete the SC, participants must meet their dietary needs—not only what they can purchase and how much they can eat, but also where they shop, and how often they eat—with significantly decreased spending ability.

A sustainability collaborative at the University of Utah, in partnership with Utahns Against Hunger (UAH, a local anti-hunger advocacy group), coordinated an SC campaign in Salt Lake City. Participants included university students, faculty, and staff, as well as community members. All were encouraged to post comments and reflections on a public blog hosted on the UAH website. The Challenge week culminated in a public event focused on food access and the farm

bill, where participants discussed their experience with the SC and their thoughts about food security and public policy.

Data consist of field notes from observations at the public event as well as comments posted by Challenge participants to the public blog. In addition, semistructured interviews were conducted with key informants, including FRAC staff and UAH's executive director, who have coordinated previous SCs, and an official from the Salt Lake City Workfare Office who has previously participated in SCs. Interviewees were asked open-ended questions regarding the potential of the SC for achieving anti-hunger and poverty-related objectives, as well as their experience participating in this and/or previous campaigns. All interviews were recorded with the participants' consent and transcribed. These preliminary textual data were analyzed for emerging patterns related to capabilities of food security.

Commodity and Capability Approaches to Food Security

Economic development and social welfare policy evaluates food security using four commodity-based criteria related to the provision of an adequate food supply: availability, proximity, utilization, and stability (Food and Agriculture Organization of the United Nations [FAO], 2008). Food security is thus said to exist when there is adequate and accessible material food production, when food is affordable, and when it can be appropriately procured and utilized to provide adequate nutrition. Operationalization has primarily emphasized measurements of access to and distribution of commodities, aiming interventions toward the re-allocation of food resources at various scales. Indeed, although food security is now favored over the outmoded paradigm of hunger (Bellows & Hamm, 2002), a commodity-deficit framework may not fully account for the structural conditions and entangled practices that contribute to (or constrain) food security (Alkon et al., 2013).

In contrast, a capability approach (Sen, 1999, 2003) brings greater focus to the complex interrelationships among the conditions of (in)food security. Drawing from Amartya Sen's (2003) work in welfare economics and sustainable development, capabilities refer to the "constitutive elements of living," or "what [a person] manages to do or to be" (p. 5). These include, among other things, education and literacy, political freedom, and health and nutrition, which are disparately afforded across social groups. As such, these activities represent "functionings" that differentially contribute to quality of life (Sen, 1999, 2003). Unlike a supply-side framework that only accounts for and reinstates the resources that undergird such activities, a capability approach instead assesses "a person's freedom to achieve various functioning combinations" (Sen, 2003, p. 8) within political-economic systems. By addressing both the "valued activities and the *capability* to achieve these activities" (emphasis added, Sen, 2003, p. 4), a capability approach centralizes the "substantive choices [individuals] have" (Sen, 1997, p. 1959) as well as opportunities for policy reform, in this case vis-à-vis the food system.

As noted, the SNAP Challenge has gained some attention in academic literatures (Robb, 2016; Schoettler et al., 2015) emphasizing how the experience of hunger can raise awareness of food hardship. This preliminary study extends this area scholarship through consideration of the material opportunities and disparities that constitute food (in)security as revealed through the SC. The remainder of this research brief explicates initial findings from analysis of the Salt Lake City SNAP Challenge.

SC and Capabilities of Food Security

Challenge participants frequently described their experience completing the SC as "eye opening," using economic and physiological impacts to articulate deviations from their typical eating and shopping practices. Through their SC reflections, participants can recognize how the food they are able to consume connects to their income, nutrition needs, and other factors that contribute to quality of life. In other words, participants articulate food (in)security in systemic terms related to their opportunities (or capabilities) for food access.

Economic Capabilities

The tight budget and strict rules prescribed by the SC forces participants to acknowledge their regular

spending and food consumption habits. For example, Susan reflected, "I am spoiled by the variety and convenience of food available to me." Students also recounted how they typically "just throw whatever we want into the [grocery] cart..." and that "I barely worried about what to eat for dinner, or [had to] eat less in order to save money." Not only is the SC their first experience shopping on a budget, it also illuminated what participants' economic capability regularly affords them.

Participants also described missing out on items they would ordinarily purchase. Daniel reported that his family "let go" of items like chips and brand-name Oreo cookies, "things that you would typically buy when we go to the grocery store." One participant's blog post put this bluntly: "No frozen pizza's [sic]. No deli foods. No name-brand foods (unless on sale w/coupon) and cheaper than store-brand [sic]. No drive-thru fast food or restaurant." Indeed, snacks and convenience foods were routinely described by participants as "junk food."

Because SC guidelines bar the use of food already owned, including spices, cooking oils, and condiments, most participants went without these common accoutrements. For example, Rachel reports that she "boiled some broccoli for dinner without any sauce or any seasoning," noting that it "tasted really terrible." Similarly, Daniel reflected that "when you're gonna have a burger for dinner and you forgot that you didn't have ketchup on your [shopping] list…[you're] having to go with a burger without a condiment." Though usually taken for granted because they normally can be afforded, the meager SC budget renders these snack foods and staple seasonings "extras" that are sacrificed for more essential items.

Physiological Capabilities

Even while spending all of the week's food budget, most participants did not have enough to eat throughout the SC. Many reported having "hunger pangs" between meals or even feeling "hunger pains" by the end of the Challenge week. Participants' expressions of hunger illustrate their recognition of how food choices contribute to their daily mental and physical well-being. For example, Michael shares that "my energy levels were lacking" during the last few days of the Challenge. Karen similarly recalls that "before the week was over I was suffering from massive headaches."

Participants shared additional physical and emotional responses to the SC. Many participants explained how they struggled to get through their work and school days because they felt tired; others noted increased irritability. A student-athlete chose not to finish the SNAP Challenge, explaining that the lack of sufficient calories negatively affected his performance in practice. Another participant reflected on feeling "stressed and anxious all week," easily getting into arguments with friends and family over minor annoyances. Participants readily attributed these sensations to their SC diet, be it from forgoing entire meals, having to ration snacks, or their increased consumption of "overly processed foods."

To summarize, SC participants articulated the challenges of living on SNAP, not only due to the strict budget, but also having to forfeit favorite foods and endure head and stomach aches. The analysis of participants' reflections on their experience completing the Challenge indicates recognition of "functionings" (Sen, 1999, 2003) like income and nutrition as dimensions of food (in)security. In other words, their reflections articulate how food (in)security occurs alongside other capabilities, such as physical health and mental stress, food preferences, and even social relationships.

Conclusion

This research brief reports on the SNAP Challenge (SC), an anti-hunger advocacy initiative aimed at providing "a new perspective and greater understanding" of food (in)security (FRAC, 2016, p. 1). Indeed, participation in an anti-hunger advocacy campaign such as the SC may aid in "learn[ing] first-hand what it is like to try to make ends meet on the average SNAP benefit" (FRAC, 2016, p. 1) by connecting daily food-related activities with income, health needs, and even relationships as entangled practices of food security. This is made possible, I argue, because initiatives like the SC connect the experience of food hardship to the structural conditions that produce or inhibit the achievement of food security.

Anti-hunger advocacy seeks to reduce hunger as part of a web of interconnected facets of food (in)security (Bellows & Hamm, 2002). Yet this objective is arguably at odds with the commodity-deficit framework that predominates approaches to ameliorating food insecurity (FAO, 2008). Incongruity between grassroots reform efforts and prevailing policy conceptualizations may hinder broader food system change. That initiatives like the SC can reveal the complex interrelationships among the conditions of food (in)security suggests the utility of a capability-based approach (Sen, 1999, 2003). In this way, I suggest that a capability approach to food security can better align anti-hunger advocacy and food system policy.

It is important to note that the SC's ability to expose the "functionings" (Sen, 1999, 2003) of food security should not belie the complex nature of anti-hunger advocacy. Mobilizing hunger to advocate for food system reform may potentially reify the social and political stigma endured by those living in poverty (Gordon & Hunt, 2018; Hunt, 2015). Food reform initiatives like the SC—that can communicate the economic, social, environmental, and physiological capabilities of SNAP recipients as well as campaign participants—may foster identification between these disparate social groups. Future research on the SC will explore these dynamics as well as investigate the degree to which participation in anti-hunger initiatives leads to action or further engagement with food system reform. This preliminary study also supports ongoing research investigating the capabilities of food (in)security in relation to the procurement and utilization of fresh produce donated to local food pantries (Hunt & McAndrews, 2018).

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Urban farmers markets as a strategy to increase access to and consumption of fresh vegetables among SNAP and non-SNAP participants: Results from an evaluation

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Abstract

Inadequate access to healthy foods is an important determinant of dietary intake among low-income populations in the United States. This study reports the results of an evaluation of two urban farmers markets in metro Atlanta, which received funding to implement Electronic Benefits Transfer card readers to accept Supplemental Nutrition Assistance Program (SNAP) benefits as a form of payment. In Spring 2013, 179 farmers market

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customers completed self-administered paper surveys to assess the extent to which they received SNAP benefits, their patterns of using the market, and their self-reported changes in access to and consumption of fresh vegetables as a result of the markets. Results indicate that 28% of surveyed customers received SNAP benefits; however, only 20% of SNAP recipients reported that they were from the immediately surrounding community (1 mile away or less). Among returning customers, 74.2% strongly agreed that the markets made it easier to purchase fresh vegetables, and 64.5% reported eating more fresh vegetables as a result of the markets. Results suggest that market customers perceive that the farmers markets increase their access to and consumption of fresh vegetables, particularly among SNAP recipients. However, greater outreach is needed to members of the immediately surrounding community, many of whom receive SNAP and may benefit from increased access to the produce sold at the farmers markets.

Keywords
Farmers Markets; Environment; Diet; Nutrition; Fruit; Vegetable; Program Evaluation; Adults, Supplemental Nutrition Assistance Program; United States

Introduction and Literature Review
A growing body of research suggests that many neighborhoods in the United States lack equitable access to healthy foods (Caspi, Sorensen, Subramanian, & Kawachi, 2012; Larson, Story, & Nelson, 2009). For example, neighborhoods composed of low-income and predominately minority residents have limited access to full-service supermarkets (Moore & Diez Roux, 2006; Zenk et al., 2005) and lower total availability of healthy foods compared to more affluent neighborhoods (Franco, Diez Roux, Glass, Caballero, & Brancati, 2008; Morland & Filomena, 2007). Greater access to healthy foods and healthy food retailers has been linked with better dietary outcomes (Bodor, Hutchinson, & Rose, 2013; Bodor, Rose, Farley, Swalm, & Scott, 2008; Franco et al., 2009) and lower body mass index (Morland, Diez Roux, & Wing, 2006). This suggests that access to healthy foods may be an important characteristic of health-promoting neighborhood environments.

In response to the growing recognition of the role local food environments may play in influencing dietary behaviors, increasing access to healthy food options has become a national public health priority. Federal health promotion programs, such as the Communities Putting Prevention to Work (CPPW) program, have focused on modifying local food environments to make them more supportive of healthy eating (Bunnell et al., 2012). This strategy aligns with one of the national objectives of Healthy People 2020—to increase the proportion of Americans who have access to a food retail outlet that sells a variety of foods that are encouraged by the Dietary Guidelines for Americans (Department of Health and Human Services, n.d.). This strategy is also consistent with theoretical frameworks of health behavior, such as Cohen's Structural Model of Health Behavior, which suggest that the availability of health-promoting resources is an important determinant of engaging in health-promoting behaviors (Cohen, Scribner, & Farley, 2000).

Access to healthy foods is a multidimensional concept that encompasses availability, accessibility, affordability, accommodation, and acceptability of healthier food options (Caspi et al., 2012). Strategies to improve access to healthy foods have included opening new retailers of healthy foods within a community, encouraging existing retailers to stock healthier options, and making healthy food options more affordable to low-income consumers (Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008). One method of increasing the affordability of fresh fruits and vegetables is to equip farmers markets with Electronic Benefits Transfer (EBT) card readers so that low-income Americans who participate in the Supplemental Nutrition Assistance Program (SNAP, formerly known as the food stamp program) may use their benefits to purchase fresh produce.

However, the extent to which these initiatives will improve dietary behaviors among SNAP participants remains an area of active research. To date, most research regarding introducing EBT card readers at farmers markets has focused on describing the factors influencing the adoption of

this technology (Hasin & Smith, 2018; Roubal, Morales, Timberlake, & Martinez-Donate, 2016; Ward, Slawson, Wu, & Jilcott Pitts, 2015) or on the effect of these initiatives on SNAP redemption rates and market sales (Buttenheim, Havassy, Fang, Glyn, & Karpyn, 2012; Hasin, Smith, & Stieren, 2016; Jones & Bhatia, 2011). Few studies have focused on nutrition and dietary behavior or perceived access to healthy foods as outcomes (Krokowski, 2016). Research regarding the ability of these initiatives to improve fruit and vegetable intake is needed to evaluate the potential significance of these programs for improving population-level dietary change.

Through the CPPW program, the Centers for Disease Control and Prevention (CDC) funded 50 communities to implement local environmental changes focused on obesity prevention and tobacco control (Bunnell et al., 2012). The Georgia Department of Public Health (DPH) used CPPW funding to expand access to fresh fruits and vegetables among local residents by purchasing EBT card readers for two local farmers markets operated by Truly Living Well Center for Natural Urban Agriculture (TLW) in Atlanta, GA. This article presents results from an evaluation of TLW's farmers markets, following the implementation of EBT card readers. The evaluation sought to answer the following questions: (1) What is the current reach of the TLW market, as measured by the demographic and socioeconomic characteristics of existing customers? (2) What are the patterns of TLW farmers market use among customers? (3) What perceived changes in access to and consumption of fresh vegetables do returning customers report as a result of the market? and (4) How do these characteristics vary between SNAP participants and non-participants?

Applied Research Methods

Research Design and Variables

This evaluation used a one-group post-test only design to evaluate the Truly Living Well Center for Natural Urban Agriculture's Open Air Farmers Markets (Shadish, Cook, & Campbell, 2002). Demographic and socioeconomic characteristics of the market shoppers, their patterns of using the market, and their perceptions about how the market impacted their access to and consumption of fresh vegetables were used as dependent variables. Receipt of SNAP benefits served as the independent variable.

Description of the Truly Living Well Center for Natural Urban Agriculture's Open Air Farmers Markets and Setting

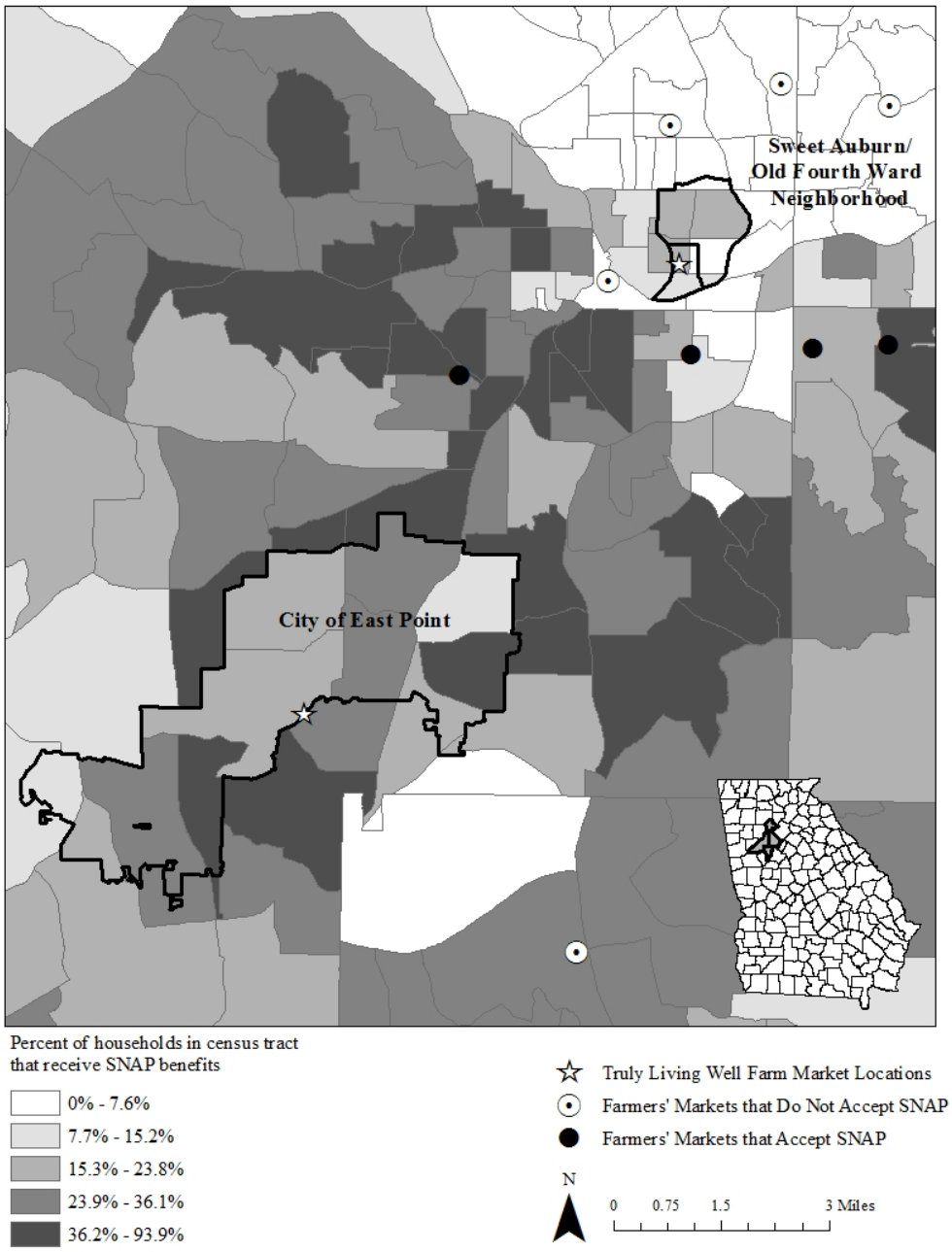
TLW is a 501(c)(3) nonprofit organization that has been operating in metro Atlanta since 2006. TLW's mission is to grow better communities by connecting people with the land through education, training, and demonstration of economic success in natural urban agriculture (Truly Living Well Center for Natural Urban Agriculture, n.d.). TLW's flagship initiative involves operating urban farms in metro Atlanta using Certified Naturally Grown methods (Certified Naturally Grown, n.d.). Each year, these farms produce an estimated 30,000 pounds (13,600 kg) of fresh fruit, vegetables, herbs, and flowers, which are sold to the general public at open-air farmers markets located on site at the urban farms. These markets exclusively sell produce grown by TLW; no other vendors sell products at these markets. In addition to these activities, TLW also runs a community-supported agriculture program (CSA) and offers a variety of educational and outreach activities for both adults and children, including urban farm tours, volunteer opportunities, summer camps, and urban agriculture training. In 2012, DPH used CPPW funding to enable TLW to purchase EBT card readers so that the farmers markets could accept SNAP as a form of payment.

At the time of this evaluation, TLW operated two urban farmers markets, which were located in the Sweet Auburn/Old Fourth Ward neighborhoods as well as the city of East Point in metro Atlanta, Georgia. Both farmers markets were open for business year-round during afternoon and evening hours. The Sweet Auburn/Old Fourth Ward location was open on Fridays, and the East Point location was open on Wednesdays. Figure 1 displays the locations of the two TLW farmers markets to provide context for this evaluation.

The census tracts in which TLW markets were located were composed of primarily Black residents (55.1–77.1% per census tract) with a greater share

of neighborhood households accessing SNAP (15.3–23.8%) compared to the overall metro Atlanta population (12.4%) (U.S. Census Bureau, n.d.). Although several other farmers markets were located in the vicinity of the Sweet Auburn/Old Fourth Ward neighborhoods, many of them did not accept EBT as a form of payment at the time of this evaluation (U.S. Department of Agriculture [USDA], 2013). No other known farmers markets existed in the city of East Point at the time of this evaluation (USDA, 2013).

Figure 1. The Proportion of Households Receiving Supplemental Nutrition Assistance Program (SNAP) Benefits per Census Tract in Neighborhoods Surrounding Truly Living Well Center for Natural Urban Agriculture Farm Market Locations, Atlanta, Georgia, USA; 2013



Sample

This evaluation sought to generate information about the customer base of the TLW farmers markets. A convenience sample of participants who shopped at the markets on nine days in Spring 2013 were invited to participate in the study. Eligible participants were adults aged 18 or older who were shopping at the TLW farmers markets and who had not completed the survey previously. The recruitment goal was to enroll as many shoppers at the TLW markets in the study as possible during the nine recruitment days. Response rates were not systematically tracked.

Instrumentation

The instrument used for this study was a self-administered, English-language, pen-and-paper

survey that contained 34 items and took approximately 10 to 15 minutes to complete. The survey included questions about demographic characteristics, attendance at the market, perceived changes in access to and consumption of fresh vegetables, perceived benefits of organic and locally grown produce, and receipt of SNAP benefits.

Demographic Characteristics: Standard demographic questions were used to measure age, gender, race, employment status, education, income, and history of volunteering with or being employed by TLW. Respondents were also asked to respond yes or no to the question, "Have you ever run out of food in the last 12 months because you could not afford to buy more?" as a potential indicator of food insecurity. Demographic characteristics were treated as dependent variables in all statistical tests assessing differences between SNAP and non-SNAP participants.

Patterns of Market Use: Frequency of market use was measured by asking participants how often they visit the farmers market on a monthly basis; this measure was adapted from a publicly available survey from an evaluation of a similar initiative (Reed, Grost, Mantinan, & Goldenhar, 2013). Participants could either indicate that this was their first time attending the market or record the number of times per month that they attended the market (less than once—4 times per month). The survey also included a question asking participants to indicate what year they began attending the market. Responses included that this was their first season attending the market, or the years 2006-2012. The survey also included a question about how far respondents traveled to get to the farmers market (less than 1 mile, 1-5 miles, 6-10 miles, 11-20 miles, or more than 20 miles). A single, check-all question was used to assess methods of transportation to the market (e.g., car, bike, train, bus, on foot, or some other method). Patterns of market use were treated as dependent variables in all statistical tests assessing differences between SNAP and non-SNAP participants.

Perceived change in access to and consumption of fresh vegetables: Perceived change in access to fresh vegetables was assessed using two questions asking participants to what extent they agreed or disagreed that the TLW farmers market made it easier to purchase fresh vegetables in their community and helped to offer a large selection of fresh vegetables in their community. Participants could select their responses using a 4-point Likert scale ranging from strongly disagree to strongly agree. These survey questions were developed for this study.

Self-reported change in vegetable consumption was measured using a single item asking participants to report to what extent they had been eating more fresh vegetables as a result of shopping at the TLW farmers market, relative to before they started shopping there. Response options were: this was their first time attending the market; no, fewer vegetables; no, the same amount of vegetables; yes, a little more vegetables; or yes, a lot more vegetables. This question was adapted from a previous evaluation of a similar initiative (Reed et al., 2013). Perceived changes in access to and consumption of fresh vegetables were treated as dependent variables in all statistical tests assessing differences between SNAP and non-SNAP participants.

Receipt of SNAP Benefits: The independent variable was assessed by asking participants to respond yes or no to the question, "In the past 12 months, did anyone in your household receive food stamps or a food stamp benefit card?"

Procedures

In 2013, DPH awarded a contract to the Emory Prevention Research Center (EPRC) to evaluate the TLW farmers markets; the EPRC, which managed the evaluation contract, was not involved in the design or implementation of this or other TLW initiatives. Representatives from DPH, TLW, and the EPRC jointly determined the evaluation questions and methodology. Once the survey instrument was finalized, trained graduate research assistants from the EPRC distributed self-administered intercept surveys to a convenience sample of customers on site at the two TLW farmers markets on nine days in April and May 2013. Because the primary purpose of this project was quality improvement, the Emory University Institutional

Review Board determined that this project was non-research program evaluation and did not require IRB approval.

Data Analysis

Data were analyzed in SAS 9.3 (2012, SAS Institute, Inc., Cary, NC, USA) using descriptive statistics, including frequencies, proportions, and means. Analyses focused on describing the demographic characteristics of evaluation participants and their patterns of market use were conducted among the entire sample. Analyses focused on perceived change in perceived access to and consumption of fresh vegetables were restricted to customers who reported that they had attended the market at least once before (n=93). Additionally, bivariate statistical tests—including chi-square tests, Fisher's exact tests, Wilcoxon-Mann-Whitney tests, and independent samples t-tests—were used as appropriate to assess differences between SNAP recipients and non-SNAP recipients on their demographic and socioeconomic characteristics, their patterns of TLW market use, and perceived impact of the market on their access to and consumption of fresh vegetables.

Results

In total, 184 customers completed the survey (52% from the Sweet Auburn/Old Fourth Ward market and 48% from the East Point market). Five surveys were later excluded, either because the participant was found to have taken the survey before (n=1) or because of missing data on key variables (n=4). This resulted in a final analytic sample size of 179 participants.

Demographic and Socioeconomic Characteristics of TLW Farmers Market Customers

Over one-quarter (27.9%) of the sample reported that they receive SNAP benefits (Table 1). The majority of respondents were Black or African American (81.4%), middle-aged (mean age: 45.5 years, SD=15.4), women (68.5%), who were employed either full- (47.5%) or part-time (16.8%). The racial composition of the evaluation sample was similar to residents of the census tracts where each farmers market was located (e.g., 55.0% Black residents in the Sweet Auburn/Old Fourth Ward census tract vs. 53.8% from the sample at that site; 77.1% Black residents from the East Point census tract vs. 76.7% at that site; data not shown). Most reported that they had a college degree (36.3%) or higher (26.8%). Relatively few respondents (12.5%) reported an annual household income of US$10,000 or less, whereas 40.9% reported an annual household income more than US$50,000. Interestingly, of customers who reported annual household incomes of US$10,000 or less, 41% reported that they did not receive SNAP benefits. Approximately one in five shoppers in the sample (21.3%) reported that they had run out of food at some time in the previous year because they could not afford to buy more. Approximately 19.0% of respondents reported a history of volunteering for, being employed by, or serving on the board of TLW in the previous 6 months.

SNAP recipients were more likely to report their race as Black or African American (75.0%) relative to non-SNAP recipients (60.5%; p<.05). SNAP recipients were also less likely to report full-time employment (p=.001), reported lower educational attainment (p<.001) and income levels (p<.0001), and were more likely to report that they had run out of food in the previous year because they could not afford to buy more (50.0%) relative to non-SNAP recipients (10.2%; p<.0001). SNAP recipients were marginally more likely to report a volunteer or employment history with TLW (28.9%) compared to non-SNAP recipients (15.5%, p=0.05).

Patterns of Market Use

Just under half of the sample reported that they were attending the farmers markets for the first time (48.0%; Table 2) and just over half of the sample reported that they were returning customers (52.0%). Over one-quarter of the sample reported attending the market 3 to 4 times per month (26.8%), though relatively few reported that they had been attending the market for 2 to 3 years (10.6%) or 4 years or more (10.6%). Many respondents reported that they traveled between 1 and 5 miles to get to the farmers market (45.8%), and car was the most frequently reported form of transportation (87.2%). Relatively few respondents came from less than a mile away (16.4%) or

Table 1. Demographic and Socioeconomic Characteristics of Customers Recruited from Truly Living Well Center for Natural Urban Agriculture's Open Air Farm Markets by Receipt of Supplemental Nutrition Assistance Program (SNAP) Benefits

	All Customers (*N*=179)		Receive SNAP Benefits (*n*=50)		Do Not Receive SNAP Benefits (*n*=129)		P-value
TLW Site — *n (%)*							
Sweet Auburn/Old Fourth Ward	93	(52.0)	26	(52.0)	67	(51.9)	0.99
East Point	86	(48.0)	24	(48.0)	62	(48.1)	
Age[a] — *mean (SD)*	45.5	(15.4)	43.81	(15.9)	46.1	(15.2)	0.39
Gender — *n (%)*							
Female	122	(68.5)	35	(71.4)	87	(67.4)	0.61
Male	56	(31.5)	14	(28.8)	42	(32.6)	
Missing	1		1		0		
Race — *n (%)*							
Black/African American	114	(81.4)	36	(75.0)	78	(60.5)	0.04
White/Caucasian	49	(27.7)	8	(16.7)	41	(31.8)	
Hispanic/Latino	3	(1.7)	1	(2.1)	2	(1.6)	
Other	11	(6.2)	3	(6.3)	8	(6.2)	
Missing	2		2		0		
Employment Status — *n (%)*							
Working full time	85	(47.5)	15	(30.0)	70	(54.3)	0.001
Working part time	30	(16.8)	10	(20.0)	20	(15.5)	
Retired	30	(16.8)	7	(14.0)	23	(17.8)	
Not employed, homemaker, student, or on disabilit	34	(19.0)	18	(36.0)	16	(12.4)	
Highest Level of Education — *n (%)*							
High School/GED or less	19	(10.6)	9	(18.0)	10	(7.8)	
Some college/technical school	47	(26.3)	20	(40.0)	27	(20.9)	0.0003
College graduate	65	(36.3)	14	(28.0)	51	(39.5)	
Post-graduate or professional degree	48	(26.8)	7	(14.0)	41	(31.8)	
Income (US$) — *n (%)*							
$10,000 or less	22	(12.5)	13	(26.0)	9	(7.1)	<.0001
$10,001–$25,000	34	(19.3)	19	(38.0)	15	(11.9)	
$25,001–$50,000	35	(19.9)	7	(14.0)	28	(22.2)	
$50,001 or more	72	(40.9)	4	(8.0)	68	(54.0)	
Don't know/Not sure	13	(7.4)	7	(14.0)	6	(4.8)	
Missing	3		0		3		
Have you ever run out of food in the last 12 months because you could not afford to buy more?							
Yes	38	(21.3)	25	(50.0)	13	(10.2)	<.0001
No	140	(78.7)	25	(50.0)	115	(89.8)	
Missing	1		0		1		
Ever volunteered for, been employed by, or served on the board of TLW in the previous 6 months?	34	(19.0)	14	(28.9)	20	(15.5)	0.05

Note. Chi square tests were used to assess differences in TLW site, gender, race (African American vs. white), employment status, education (college degree or higher vs. not), income, running out of food in the previous 12 months because you could not afford more, and volunteer status comparing customers who receive SNAP benefits to those who do not. Independent samples t-test was used to assess differences in age comparing customers who receive SNAP benefits to those who do not.

[a] Data are missing for three participants.

traveled by foot, bicycle, or public transit (8.4%).

SNAP recipients were similar to non-SNAP recipients regarding their frequency of attending the market and distance traveled to get to the market. However, SNAP recipients tended to have started attending the farmers markets more recently than non-SNAP recipients ($p<.05$). SNAP recipients were also less likely to report having taken a car to get to the market (76.0%) as compared to non-SNAP recipients (91.5%; $p<.05$).

Perceived Changes in Access to and Consumption of Fresh Vegetables

Returning customers who responded to the survey reported high levels of agreement that the TLW farmers market made it easy to purchase fresh vegetables in their community (74.2% strongly agree, 17.2% agree) and helped offer a large selection of fresh vegetables in their community (64.5% strongly agree, 25.8% agree; Table 3). There were no statistically significant differences in either of these responses between SNAP and non-SNAP recipients.

Results regarding the perceived changes in fresh vegetable consumption as a result of shopping at the farmers market were mixed. Approximately one-third of returning customers reported that they were eating the same amount of fresh vegetables as a result of shopping at the farmers market (34.4%), that they were eating a little more fresh vegetables (30.1%), or that they were eating a lot more fresh vegetables (34.4%;

Table 2. Patterns of Use by Customers Recruited from Truly Living Well Center for Natural Urban Agriculture's Open Air Farm Markets by Receipt of Supplemental Nutrition Assistance Program (SNAP) Benefits

	All Customers (*N*=179)		Receive SNAP Benefits (*n*=50)		Do Not Receive SNAP Benefits (*n*=129)		
	n	(%)	n	(%)	n	(%)	*P*-value
Frequency of Attendance							
First time	86	(48.0)	25	(50.0)	61	(47.3)	
Less than 1 time per month	12	(6.7)	3	(6.0)	9	(7.0)	0.95
1–2 times per month	33	(18.4)	8	(16.0)	25	(19.4)	
3–4 times per month	48	(26.8)	14	(28.0)	34	(29.4)	
Length of Attendance							
First time	86	(48.0)	25	(50.0)	61	(47.3)	
First season	25	(14.0)	8	(16.0)	17	(13.2)	0.04
1 year ago	30	(16.8)	13	(26.0)	17	(13.2)	
2–3 years ago	19	(10.6)	3	(6.0)	16	(12.4)	
4 years ago or more	19	(10.6)	1	(2.0)	18	(14.0)	
Travel Distance to TLW							
Less than 1 mile	29	(16.4)	10	(20.0)	19	(15.0)	
1–5 miles	81	(45.8)	18	(36.0)	63	(49.6)	
6–10 miles	44	(24.9)	15	(30.0)	29	(22.8)	0.54
11–20 miles	17	(9.6)	5	(10.0)	12	(9.4)	
More than 20 miles	6	(3.4)	2	(4.0)	4	(3.1)	
Missing	2		0		2		
Method of Transportation to TLW							
Car	156	(87.2)	38	(76.0)	118	(91.5)	0.03
Other method (foot, bike, train, or bus)	15	(8.4)	8	(16.0)	7	(5.4)	

Note. Chi Square tests were used to assess differences in frequency of attendance and length of attendance, and Fisher's exact test was used to assess differences in travel distances to TLW and method of transportation between customers who receive SNAP benefits and those who do not.

Table 3). Among SNAP recipients, 44% reported eating a lot more fresh vegetables and 36% reported eating a little more fresh vegetables compared to non-SNAP recipients, of whom 31% reported eating a lot more and 28% reported eating a little more fresh vegetables (p=0.08).

Discussion

This article describes results from an evaluation of two farmers markets in Atlanta, Georgia, that received funding through the CPPW program to purchase additional EBT card readers so that they could accept SNAP benefits as a form of payment, thereby making their produce more affordable to low-income customers. In recent years, there has been growing interest in increasing low income people's access to farmers markets as a strategy to prevent chronic disease (Blanck, Thompson, Nebeling, & Yaroch, 2011; Bunnell et al., 2012; Jones & Bhatia, 2011); however, little evidence exists regarding the potential impact of these programs on perceived access to healthy foods and dietary behaviors (McCormack, Laska, Larson, & Story, 2010). This study adds to the growing body of literature regarding the ability of urban farmers markets to reach low-income shoppers and the role that they may play in improving perceived access to healthy foods and dietary behaviors.

Results from this evaluation suggest that the TLW farmers markets succeeded at reaching customers from a range of socioeconomic backgrounds, including those who receive SNAP benefits, despite the fact that a large proportion of the sample reported educational, employment, and income levels indicative of higher socioeconomic status. Although the high proportion of SNAP recipients shopping at the farmers markets cannot be directly attributed to the introduction of EBT card readers, our survey found that SNAP recipients were more likely to have reported that they started attending the market recently compared to non-SNAP participants. These findings

Table 3. Perceived Changes in Access to Healthy Foods and Fresh Vegetable Consumption among Returning Customers Recruited from Truly Living Well Center for Natural Urban Agriculture's Open Air Farm Market by Receipt of Supplemental Nutrition Assistance Program (SNAP) Benefits

	All Returning Customers (N=93)		Returning Customers Who Receive SNAP Benefits (n=25)		Returning Customers Who Do Not Receive SNAP Benefits (n=68)		
	n	(%)	n	(%)	n	(%)	P-value
This Farm Market has made it easy to purchase fresh vegetables in my community							
Strongly agree	69	(74.2)	19	(76.0)	50	(73.5)	0.80
Somewhat agree	16	(17.2)	4	(16.0)	12	(17.7)	
Somewhat disagree	2	(2.2)	1	(4.0)	1	(1.5)	
Strongly disagree	6	(6.5)	1	(4.0)	5	(7.4)	
This Farm Market has helped to offer a large selection of fresh vegetables in my community							
Strongly agree	60	(64.5)	17	(68.0)	43	(63.2)	0.65
Somewhat agree	24	(25.8)	6	(24.0)	18	(26.5)	
Somewhat disagree	3	(3.2)	1	(4.0)	2	(2.9)	
Strongly disagree	6	(6.5)	1	(4.0)	5	(7.4)	
As a result of shopping at the TLW Farm Market, have you been eating more fresh vegetables than before you started shopping here?							
Yes, a lot more	32	(34.4)	11	(44.0)	21	(30.9)	0.08
Yes, a little more	28	(30.1)	9	(36.0)	19	(27.9)	
No, the same amount	32	(34.4)	5	(20.0)	27	(39.7)	
No, fewer	1	(1.1)	0	(0.0)	1	(1.5)	

Note. Wilcoxon-Mann-Whitney tests were used to assess differences between returning customers who do and do not receive SNAP benefits.

suggest a potential association between the introduction of EBT card readers and increased use of the farmers market by SNAP participants. Interestingly, the market also served low-income customers who were not enrolled in SNAP benefits. This suggests that the farmers market may be a potential outreach site for enrolling low-income customers in public assistance programs, such as SNAP.

Despite the fact that a relatively large proportion of survey respondents reported receiving SNAP benefits, evaluation results indicated that the markets may not be reaching people from the immediately surrounding communities, which include areas with a high proportion of households on SNAP (U.S. Census Bureau, n.d.). Based on these results, greater outreach into neighborhoods immediately surrounding the markets is needed. At the time of this evaluation, TLW was planning to increase outreach efforts, in part, by enrolling in Georgia Fresh For Less, an incentive program that enables SNAP recipients to double their food purchases when they shop at participating markets (Wholesome Wave Georgia, n.d.). Similar initiatives have been shown to result in improvements in fruit and vegetable consumption among SNAP recipients (Zimmerman, Roskos, Feller, & Durward, 2016).

However, initiatives to increase the affordability of products sold at the market may be insufficient methods of attracting SNAP recipients. Results from a recent systematic review suggest that low-income consumers face numerous barriers to shopping at farmers markets. Although the introduction of EBT card readers at the TLW farmers markets addresses one of the most commonly cited barriers identified by this review (i.e., the perception that SNAP benefits are not accepted at farmers markets), low-income consumers perceive many other barriers not directly related to affordability (e.g., lack of racial and/or ethnic diversity at the markets, mismatches between the farmers markets and personal lifestyles, etc.) (Freedman et al., 2016). It is possible that interventions solely focused on increasing the affordability of fresh produce may be insufficient for reaching low-income consumers; future programming should also address other components of access conceptualized by Caspi et al., including the availability, accessibility, accommodation, and acceptability of markets and their products (Caspi et al., 2012). More research is needed regarding how farmers markets can address these other dimensions of access to attract SNAP recipients as customers. Future studies should focus on documenting how SNAP customers learned about the farmers market, as well as what motivated and made it easier for them to shop at the market. These results could help inform future outreach efforts.

An important finding from this evaluation was that returning TLW farmers market customers reported improvements in both their perceived access to and consumption of fresh vegetables as a result of the markets. These results are consistent with other evaluations of farmers markets and similar initiatives in how they affect customers' dietary behavior. For example, an evaluation of two farmers markets in Los Angeles reported that 97–98% of customers agreed or strongly agreed that they eat more fruits and fresh vegetables because of the market (Ruelas, Iverson, Kiekel, & Peters, 2012). Additionally, an evaluation of a fruit and vegetable stand in Cobb County, Georgia, found that 65% of participants reported eating more vegetables, and 55% reported eating more fruit since they began shopping at the produce stand (Woodruff et al., 2016). These results suggest that farmers markets may have a positive impact on the dietary behavior of customers.

In addition to benefitting the general customer base, the introduction of EBT card readers may have benefitted SNAP recipients in particular. Although prior studies have found that implementing SNAP/EBT card readers at farmers markets is associated with increased use of farmers markets by SNAP recipients (Jones & Bhatia, 2011), increased SNAP redemption rates (Hasin et al., 2016), and market sales (Buttenheim et al., 2012; Hasin et al., 2016), these results add to the growing body of literature assessing the potential dietary impact of these initiatives on SNAP recipients. The one known prior study that evaluated the effect that introducing EBT card readers had on dietary intake found that among 1,320 SNAP recipients surveyed, 99% reported increased fruit and vegetable consumption attributable to the

introduction of the EBT card reader (Krokowski, 2016). These results suggest that introducing EBT card readers at farmers markets may be an effective way to increase fruit and vegetable consumption among SNAP recipients.

This evaluation had several limitations that are important to note. This study was primarily conducted as a quality improvement initiative for TLW; as such, our results are not intended to represent the entire TLW customer base and are not intended to be generalized to other initiatives as a way to increase access to healthy foods in other settings. We conducted a one-group, post-test–only study design with a convenience sample of market customers during the spring months of the TLW farmers market. This evaluation did not use a pre-test, but instead relied on retrospective questions asking customers to reflect on how their community food environments and their own dietary intake have changed since beginning to shop at a TLW farmers market. Although similar measures have been used in prior studies (Woodruff et al., 2016), they may have been susceptible to several forms of bias, including social desirability bias, especially given that approximately 19% of survey respondents reported that they had volunteered for, been employed by, or served on the board of TLW within the previous six months. Although a pre/post design using valid and reliable measures to assess change in key outcomes of interest would have been a stronger evaluation design, this retrospective measurement approach was most feasible given the limited resources available for this evaluation and the need to keep the survey brief. Additionally, this evaluation did not have a comparison group of shoppers who did not use the TLW farmers markets. The small sample size may have had limited power to detect statistically significant differences between customers based on receipt of SNAP benefits.

Conclusions

Despite the study's limitations, these results suggest that the TLW urban farmers markets were able to attract low-income customers, that these customers use the market regularly, and that SNAP recipients perceived that they had increased access to and consumption of fresh vegetables as a result of shopping at the market. More rigorous research is needed regarding the most effective methods of increasing access to healthy foods among low-income Americans and the potential of these initiatives to improve diet and prevent chronic disease.

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Building sustainable food systems through food hubs: Practitioner and academic perspectives

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Abstract

In this paper, we explore the current state of the food hub by discussing innovative practices supporting efforts to build healthy, equitable, and sustainable food systems. We present key insights from a roundtable discussion among scholars and

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practitioners from Australia, Canada, and the United States held during the 2017 Annual Meeting of the American Association of Geographers. Our discussion presents a food hub continuum that describes different pathways to effect change, from enhancing food supply chains to challenging the negative outcomes of the dominant food system through a social and ecological justice approach. This perspective problematizes typical descriptions of food hubs by recognizing the different goals and objectives as well as the resulting opportunities, challenges, and innovations. While we do not suggest one end of the continuum is more important than the other, we identify a series of productive tensions that emerge. Our discussion is structured around four central themes from the collaborative conversation: (1) Descriptions of food hubs; (2) Differing objectives; (3) Navigating success; and, (4) Encountering barriers. We conclude with suggestions on ways to bolster the work of foods hubs through research, policy change, and greater collaboration. This contribution is significant for bridging the overlapping yet diverging conversation between scholarship and practice to better inform food hub development.

Keywords
Academic; Food Hub; Food Movements; Food Systems; Practitioner; Social Justice; Sustainability

Introduction
Over the past decade, interest in food hubs has gained significant traction in communities and among policymakers, governments, and researchers. In 2013, the United States National Food Hub survey identified 222 food hubs (Fischer, Hamm, Pirog, Fisk, Farbman, & Kiraly, 2013), and by 2015, there were well over 400 (Hardy Hamm, Pirog, Fisk, Farbman, & Fischer, 2016).[1] In Canada, a recent survey found 187 operations identifying as food hubs in Ontario alone (Centre for Sustainable Food Systems [CSFS], 2016). This paper explores the current state of food hubs by discussing innovative practices supporting efforts to build healthy, equitable, and sustainable food systems. We present key insights from a collaborative roundtable discussion among academics and community practitioners held as part of the 2017 Annual Meeting of the American Association of Geographers (AAG) in Boston. The goal of the session was to address critical questions by putting research and theory into conversation through the experiences of those coordinating and advocating for food hubs. Reflecting on the emerging debates, this paper presents unique perspectives from scholars and practitioners at the forefront of food hub work in Australia, Canada, and the United States. While scholarly research can often be disconnected from the experiences of practitioners, food hub managers often have limited time and capacity for thoughtful reflection about their work and to consider their impact on the broader food system. Thus, the contribution of this paper is significant for bringing together overlapping and divergent perspectives from scholars and practitioners to better understand and inform food hub development.

Following a description of the processes behind the collaborative conversation hosted at the AAG as well as a description of our analytical approach, we discuss the central themes that emerged in relation to the existing academic literature. Our discussion presents a food hub continuum that describes different pathways to effect change, from enhancing food supply chains to challenging the negative outcomes of the dominant food system through a social and ecological justice approach. While the mission of particular food hubs may be aligned with one end of the continuum, they are often pulled in different directions by competing economic and social forces. This perspective problematizes typical descriptions of food hubs by recognizing the different goals and objectives as well as the resulting opportunities, challenges, and innovations. While we do not suggest one end of the continuum is more important than the other, our analysis identifies a series of

[1] The survey is conducted by the Michigan State's Center for Regional Food Systems and Wallace Center at Winrock International. Of note, while there was significant growth in the number of food hubs, this figure also reflects the successful identification of additional hubs, some of which existed before the 2013 survey.

productive tensions that emerge. We conclude with suggestions on ways to bolster the work of food hubs through research, policy change, and greater collaboration. We argue that bringing together the knowledge and experiences of both scholars and practitioners can make an important contribution to understanding factors that contribute to a food hub's impact. This paper, and the roundtable from which it emerged, bring these different perspectives into conversation to better understand ways in which academic research can contribute to addressing food hub challenges, in which practitioners can lend insights to gaps in the literature, and in which new avenues for academic-practitioner collaboration can be identified.

Methods

To interrogate the developments, opportunities and challenges surrounding food hubs, Charles Levkoe and Colleen Hammelman organized a session at the AAG that brought together practitioners and researchers involved with food hubs in Australia, Canada, and the United States. The session was convened in response to a recognition among members of the AAG's Geographies of Food and Agriculture Specialty Group (GFASG) of the growing importance of food hubs and emerging questions surrounding their current and future functions. To determine the composition of the panel, we contacted GFASG members to identify individuals and organizations that were leaders in the field and could speak to food hubs both from scholarly and applied perspectives. Considering the many recommendations, we selected national leaders (such as Jeff Farbman), those involved in sustained and engaged research (such as Phil Mount and Luke Craven), and those actively coordinating innovative and well-respected food hubs (such as James Harrison and Gavin Dandy). We also attempted to strike a balance in representation between academics and practitioners.

Prior to the roundtable discussion, the group met virtually to discuss the major issues that would be addressed in the session. The organizers asked the panelists to draw on their experiences when considering the challenges of expanding their work as well as the resources, policy changes, and research that could help to overcome prevailing challenges. Each participant was asked to prepare a short presentation that considered the following key questions: How are food hubs addressing structural challenges in the food system? What resources, research, and policy changes are needed to support the further development of these models? During the session, each participant presented their initial responses to these questions before the floor was opened to comments and questions from members of the audience.[2]

The roundtable discussion was recorded and transcribed verbatim. Levkoe and Hammelman individually reviewed the transcript to identify dominant themes emerging from the discussion. Accordingly, the transcripts were coded and organized into a coherent outline and written into a draft manuscript. The remaining authors (all panelists in the session) provided editorial feedback on the draft. The resulting structure of the paper is based on the conversations that took place during the discussion and presented as a series of direct quotes and a synthesized analysis. Throughout the text, we describe emerging tensions by articulating the work of food hubs through a continuum that describes different pathways to effect change, from enhancing food supply chains to challenging the negative outcomes of the dominant food system through a social and ecological justice approach. In this paper, we present insights from the collaborative conversation through four key themes: (1) Descriptions of food hubs; (2) differing objectives; (3) navigating success; and (4) encountering barriers. In order to highlight the various contributions made to the conversation, we rely on a series of direct quotes from the panelists. Doing so provides their perspectives without unnecessary academic interpretation. We believe this approach preserves the valuable insights that emerged from engaging the relationship between the scholarly literature and the experiences of practitioners.

[2] The 100-minute session, titled "Food hubs building sustainable communities: Activist-scholar roundtable," was open to all conference attendees and promoted by the GFASG. Approximately 50 people attended the roundtable presentation and participated in the ensuing discussion.

Through our analysis, we integrate these insights to highlight points of cohesion, gaps, and avenues for future collaboration.

I. Descriptions of Food Hubs

The most widely accepted definition of a food hub comes from the U.S. Department of Agriculture which describes them as "a business or organization that actively manages the aggregation, distribution, and marketing of source-identified food products primarily from local and regional producers to strengthen their ability to satisfy wholesale, retail, and institutional demand" (Barham, Tropp, Enterline, Farbman, Fisk, & Kiraly, 2012, p. 4). While many food hubs responding to a specific lack of infrastructure would likely recognize themselves in this definition, many others explicitly aim to address a much broader range of social, economic, and ecological concerns. These include ensuring access to culturally appropriate and healthy food, fostering local decision-making power, keeping money within the community, providing good jobs, and encouraging ecological sensitive production practices. Incorporating these kinds of goals and objectives, Blay-Palmer, Landman, Knezevic, and Hayhurst (2013) describe food hubs more broadly as, "networks and intersections of grassroots, community-based organizations and individuals that work together to build increasingly socially just, economically robust, and ecologically sound food systems that connect farmers with consumers as directly as possible" (p. 524). At the core of this description is the idea that while there are key elements within the food supply chain that most food hubs are responding to, many address issues that go well beyond food. The roundtable discussion added further insight by making it clear that no single definition could fit all food hubs. Instead, the different goals and objectives exist on a continuum that describes different pathways to change, from enhancing food supply chains to challenging the negative outcomes of the dominant food system through a social and ecological justice approach. For example, one of the participants proposed a food hub definition that fit much more closely with a focus on supply chains, while another pointed to shifts towards a much broader range of functions.

Farbman: At the Wallace Centre at Winrock International (http://www.wallacecenter.org), our definition of a food hub follows the USDA's definition which is quite business-oriented. For us, a food hub is an aggregator, distributor, and marketer of primarily local food with the intention of scaling up markets. That can range from institutional markets to working with larger food box programs. The archetypical hub might have a warehouse, a few box trucks, approximately 40 farmers and/or suppliers, and a similar number of wholesale buyers, as well as a means for selling directly to consumers (e.g., a CSA-style box program, a buying club, etc.). There might be a couple of warehouse staff, some drivers, a small sales team, and a small purchasing team (though sometimes "team" is less than a single full-time equivalent staff).

Mount: We have been doing research on food hubs in Ontario for over a decade now. The description of what a food hub is has changed a lot over that time, so it might be better to think of the definition as a moving target. The definition that we used for our food hub research also reflects the USDA definition. Our working definition was, "Food hubs are actual or virtual places through which food is collected and resold to processors, retailers, or restaurants. Food hubs can also provide space for other food-related activities, including food preparation, handling and/or processing." Unlike traditional businesses models, the work of a food hub often moves beyond a straightforward link in the supply chain. Food hubs are complex beasts and often do more than just aggregate and distribute food.

Three of the roundtable participants discussed food hubs' explicit intentions of systems change and the fluidity with which they fit onto the continuum.

Farbman: Rich Pirog of the Center for Regional Food Systems at Michigan State University is quoted as saying, "you've seen

one food hub, you've seen one food hub." This idea emphasizes the wide diversity of food hub models.

Craven: From my experience in Australia, a food hub is about a range of issues and activities and not always primarily about food. This might include food access for lower-income people, social justice, and a series of collaborative processes that draws various initiatives together with and through food hubs.

Dandy: The two food hubs I coordinate, Everdale and The Seed, share a number of characteristics of the various definitions presented already. They focus on the aggregation, storage, processing, distribution, and/or marketing of locally or regionally produced food products along with community development and building healthy, equitable, and sustainable food systems. Everdale's urban and rural teaching farms and The Seed's multi-location hub project are hybrids, combining different ingredients of the food hub archetypes into a unique local recipe. They reflect the cultural and demographic subtleties and particular resources of the communities they serve. They also express the personalities and convictions of their staff and volunteers. As such, no two food hubs are alike—and this is as it should be. Embracing diversity is the key to success.

These perspectives fit closely with the work of Berti and Mulligan (2016) who addressed these differing definitions in their review of the food hub literature. The practitioner perspectives from the roundtable add to that discussion by highlighting the fluidity between the definitions and the corresponding tensions that can exist within a single food hub. As Dandy pointed out above, the particular definition a food hub aligns with is not always clear. Many food hubs align themselves with different definitions at different times in their development, and their activities and orientations may shift along the continuum in a fluid manner. These perspectives are emblematic of debates in the literature that have pushed for more expansive food hub definitions. This includes viewing food hubs as an integral part of networks that strive for food security, food justice, and food sovereignty via direct connections between producers and eaters, working more closely with natural systems, and advocating for democratic decision-making power in food systems. Figure 1 provides illustrative descriptions of these diverse efforts.

These examples present the range of food hub goals and objectives, from the supply chain–focused Red Tomato to the social and ecological

Figure 1. Some Examples of Innovative Food Hubs Described by Roundtable Panelists

Red Tomato, Plainville, MA, http://www.redtomato.org/

Farbman:
Red Tomato is a food hub with no warehouse and no trucks. However, the hub still actively manages the aggregation, distribution, and marketing of local products along with the sales. It's a type of "brokering plus," because they are doing far more than just making connections, they are supporting the whole partnership process to ensure food gets to where it needs to be.

FoodShare, Toronto, ON, http://www.foodshare.net

Mount:
We are involved with a food hub run by FoodShare, a large not-for-profit social enterprise that operates the Good Food Warehouse. In partnership with agencies across the city, FoodShare runs a series of food programs that delivers 30,000 boxes with over 670lbs of fresh produce to 100 drop-off points across the city. Through facilitating regional food distribution, FoodShare offers an economy of scale, efficiencies in cost savings, support for local business, local economic development. Through their programs, they increase access to fresh local food and to food system knowledge. This includes programming in student nutrition, food justice, facilitating community gardens, composting, mobile markets in low income neighborhoods, school-based programing, growing food on rooftops and school yards, and baby and toddler nutrition, to name just a few.

continued

Two Rivers Food Hub, Smith Falls, ON, http://www.tworiversfoodhub.com

Mount:
Two Rivers is a not-for-profit social enterprise with a mission to increase markets for local farms. This is a more conventional model of a small regional aggregator and distributor that emerged when a regional health care facility was abandoned by the government in 2008. Two Rivers had access to a large commercial scale kitchen and equipment for processing excess produce. With aggregate product from small local growers, they developed a food basket and added beef from a local co-op that needed marketing support. Two Rivers has an online market and delivers to various depots across the region.

Everdale's Hillsburgh Community Farm, Hillsburgh, ON, http://www.everdale.org

Dandy:
Located in a relatively prosperous, rural community just northwest of Toronto, Hillsburgh Community Farm is a very productive not-for-profit operation that grows, buys, and distributes a large volume of fresh food, and offers a well-crafted menu of food skills programs that focus mainly on training new agroecological farmers and teaching food literacy skills to youth.

Black Creek Community Farm, Toronto, ON, http://www.blackcreekfarm.ca

Dandy:
Located in one of Toronto's lowest income and most racialized neighborhoods, Black Creek Community Farm is a seven-acre farm nestled between high-rise apartment buildings, public housing units, York University's main campus, and a newly constructed extension of the subway system. It is focused on maximizing food production, but it has a much sharper focus on food justice, the sharing of multi-cultural food skills, and community governance.

The SEED, Guelph, ON, http://www.theseedguelph.ca

Dandy:
The SEED is an innovative food hub without a physical location. Its programs and services—mainly focused on fresh food access and food skills for people experiencing food insecurity—are delivered in several locations. As such these programs tend to reflect the unique qualities of the neighborhoods where they are located. For example, Guelph Youth Farm (a project of The SEED and Everdale) is located in the Onward Willow neighborhood, identified by Public Health as one of the four priority neighborhoods in Guelph. The farm is run by and for low income youth and has a food justice focus.

The Food Project, Boston, MA, http://www.thefoodproject.org

Harrison:
Twenty-six years ago, The Food Project emerged from a friendship between an African-American Minister and a white farmer with a vision of bringing young people together across class, race, and geographic difference to grow fresh healthy food. Its mission is to create a thoughtful and productive community of youth and adults from diverse backgrounds to build equitable and sustainable food systems. This includes hiring over 120 teenagers every year and building teams of young people that are representative of the regional communities. We farm on over 70 acres of land in Boston and the surrounding area and grow about 250,00lbs of food annually. One major success has been a direct farm-to-consumer matching program that began in 2005 when we got one of the first wireless terminals at our farmer's market that could accept SNAP benefits.[3] After the first year, we were disappointed by the volume of sales and wanted to find a way of making local food more accessible and affordable for SNAP recipients. To make this work for low-income residents, we created a demand-side subsidy in the form of a dollar-for-dollar match when people used SNAP benefits at the farmer's market. It was great for our farmers and customers because it added these additional dollars into the local economy. We scaled this out to become the Boston Bounty Bucks program which is now operating at twenty-three farmers markets and funded by the City of Boston. From there, we developed partnerships in other states, and now there is US$100 million in funding around the country provided by the last Farm Bill. We have also developed partnerships with community development agencies, a nonprofit food processor, and early education centers.

justice orientation of the Food Project (and many in between). These varying types of food hubs fit within different parts of the continuum, and the differences between them are important to articulate and reflect on. Where a food hub falls along the continuum and how that matches stakeholder definitions has implications for the outcomes expected of specific operations. When

[3] The Supplemental Nutrition Assistance Program (SNAP) is part of a government program that offers nutrition assistance to eligible, low-income individuals and families and provides economic benefits to communities (see http://www.fns.usda.gov/snap/supplemental-nutrition-assistance-program-snap).

investors, policymakers, and other stakeholders measure the success of food hubs, the criteria of a business-focused, supply chain-oriented food hub may be different than one primarily focused on social and ecological justice. Accordingly, the next section describes the differing objectives that arise in response to food hub types and stakeholder expectations.

II. Differing Objectives

A growing body of literature has explored the various contexts in which food hubs arise which often follows from differing objectives (Azzarello et al., 2012; Barham et al., 2012; Cleveland, Müller, Tranovich, Mazaroli, & Hinson, 2014; Horst, Ringstrom, Tyman, Ward, Werner, & Born, 2011; Rimal, Muzinic, Onyango, & Duitsman, 2016; Stevenson, Clancy, King, Lev, Ostrom, 2011). Food hubs tend to emerge from a regional context to meet the needs of a specific group of people rooted to a particular place. In most cases, they are based on a general desire to contest the dictates of the corporate, industrial food system and create collective solutions that meet one or more specific needs (Berti & Mulligan, 2016; Perrett & Jackson, 2016; Stroink & Nelson, 2013). Many have physical locations where food is aggregated, processed and/or distributed, while others use internet technology to connect members. Food hubs can range in scale and often operate within both mainstream and alternative markets (Cleveland et al., 2014; Knigge, Brimlow, & Metcalf, 2016).

Differing food hub orientations toward enhancing the supply chain or challenging the negative outcomes of the dominant food system through a social and ecological justice approach were particularly evident in the conversation on the objectives of specific models and the work more generally. This discussion builds on the pathways to change continuum by highlighting tensions that arise from perceiving food hubs as part of the market economy and a driver of economic development or as agents of social justice and ecological sustainability. For example, Farbman saw food hubs as an opportunity for responsible economic development:

> At the Wallace Centre, we are interested in market-based solutions to increasing the supply of what we call "good food," that is healthy, fair, affordable and environmentally sound options in the food system. Our focus is on scaling-up. Local food has its limitations because there is limited supply and you can't just import new farmers. At the same time, you have limited demand because you can't import new buyers. This generates an environment conducive to a transparent business model, what we call a "values-based supply chain," where farmers can use a food hub to coordinate with the larger scale buyers so they know what to grow. It creates a virtuous cycle. I would also say a food hub is a supply chain coordinator connecting supply and demand, plus infrastructure, plus investment in building relationships.

Farbman also reported on economic objectives alongside food system change goals. He discussed a National Food Hub survey that found that 75% of food hubs have operating expenses that are less than or equal to their gross revenue (i.e., breaking even or better). The survey also reported that "mission-based goals" (e.g., social justice and community development) were increasing. He argued, "Food hubs are adding revenue year-over-year, and new hubs are springing up all over the place, so growth is strong."

Scholars and practitioners have argued for the need to better understand the economic performance of food hubs (Farm Credit East, Wallace Center at Winrock International, Morse Marketing Connections, and Farm Council, 2015; Hardy et al., 2016; Jablonski, Schmit, & Kay, 2016; Schmit & Jablonski, 2017). For example, Hardy et al. (2016) found that three-quarters of food hubs in a US National Food Hub survey were breaking even or better. However, Farm Credit East, Wallace Center at Winrock International, Morse Marketing Connections, and Farm Council (2015) argued that food hubs could perform even better with increased efficiency. These economic goals are critical for sustaining many food hubs.

Alternatively, other roundtable panelists named social and ecological justice at the core of their food hub work.

Mount: From our survey in Ontario, we found that food hubs were highly motivated to support sustainable food systems. More than 80% of respondents prioritized responsible, sustainable production practices and where products were grown. Further, more than 60% identified social justice as a priority over profitability.

Harrison: Despite being progressive, Boston still struggles with being a very racially segregated city. The Food Project's founders saw working with youth as a starting point for breaking down barriers. Growing and distributing food is a way to bring people together across class and race differences. We can't have systems change if people aren't talking to each other and aren't in relationship.

Dandy: For both Everdale and The Seed, the main priority is food justice. Food production is the foundation of all of our food hubs. Our community farms generate income, create employment, stimulate leadership, and galvanize community learning and engagement. We believe that the current global food system is deeply flawed, but we also believe that it is essential that to work within this system. We love the social enterprise model for our farms. It stimulates food justice and creates a financially sustainable foundation for our work. Farm profits go back into our food justice programs and services. Moreover, the social and employment benefits of these social enterprises become outcomes in themselves. To achieve maximum benefit, it is essential that each social enterprise is run by and for the people it serves. Empowerment of disempowered people is the biggest "profit" of our social enterprises.

Our food hubs are financially viable in large part because of revenue from our social enterprise farms. However, the reality is that our food hubs are constantly facing financial challenges as we work inside the misaligned economic fundamentals. We are continually re-evaluating our business plan and questioning how well we are balancing social goals with financial needs. It is a complex problem with many moving parts. We believe that sustainability comes from pursuing a mixture of revenue sources: farm sales income, program fees (where practical), grants from public sources, support from private foundations, corporate sponsorships, fundraisers, and a solid base of private donors. These financial tensions do not mean that a food hub's financial and social goals and objectives are contradictory. In many ways, these tensions propel our work forward.

These examples point to the multiple objectives and resulting tensions that exist within individual food hubs. Several panelists discussed the ways that economic and social forces pushed and pulled them between challenging the negative outcomes of the dominant food system and needing to compete economically with other food chain actors. This salient challenge of finding ways to develop local, grassroots alternatives to the industrial food system that address social and environmental concerns while remaining economically viable has also been raised in the literature on food hubs (see for example, Ballamingie & Walker, 2013; Blay-Palmer, Landman, Knezevic, & Hayhurst, 2013; Cleveland et al., 2014; LeBlanc, Conner, McRae, & Darby, 2014). In this literature, some scholars have questioned the ability of food hubs to meet food-system-change goals. Perrett and Jackson (2016) argue that food hubs are important for linking local food and mainstream markets, but they "alone cannot challenge industry norms and practices, and they can even aid the food industry in maintaining the status quo" (p. 2).

The panel participants provided nuance to this discussion, highlighting the various stakeholders (such as business owners and funding agencies) that contribute to these tensions when they work under competing visions of what a food hub should be.

Harrison: Business owners are telling us to stop giving away free food and to stop creating these models that work around the existing market. They are asking us to get good food into the businesses and help create

economic development and activity in the neighborhood through food. We support that idea and are really trying to work that tension. The challenge is that the dominant economy has put so much downward price pressure on farmers that they can't sell for any less, and if our communities can't afford good food at that price point, we have a problem.

Craven: When you have someone working in a low-income community for whom the food hub is about access and social justice coming together with the chamber of commerce that is interested in the food hub as an economic development strategy, they often but heads. For example, the city of Sydney recently committed to establish a food incubator for low-income communities because they see it as a project of economic development and entrepreneurship. They're not interested in a food hub *per se*, but they are interested in using underutilized community space and commercial kitchens as a way to provide economic opportunities for underserved communities. Thus, it became a beneficial project for the City but also for the many food systems advocates that had not gained much traction in their efforts to build better infrastructure.

Mount: Food hubs are a complex beast and the more complex they get, the more they demand collaboration of multiple actors with competing priorities. In Ontario, we have seen food hubs with competing interests that pull in different directions even where they share broad objectives like social justice and food access. Those tensions are most often amplified by the difficulties of funding agencies that also pull food hubs in different directions.

Farbman offered a potential strategy for working through these competing objectives. He suggested a financial separation of the nonprofit (e.g., increasing access to underserved populations, training farmers in market readiness, creating new sustainable growing protocols) and business aspects (e.g., aggregating, distributing, and marketing food—the trucks, the sales staff, the electric bill, etc.) of a food hub. He argued, "It makes a lot of sense to tease out these pieces - it makes the business look and perform better (e.g., in the eyes of a lender) but recognizes that the food system isn't going to fix itself. This separation also benefits the nonprofit funders. Their philanthropy can be fully directed to the social projects instead of buying a warehouse and trucks."

These examples provide important insight into the tensions that exist along the continuum, but also ways that food hubs might pursue both economic and social justice objectives. The food hub practitioners expressed struggles relating to these tensions, which are also identified in the literature. The panelists also offered a variety of strategies for addressing these tensions and sustaining their work, which are taken up in the next section.

III. Navigating Success

Participants described several strategies for navigating the competing demands described above. These practical experiences provide important insights into challenges of food hub work identified in the literature. Ballamingie and Walker (2013) describe a specific food hub's efforts toward building social and economic relations that are constrained by the logic of the neoliberal market. Similarly, the panel discussed these kinds of constraints, but also provided several practical examples of viable solutions. This is also important for moving beyond individual cases explored in the scholarly literature (e.g., Azzarello et al., 2012; Cleveland et al., 2014; Horst et al., 2011; among others) to understand commonalities in achieving success. Key strategies discussed by the panel participants included the need to be creative, flexible, and innovative; emphasizing the positive impacts provided by food hubs; building collaboration; and, aligning food hubs with alternative food networks and social movements. Many of these strategies are interwoven and were discussed through a variety of examples.

Mount pointed out that multiple examples of successful food hubs were rooted in an ability of proponents to be flexible and innovative:

> The key to success is that food hubs have the ability to be persistently creative. They find workarounds to limited funding with a social enterprise approach that maximizes available program funds. They integrate work across the food chain, and they build and expand gradually, but also build relationships across different sectors by engaging with different communities.

This sentiment was also expressed by other participants who described innovative models for addressing the infrastructure, distribution, and marketing needs critical for the success of food hubs, but for which it is difficult to garner funding.

> Farbman: There's an interesting and growing model of infrastructure-poor food hubs that are finding creative ways to succeed. Even though they move their food around on other people's trucks, they own the product, so they have buy-in. This idea of developing food ports is almost like a city-planning model where you have a hub that is at the core of a large number of congregated sets of businesses. Because you have an aggregator or distributor of food that's at the core of the model, the local food processors or sellers can take advantage of that and develop additional efficiencies.

> Harrison: In Massachusetts, we have developed a flexible system to establish incentive programs and supplemental benefits that help close the gaps between low-income communities and farms. If you are working in a food desert where there are few retailers, you could use the technology to create incentives to increase the value of food assistance. It's really interesting to think about food security from that perspective—what is required to make local food affordable may not be a dollar-per-dollar match of benefits. It may be much less than this and could vary based on consumer need, supply, and demand. What might be called a discount or incentive for SNAP beneficiaries, the rest of the world just calls a sale. There is a lot of opportunity to use technology to help create economic development by selling fresh and healthy food if we use government programs efficiently, creatively, and responsibly.

> Dandy: The social enterprise of our community farms is vital to our success. Everdale and The Seed have been able to access funding through business grants because we are presenting a business model that is attractive to funders. In this way, we raise capital and operational dollars for a fresh food aggregation and distribution warehouse that serves community members experiencing food insecurity. We were also able to attract about CAN$2 million in social investment to start Black Creek Community Farm in large part because of its social enterprise format and food justice goals.

In fostering this flexibility, the panelists also discussed circumstances where food hubs would focus less on food and more on the other features and outcomes of the work. Craven described this is as becoming a "food hub by stealth," whereby:

> Local farmers who are interested in selling to a food incubator are connected, which is mainly about value-added products. For example, there are a lot of seconds that could go into jams, chutneys, and other things like that. Over time, that will become a box program and be able to fulfill some of the roles that a normal food hub would do. A lot of people across Australia are asking: How do we get a food hub without having a food hub? Nationally, we have recognized that you can't just ask local government for a food hub. They're going to say that it is far too difficult and that they don't have the money or that they can't license you.

Other panelists also discussed the importance of looking beyond food in order to create successful food hubs:

> Farbman: If you are going to create a good food system, you need sufficient

infrastructure. You need to have aggregation, distribution, and marketing. Funders are interested in all sorts of different things, whether it's food access for under-served communities or economic development or positive environmental impacts. They understand that this kind of unsexy middle part is important. Usually, food hubs that are doing well have access to a large market, rather than have access to a large amount of supply. If the local government is saying it is able to make a long-term commitment (perhaps investing in a food system for twenty years), they might say we're going to build this food hub that's never going to be profitable, but we're going to keep it around because it raises quality of life or economic development for the farmers.

Harrison: What often prevents progress is a failure of policy. How do we create legislation that clears obstacles and barriers for school food service directors looking for fresh, high-quality food and small-scale farmers looking for new markets? Working on these problems on the ground and making it clear to government what is standing in the way of systems change is critical.

The participants also emphasized the importance of collaboration for accessing a variety of resources.

Farbman: I want to emphasize an approach that focuses on the networking of resources—a supply chain coordinator. This could be a person or an organization who facilitates good food in a particular area. This role might include being a market matchmaker or broker, a convener or relationship builder, a resource prospector (suggesting new directions and/or resource opportunities), a policy thought-leader, a technical assistance provider, or a catalyst.

Beyond collaboration with other food hubs, several participants and audience members discussed the importance of doing this work in collaboration with broader food movement networks.

Mount: There are a significant number of food systems network organizations, and in the Canadian context we also see regional groups being developed to support food hubs. For example, Just Food Ottawa is a food systems organization that does many things—from the very practical, like the operation of a food hub, to food policy conversations at the municipal level. I'm a board member of Sustain Ontario which is a provincial food systems organization. Further, we are a member of Food Secure Canada, a national food movement organization. These networks enable us to share our work more broadly and have food policy conversations based on our local experiences at all different levels.

Craven: The Open Food Network is an international not-for-profit group that does online infrastructure for food hubs and the food movement. A key gap that networks like this fill is creating a community of practice for food hubs and building capacity to share knowledge around what works and what doesn't.

Mount: I think this is one of the places that academia can step in because most on-the-ground actors in food systems have our hands full. Reaching out and making connections with people who are doing similar things elsewhere is not something we have the capacity to take on. But academics can often find ways to bring people together and have these conversations.

This discussion of practical strategies for success provides insights into the current work of several food hubs, from overcoming constraints to sustaining their work. It also provides insight into certain tensions resulting from the different goals and objectives on the food hub continuum. In doing so, it adds to both the practice of food hubs and to scholarly literature that has focused on challenges faced in different case studies.

IV. Encountering Barriers

While food hubs have garnered much success, they also face a range of challenges. Several studies have addressed constraints related to logistics and competition with traditional food businesses (Barham et al., 2012; Diamond & Barham, 2011; Matson, Thayer, & Shaw, 2015; Stevenson, Clancy, King, Lev, Ostrom, & Smith, 2011); reliance on external funding (LeBlanc et al., 2014; Rysin & Dunning, 2016); and obstacles to building collaboration across communities with different identities and priorities (Mount et al., 2013). Similarly, panelists discussed the role of food hubs in addressing tensions but also breaking down barriers encountered in establishing and sustaining them. They highlighted key challenges to sustaining the range of food hub work at both institutional and community levels, including obstacles to competing with other food businesses, supporting existing resources, and expanding production to meet stakeholder expectations. In describing these impediments, the panelists reinforce existing studies that question the ability of food hubs to challenge mainstream logics (e.g., Cleveland, Müller, Tranovich, Mazaroli, & Hinson, 2014), but they also identify challenges that exist within the movement itself. Craven noted that the future of food hubs is uncertain because of the disproportionate power of large food retail outlets:

> I think food hubs in Australia work really well. But, I am concerned because I don't think they have a very sustainable future. For example, New South Wales is going through a planning reform process, and it's going to disproportionately value larger food retail outlets in ongoing planning decisions. In this form of urban regeneration, small vendor options will be severely limited. In Australia, we have a heavily corporatized food system, and that means that it's very difficult for small-scale producers and small farmers, but also for new models that are trying to do innovative things to get a start. That is because the major players are in cahoots with the regulators. If you want to get food safety buy-in and have your retail license to sell food, it costs. Those start-up costs are a huge put-off to a lot of people entering the space. Additionally, the regulatory space makes it hard for food hubs to get access to any of the market share. We have a lot of sexy, well-designed feasibility studies about food hubs but very few actual food hubs.

> Farbman: There's not so much hub-to-hub competition. It's really competing with the establishment that presents the biggest challenge. What happens when consumers are less willing to pay the extra that it takes to deal with the inefficiencies that smaller scale operations have? At this point, there's a limited audience but maybe if there are government regulations that take into account the externalities of conventional meat, produce, and commodities, that would help. Then you wouldn't even need to work with the consumer because that potato chip is not going to be the cheapest thing on the shelf anymore.
>
> Moreover, food hubs tend to rely on a significant amount of volunteer work. What happens when it's less hip? Even people who are paid workers need to have competitive rates for pay. There is a growth of the field but also as hubs are two, five, and ten years old, the buyers are going to be less willing to put up with what appears to be amateur service and mistakes. The mainstream establishment is very good, very efficient, quality is spot on, and when you have some of the farms that hubs work with that are new to the wholesale markets, quality can suffer. The zucchini is a little too long or a little too short, these sorts of things. That tolerance is going to get lower.

Another barrier discussed by panelists was the flow of resources from stakeholders into innovations instead of supporting existing successful projects. While roundtable speakers recognized the need to be constantly creative (as discussed in section III), they also seek more support for initiatives that are succeeding.

> Harrison: We've got these incredible food hubs in neighborhoods. How are we

> supporting them? That's one practical thing that I see government missing over and over again—not supporting existing businesses and people that are doing well.

> Mount: Many food hubs are overly dependent on funders. They are put in a difficult position of always having to chase the shiny new thing. They get pressure to do something completely different instead of working with people who are already trying to solve the problems and adequately address the issues.

> Craven: In Australia, there has been almost no philanthropic funding for things that have been established more than five years. It is also about constantly chasing that shiny new thing. It always has to be innovative if you're going to get some kind of philanthropic buy-in.

The panelists also discussed challenges to scaling up in order to meet the economic expectations of various stakeholders.

> Mount: Removing barriers for producers could substantially increase production. Our research found that there is a huge appetite for growth amongst farmers for access to regional food hubs if they can be developed in a way that can service the farmers' needs. The top impediments to expansion across all food hub respondents are connecting to buyers. Further, they struggle with financing expansion, increased production, and trying to work with large buyers. On this latter point, the expectations of certification from large buyers, delivery demands, minimum order requirements, and product consistency put up major barriers. Typically, food hubs are playing the role of not-for-profits that are being ignored by the market.

The comments from the panelists reinforced many of the sentiments from existing food hub literature in discussing barriers to competing with mainstream agricultural producers. They also add new insights to highlight challenges within the sector that are driven by stakeholder expectations of constant innovation and economic expansion.

Conclusion

This paper has brought together the voices of both scholars and practitioners in order to share the results of sustained food hub research with the practical experiences of food hub operations and advocacy. The aim was to enrich our understandings of food hub initiatives along with the further development of the field. In particular, we have discussed key insights that relate to different descriptions of food hubs, differing objectives, navigating success, and encountering barriers. To frame this discussion, we identified a continuum that describes different pathways to effect change (from enhancing food supply chains to challenging the negative outcomes of the dominant food system through a social and ecological justice approach). This discussion highlights the tensions that emerge between and within food hubs and the mainstream food system. Indeed, these tensions are often productive, helping food hubs to see new ways of *being* food hubs. In conclusion, we discuss three key opportunities for moving forward in support of food hub innovations and challenges identified by the panelists.

One of the key lessons from the roundtable discussion with implications for the future of food hubs is the role of technology. The use of open-source technology (e.g., Open Food Network) points to a common issue that food hubs struggled with: complex logistics and accounting systems that can accommodate the diverse needs and capacities of suppliers and consumers. Some literature (Berti & Mulligan, 2016; Barham et al., 2012) has pointed to the importance of technology for the development of robust food hubs, yet many have struggled to adapt these systems to their own needs. As such, a commons-based peer production platform for hub technology has the potential to provide adaptable solutions that build on previous experiences shared by others, without having to repeat the same mistakes.

Another key lesson relates to the need to fund the social and community-based services provided by food hubs. The idea of a supply chain coordinator captures the many functions performed by

those who facilitate food hub work—particularly those functions that go beyond the tasks required for day-to-day operation. These functions, including matchmaker, educator, relationship-builder, policy thought-leader, and catalyst, are not easily reflected on a balance sheet. Investment in these functions will produce long-term economic and community development benefits. Academics and practitioners working together must find a way to clearly communicate the value of investment in the many functions performed by supply chain coordinators. This also illustrates the importance of understanding the differing goals of food hubs, their fluidity along the continuum, and the need for further research and greater collaboration among researchers and practitioners so as to support investment in the various economic and social justice goals of the field.

Finally, scholars can make valuable contributions to this work by facilitating connections and research. Matson and Thayer (2013) suggested that as recently as five years ago there was little research on food hubs. While that research has grown dramatically alongside the expansion of the field, many important areas for future research were identified during the panel discussion. These included the need to better understand primary drivers for food hubs, food hub viability and scale, food safety, food hub responses to market signals, and the effects on community revitalization. The success of the Food Project's Bounty Bucks program demonstrates the critical role governments can play in dealing with the seemingly intractable problem of providing healthy food to low-income populations within a larger industrial food system. This is an example of a role for academics to play in gathering the necessary evidence to make a case for government support by presenting healthy diets as an investment in healthcare, educational outcomes, and community well-being. Academics and practitioners alike can work together to convey the interconnected nature of these problems and solutions to policy-makers. Another critical area of further research is around food systems as economic development. These include quantitative studies (e.g., exploring job creation, economic multipliers of a local food system, increases in farm viability) and qualitative measures related both to the attractiveness of the area for non-geographically bound operations (e.g., technology) and to the impacts of a thriving local food system on quality of life.

The discussions presented in this paper have touched on a range of topics and demonstrate the importance of hosting these kinds of collaborative conversations between academic researchers and practitioners in order to share experiences and critically reflect on scholarly literature.

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Three-year case study of national organizations participating in a nutrition cohort: A unique funder-initiated learning collaborative

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Abstract

Improving food access is a complex challenge, and a broad range of U.S. nonprofit organizations are working to create positive change. In an attempt to amplify the impact of a single organization, foundations have begun funding collaboratives of multiple, high-achieving organizations. This three-year case study documents the successes, challenges, and recommendations of the funder-initiated but grantee-driven Nutrition Cohort. The Cohort, initiated and funded by a foundation, includes six nutrition-focused member organizations, and was evaluated by a university partner (Tufts University). Study data from three annual waves of collection

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were triangulated using (1) key informant interviews with Cohort members and Foundation staff, (2) a survey of Cohort members, and (3) review of documents about or created by Cohort organizations. Over the study period the primary reported success of the Cohort was its commitment to work together as a "learning collaborative." Crucial changes over the study period included enhanced trust and relationship building and promising shifts in perceptions surrounding the necessity of meeting attendance. This study also highlights additional benefits of the Cohort's formation and growth across the three-year period, including organizational capacity building, improved fundraising strategies, and enhanced community impact. Study findings have implications for the practice of food systems development and may provide guidance for other foundations interested in starting similar collaboratives.

Keywords
Nonprofit Organization; Learning Collaborative; Nutrition Education; Food Access; Grantee-Driven; Case Study

Introduction and Literature Review
Foundations represent prominent sources of funding for enhancing the development and expansion of nonprofit organizations (Grønbjerg, Martell, & Paarlberg, 2000). In an attempt to strengthen the impact of single organizations, foundations across the U.S. have begun funding "collaboratives" of high-achieving organizations that have a shared vision or common goals. For example, foundations will connect organizations in a specific sector and treat them as an "investment cluster," with the goal of encouraging synergy among grantees (Braverman, Constantine, & Slater, 2004).

Funder-initiated collaboratives can vary in terms of the foundation's expectations for grantee commitment, accountability, and reporting (Chaidez-Gutierrez & Fischer, 2013; Fairfield & Wing, 2008). For example, the Robert Wood Johnson Foundation convenes over 120 representatives from national nonprofit organizations annually for a three-day Culture of Health Partners Workshop to encourage "in-depth exchange, engagement, and action" (Robert Wood Johnson Foundation, 2016). Other foundations have utilized collaborative strategies to bolster grantees' capacity to meet foundation expectations (Wade, Kallemeyn, Ensminger, Baltman, & Rempert, 2016). For example, the Robert R. McCormick Foundation formed and funded an evaluation learning community in which grantees shared ideas regarding dashboard tools and reporting systems, ultimately reporting a sense of community during the process (Wade et al., 2016). Other strategies include "innovation platforms," commonly used in agricultural research, which allow stakeholders, often with different backgrounds, to engage in learning and to work collaboratively to solve common problems in their field (Nederlof, Wongtschowski, & van der Lee, 2011; Pali & Swaans, 2013).

Foundations have also attempted to implement a "collective impact" model, whereby multiple organizations or entities embrace a common agenda, but this can be challenging given the importance of the grantees initiating this agenda and then cultivating a working relationship over time (Kania, Hanleybrown, & Splansky Juster, 2014). A successful example in the food systems area is food policy councils, which can provide a supportive conduit for nonprofit organizations to broaden their food access initiatives (Santo, Yong, & Palmer, 2014). The importance of dedicating sufficient time when working with multiple organizations can be overlooked by funders, so there needs to be a greater level of early grantee involvement if the goal is to achieve large-scale social change (Easterling, 2013).

While there is versatility in funder-driven collaborative models, there exists as well a deficit of empirical literature to demonstrate how foundations can successfully form collaboratives and effectively support their grantees through this structure. In this paper, we explore the case of a three-year funder-initiated, grantee-driven collaborative, the Nutrition Cohort (hereafter referred to as the Cohort).

Formation of the Nutrition Cohort
Throughout the U.S., food access and nutrition education have become central to the work of many food-oriented nonprofit organizations, with

efforts ranging from school gardens to farmers' market incentives for purchasing fruits and vegetables (Anderson, 2013; Kobayashi, Tyson, & Abi-Nader, 2010). In 2012, an independent, private foundation (hereafter referred to as the Foundation) with a core focus in nutrition provided two-year grants to support 42 organizations in the domains of food access and nutrition education in low-income communities. During the first round of awards, it became evident to Foundation personnel that a cluster of six organizations were similar in their mission, vision, leadership, scope, and reach. They were small to mid-sized organizations that were highly innovative and influential in these domains.

In 2014, the Foundation provided funds to a cluster of six food-oriented nonprofit organizations that collectively have a national scope (Table 1). These organizations focus on food access (n=3: FA1, FA2, FA3) and nutrition education (n=3: NE1, NE2, NE3), and were chosen in part because they were at a similar stage of organizational growth. Using a unique approach, the Foundation paired three years of capacity-building funding for each grantee with a request to participate in the Cohort collaboration. The chief executive officers/executive directors for each organization served as the primary members of the Cohort.

At the inception of the first year of funding, the Foundation suggested a variety of ways in which the Cohort could work together along the spectrum of collaboration, ranging from informal networking to collective impact. While the funder provided these suggestions, the intention was for the leadership of the Cohort organizations to build trust and decide as a group what type of collaboration might be most beneficial for members and their organizations.

Although the organizations had similar missions, at the onset the Cohort members were not necessarily familiar with the work of each other's organizations. A third-party consulting agency was hired to facilitate trust-building and planning exercises to guide the Cohort towards a plan for their time together. During their first few meetings, the Cohort discussed which approach would be most feasible and helpful to their organizations at that point in time. The group ultimately decided on a learning collaborative structure for the duration of the funding period to help each organization achieve increased scope, impact, and sustainability. In order to assess the formation process and final impact of the Cohort, the Foundation decided to simultaneously engage an evaluation focused on the chief executive officers/executive directors of each of the six organizations. A university partner (Tufts University) with expertise in nutrition and evaluation was funded at the same time as the Cohort and followed the group through the three-year collaboration.

The objective of this paper is to provide an intrinsic case study of the three-year (December 2014–December 2017) funder-initiated, grantee-driven collaborative. We aim to describe the evolution of the Cohort by synthesizing accounts of the successes, challenges, and lessons learned that the members reported based on their experience.

Table 1. Overview of Nutrition Cohort Member Organizations at the Time of Initial Funding (2014) and End of Funding Period (2017)

Organization	Years in Operation (2014)	2014 Operating Budget (in millions of US$)	2017 Operating Budget (in millions of US$)
Nutrition Education 1	<5	$9.2	$15.5
Nutrition Education 2	5–10	$1.9	$1.8
Nutrition Education 3	5–10	$1.5	$3.0
Food Access 1	5–10	$3.2	$5.8
Food Access 2	>10	$9.2	$10.2
Food Access 3	5–10	$4.8	$6.6

Applied Research Methods

Case Study Approach and Triangulation of Three Data Sources

An intrinsic case study approach (Baxter & Jack 2008; Stake, 1995; Creswell, 2013) was used to assess the Cohort. Three data sources were triangulated to assess Cohort successes, challenges, and lessons learned during its formation and evolution: (1) yearly key informant interviews regarding Cohort member perceptions of motivation, successes and challenges, benefits of participation, and future directions (Table 2); (2) a 41-item survey, and (3) document reviews of a variety of sources including relevant e-mails, phone and in-person meeting minutes, and other records documenting the exchange of information within the Cohort across the three years. The results presented are a synthesis of the data from the three sources, which were collected annually from the Cohort members. The key informant interviews are the predominant source of information, as they provided the richest insight into Cohort member perspectives across the collaboration.

Key Informant Interviews

Key informant interviews were conducted with the six Cohort members at the end of each year and the Foundation managing director and grants manager were interviewed at the end of Year 1. Key informant interview questions were developed, based on a script by Caulum, Outar, Shardlow, Thomas-Tielke, & Tulpule, to evaluate the effectiveness of a food access coalition (Caulum et al., 2013). The question domains for Cohort member interviews are presented in Table 2. Interviews with the Foundation during Year 1 addressed similar areas but were adapted to include topics such as motivation for starting the Cohort, facilitation strategies, perspective on future plans, and successes and challenges. Questions were semistructured and facilitated by a moderator who was a member of the university research team.

Each interview was audiotaped and transcribed verbatim. Two researchers independently reviewed and coded a portion of the transcripts to assess inter-rater reliability. Researchers also implemented peer de-briefing throughout this process to identify emerging themes. The inter-rater reliability was

Table 2. Cohort Member Key Informant Interview Question Domains

Question Domain	Time Point Assessed	Topic Areas Addressed
Motivation	• Year 1	• Organization's interest in applying for funding • Individual/organizational role in Cohort
Cohort Successes and Challenges	• Years 1 & 2	• Development of common vision • Cohort's short-term goals • Cohort's long-term goals • Cohort members' levels of investment • Major success(es) of Cohort • Major challenge(s) of Cohort
Benefits of Participation	• Years 1, 2, & 3	• Development of new and/or strengthening of current relationships • Implementation of new projects and/or ideas with other cohort members
Future Direction	• Years 1, 2, & 3	• Concerns about the Cohort • Vision for Cohort moving forward (i.e., structure, funding, staffing) • Achievements Cohort is capable of
Overall Experience	• Year 3	• Willingness to be involved in a similarly structured Cohort again • Impact on food and nutrition issues as a Cohort • Advice to other organizations considering joining a Cohort • Reflection on convening topics

80%-100% across all domains; thus remaining transcripts were coded independently. Predominant themes were identified using an inductive and deductive content analysis approach with QSR International's NVivo 10 software (QSR International, Melbourne, AU) (Fereday & Muir-Cochrane, 2006).

After documenting themes and identifying key quotes from Cohort and Foundation members, the evaluation team conducted a member check-in phase with the Cohort and Foundation partners. Since key informant interviews were the focal point of this case study, the evaluation team requested that participants review their statements to ensure accurate representation of their views.

Survey

At the end of each year, a survey was also administered to the six Cohort members within the same month as the key informant interviews using Qualtrics software (Qualtrics, Provo, Utah). The blinded 41-item survey was developed by the university partner with input from the Foundation and the third-party consulting agency. The surveys assessed each Cohort member's perception of (1) the mission, strategy, and goals of the Cohort; (2) his/her role within the Cohort given his/her professional background in nutrition and/or food access and administrative leadership experience; (3) the benefits of participation in the Cohort; and (4) during just the Year 1 survey, the value of the third-party consulting agency as a Cohort facilitator. Questions used a five-point Likert scale to assess the extent to which the Cohort members agreed or disagreed with a statement. Survey data were downloaded and tabulated for all six Cohort members across response categories. The university researchers were blinded to the identity of the respondents for all survey questions so as to not bias interpretation of these data.

Document Reviews

Minutes from phone and in-person meetings and relevant e-mails were captured across the three years to document information exchanges and decision-making processes. Additionally, Cohort members were asked to record instances of peer-to-peer communication, collaboration, and successes in a shared Google Doc to catalog interactions outside organized Cohort meetings. These documents were also coded in NVivo 10, utilizing the coding scheme developed for the key information interviews, and an inductive approach was used to identify additional themes.

Results

Funder Perspective During Year 1

Interviews with the Foundation managing director and grants manager at the end of Year 1 addressed their role in the evolution of the Cohort and perceived successes and challenges, as this was the critical period for defining Cohort mission and goals.

Role of foundation

During the initial (Year 1) interviews, the two Foundation members agreed on three major roles that evolved over the course of the first year: investor, connector, and learner. As an "investor," the Foundation was financially supporting the specific needs of each grantee, as well as the Cohort-determined goals. As a "connector," the Foundation facilitated the trust- and relationship-building of the Cohort members through e-mail forums and formal Cohort meetings. Serving as a "learner," Foundation members noted:

> We want to listen and learn from them. In terms of the development of this case study, whether the outcome is positive or negative—we would share that with other funders or grantees in the field to say "this is an approach we tried and we think it worked or didn't work."

Throughout the first year, the Foundation evolved in terms of its relationship with the Cohort. Early in the year, the Foundation and the third-party consultant were heavily involved in orchestrating phone calls and planning the meeting topics in a way that promoted relationship-building within the Cohort. The Cohort's shift to a peer learning collaborative halfway through the first year prompted the role

of the Foundation to become more administrative as Cohort members assumed responsibility for deciding the frequency of meetings, identifying meeting topics, designing the agenda, and facilitating the day-long events.

Challenges and successes

The first four to five months of the funding period represented a challenging time for the Foundation in terms of re-affirming that the Cohort members, and not the Foundation, would be driving the agenda. The Foundation leaders explained that they had an initial idea for the Cohort to pursue a collective impact project in the community, considering the strengths of each Cohort organization. However, this suggestion dissipated quickly during preliminary Cohort conversations. The Foundation recognized that the Cohort members may not have had the capacity to pursue a collective impact project during the three-year grant period; if they did, it should develop more organically and likely would require more time. As a result, the Foundation had to prove that it did not have any further expectations or ulterior motives for what the Cohort would accomplish. This outcome after Year 1—clarification that the format would be a learning collaborative rather than collective impact—was ultimately viewed as a success. The establishment of overall trust among the group and Cohort members was viewed as a major accomplishment by the Foundation.

Grantee Perspective

In terms of the grantee perspective, findings from Years 1 and 3 are emphasized since those time periods were most transformative for the Cohort. Year 1 was critical for identifying the mission and goals of the Cohort. Year 3 reflections focused on the overall experience and next steps for the Cohort's work. No new themes emerged during the Year 2 interviews, as by this time the learning collaborative structure had been established, and the focal point throughout the year was Cohort member engagement in the meeting topics agreed upon during Year 1.

Evolution of Cohort Culture

Cohort structure and facilitation

One of the crucial structural components from Cohort members' perspective was the importance of their collaboration being driven by Cohort members (i.e., grantee-driven) and not by the funder. One member shared that at the first meeting there was a brief moment of funder-created pressure around whether the groups were ready to dive into a collective impact project together. The member said: "My view of the world is partnerships never work when they are forced, so all you can do is invite people to the table and see what unfolds" (NE1).

The vision for a collective impact project then took more of a backseat to the process of trust-building among the members and allowing for space to see what would unfold. The Cohort members reported valuing the focus of initial conversations about each organization's work and where connections existed. Understanding one another's operating styles and establishing a structure that supported the innate leadership qualities of the Cohort leaders was integral (FA3). Another member emphasized that the Cohort consisted of CEOs and pressed the importance of a structure in which none of the members felt subordinate (FA2).

By the end of Year 1, the learning collaborative model had taken shape and was sustained across Years 2-3. The members decided that the learning collaborative would focus future in-person meetings on six topics of major interest: (1) fundraising and funding models, (2) effective board development, (3) succession planning and management, (4) employee performance management and development, (5) technology and communications, and (6) the national nutrition policy landscape.

Importantly, all six of the Cohort members reported that they felt like everyone in the Cohort had a voice in decisions from Year 1 (Blinded online survey: n=4 strongly agree; n=2 agree) through Year 3 (n=3 strongly agree; n=3 agree), which was necessary for developing and sustaining goals. The strength of the learning collaborative approach leveraged each member's experience and

leadership qualities as they co-facilitated the meeting topics. One member reflected on how well this method worked during the first learning session about fundraising, saying that, as a result, all the members felt more at ease digging deeper into these topic areas and being accountable during future meetings (NE2).

Relative to other aspects of the Cohort facilitation, two members felt that having a third-party facilitation partner during Year 1 was not essential to the progress that happened (FA2, NE1). During Years 2-3 this was addressed for the remaining meetings, as Cohort members either individually or with another Cohort partner embraced organizing and leading each meeting topic. Another suggestion for future work during this timeframe was that there be one or two designated "executive administrators" dedicated to ensuring that information is flowing and that work continued to be done between meetings.

Ultimately, the Cohort praised the Foundation's management approach and candidness throughout the course of the grant period, particularly its openness to the grantees trying new and innovative ideas (FA2). One member (FA1) credited the Foundation with being more successful at bringing collaborators together than any other funder-initiated effort in which this member had worked. Three Cohort members (FA2, NE1, NE2) were in agreement that the small size of the Cohort was appealing as it enhanced the ability to form a trusting learning community. This sentiment was expressed at the end of the grant period as well. One member shared during the Year 3 interview, "It was a refreshing experience to not have the Foundation direct the interactions of the Cohort members, and it was amazing to see what came out of it. There was a lot of learning that happened out of that openness and flexibility on the part of the Foundation" (NE2).

Investment of members and drivers of Cohort activity

All six Cohort members described themselves as personally invested in the Nutrition Cohort, with the same distribution of responses during Year 1 and Year 3 (n=3 strongly agree; n=3 agree). A member stated that when the group was together, every member took the work very seriously. Another exclaimed, "everyone is on fire and really motivated, and I get re-energized from this group" (FA2). Members also described how the meetings and other Cohort member interactions permeated the activities of their organizations. One member (NE3) explained that the meetings and sessions influenced day-to-day organizational activities, and another shared how topic areas became infused into conversations with staff internally (FA2).

Developing common vision

During preliminary phone calls with each Cohort member in Year 1, many expressed the desire to develop a common vision for the group. By the end of the first year, however, members were divided as to whether or not a common vision was achieved and what it entailed. Four members (FA2, FA3, NE2, and NE3) expressed that they did not feel that there truly was a shared common vision yet, and two members (FA1, NE1) considered the decision to become a Cohort-driven learning collaborative as the common vision of the Cohort. Members (NE1, NE2) also referred to the common vision as a broader goal of improving the food system beyond the grant timeframe and funding: "A big picture vision that we're all working to achieve outside the bounds of the grant is a food system that is just, equitable, sustainable, and healthful" (NE1). Despite the discordance of Cohort members around defining a common vision, there was an apparent commitment to learning from each other and a recognition that they may share certain goals that could not fit in the three-year timeframe of the Cohort.

Challenges

Initial lack of clarity during Year 1

A major challenge encountered during the first year was lack of clarity surrounding what the Cohort would accomplish during the funding period, described by one member as "general murkiness" (NE2). Cohort members connected this lack of clarity to both the application process and initial meetings in terms of what their commitment to the Cohort would look like. However, as the members reflected on the culmination of the first year, many

agreed that the direction of the group was more clearly defined:

> During the initial discussions, we were not 100 percent sure how we were going to go about tackling some of these issues that we had laid on the table—that we wanted discussion, discourse, and learning—and now it seems a little more tangible and doable. (NE2)

All Cohort members agreed that planning and relationship-building during the first year was essential before reaching a point where they were working towards concrete goals. Ultimately, initial lack of clarity set the stage for more in-depth discussions to identify what members wanted to get out of their experience.

Interestingly, three Cohort members themselves claimed to be the biggest skeptics due to the lack of clarity, but by the end of the three-year grant period their views were vastly different:

> Probably my major reflection is that initially I was the greatest skeptic about the potential of this Cohort to really accomplish much of value for those of us involved. That attitude has really shifted. I have found great value in participation and am actually sad that the formal part of this has come to an end. I found that I was really looking forward to meetings and found that the formal and informal interactions with others to be valuable. (FA1)

Organizational capacity and time

The perspectives of the Cohort members on their organizational capacity and availability to engage with the Cohort changed from Year 1 to Year 3. During Year 1, the members expressed challenges involving their capacity as organization leaders and lack of time, especially as the latter affected travel and attending meetings in person. Five of the six members spoke about their concerns balancing the priorities of serving their own organizations with being able to prepare for and attend meetings properly. One member explained:

> The only challenge I see is related to the organizational capacities of each of the organizations and how that allows people to prepare for gatherings, be on the phone calls, and make it to the gatherings in 100% good shape to really dive in and devote. (FA3)

This member also felt that some of the organizations were truly "capacity-strapped" while others were able to devote more time and thought to actively participating in cohort exercises (FA3).

However, the feeling of lack of time and capacity shifted by the end of Year 3. Four of the Cohort members stated that they truly desired more time, not only to discuss the meeting topic at hand, but also to spend time together learning and exchanging ideas (NE1, NE3, FA1, FA2). Two members pressed the importance of being "present" during meetings (NE3 and FA2), both in terms of in-person attendance and engagement. Although the meetings were conducted in person, Cohort members occasionally participated through video conferencing. One member explained that this option took away from the dynamic to such an extent that physical attendance should be required for meetings (FA2). Another shared that they wished they had spent more time with the other Cohort members, instead of using time between presentations to take phone calls and send email (NE3).

Successes and Benefits

Fostering personal connections

At the beginning of the first year, many Cohort members expressed different ideas as to how a successful Cohort might look, including traits such as trust, communication, commitment, and coordination. There was variation in the extent and depth of prior relationships among members, with some members having working relationships and others having never met. By the end of the first year, new relationships emerged and existing ones strengthened. The members' perspectives were in alignment regarding the benefit of the relationship-building aspect of the Cohort:

> There are cross-connections that are happening that we may not have thought about otherwise. All of us see each other as partners and committed players in this space, and there are relationships that have developed.... There is no hesitation picking up the phone or emailing somebody and saying, "hey, I need this, I need you to make an introduction for me," which I don't think was there across all six organizations when we started. So that in and of itself is a huge benefit to all organizations that are a part of the Cohort. (NE2)

Not only were these personal connections important for promoting comfort and trust within the Cohort, but members also discussed using these relationships as a springboard for enhancing their organization's community impact. By Year 3, the members collectively expressed that the personal connections developed truly enhanced their overall experience with the Cohort and that they hoped to sustain these relationships after the funding period. One member shared that it was beneficial to get peer support with the many concerns and stresses that often come with running a nonprofit, saying "I feel that there is now a solid, strong connection between me and the other Executive Directors" (FA2). Another indicated that they left the Cohort experience "feeling deeply grateful for the relationships [they've] built, and know that those folks will be there for [them] if ever in a time of need" (NE1).

Bolstering community impact

During Year 1, many members indicated that a natural "big picture" goal for the Cohort would be to achieve an aligned vision for changing food system policy, advocacy, and programming. One member echoed this at the end of the first year: "If we combined strengths of each of our organizations, and coordinated them in a meaningful way, it could be something that actually moves the field forward faster" (FA3). The Cohort's perceptions of their ability to make an impact remained throughout Year 3, with potential to extend beyond the funding period:

> I think that this will have a lasting effect that will be very good for the work, and what happens in different cities and communities throughout the country. The reach of these groups is incredible. These bonds are really significant. (FA2)

Additionally, the Cohort-facilitated connections yielded substantive gains for many members across the three years. Table 3 highlights the types of successes that were achieved by one or more Cohort members as a result of these networks, including organizational capacity building, funding opportunities, and formal Cohort collaborations. In nutrition education, one member stated that Cohort members were serving as outreach partners for their national awareness month and were also planning to attend and present at their organization's national conference (NE2). Another member (NE3) shared that a deeper collaboration formed when one Cohort member's organization (NE1) incorporated volunteers from the other partner's organization into their program schools (NE3). From the food access-focused organizations, one leader (FA1) discussed a budding partnership (with FA2) focused on distributing healthy foods to small convenience stores and bodegas that are WIC-certified. The interest in pursuing policy initiatives during Year 1 was substantiated during Years 2-3, as Cohort members expressed joint support of policy approaches involving nutrition incentives as part of the next Farm Bill (Table 3), and dedicated a substantial portion of their final Cohort meeting to topics of current policy engagement.

Sharing and teaching

The central success of the Cohort was the formation of the peer learning collaborative during Year 1, which provided a foundation for teaching and sharing both within and out of meetings across Years 2-3. All Cohort members reported that they implemented new ideas and changed aspects of how they run their organizations as a result of participating in the Cohort. They immensely valued the opportunity to learn from other leaders in the food system movement facing similar personal and organizational challenges and opportunities. One

leader explained:

> All of the leaders are going through similar issues. The Foundation is really generous in the support they are offering to provide a forum for these leaders to convene and discuss some of the things that organizational leaders or Executive Directors do not have the opportunity to discuss unless you have relationships on your own and time to be able to pursue one-on-one conversations. (NE2)

The Cohort members mutually appreciated that meetings served as a formal setting for peer-to-peer education that prioritized topics which they

Table 3. Nutrition Cohort Member Accomplishments During Years 1–3

Type of Outcome	Examples of Accomplishments		
	Year 1	Year 2	Year 3
Organizational Capacity Building	Enhanced administrative systems through new connections to potential IT partners, marketing firms, and job candidates →		
	Shared resources (e.g., evaluation tool for school meals) →		
	Participated in another Cohort member's board meeting and offered strategic support		
Funding Opportunities	Facilitated introductions to new potential foundation funders →		
	Identified SNAP-Ed funding opportunities for existing initiatives	Worked together to raise funds for a member's initiatives	
	Strengthened government support through connection with state-level department of education	Submitted joint proposal to a community food funder	
Formal Cohort Collaborations	Explored new collaborations (e.g., a healthy food incentives initiative for smaller stores/ bodegas, a new food access pilot project in sports stadiums.) →		
	Provided promotion and participated in other cohort members' events (e.g., conferences, month of awareness) →		
	Facilitated a member's expansion into program schools located in new city	Support of policy strategy for next Farm Bill involving nutrition incentives →	
	Made progress on a project based on mini-grant from state partner		Three Cohort members co-authored a report about food access
			Expressed that Cohort members forged stronger bonds with other organizations that will continue after grant period

chose themselves because they would benefit members individually and collectively. One member stated a personal, Cohort-related goal of taking responsibility for his own learning and sharing his experience and insights with other members:

> I really see my role as helping the Cohort to grow into a catalyst for greater effectiveness and change in the food system, because all of us are getting better at our work by sharing what we know and what challenges we're experiencing. (FA1)

Members reported that the trust built during the first months of the Cohort was integral to the fundraising meeting discussions that required sharing personal perspectives. Comparing Year 1 to Year 3, the Cohort members either strongly agreed (Year 1, n=4; Year 3, n=3) or agreed (Year 1, n=2; Year 3, n=3) that they were comfortable expressing their point of view even if others might disagree. Half (n=3) of the members strongly agreed that they were comfortable bringing up new ideas at meetings during Year 1, which was comparable for Year 3 (n=4). Two members (FA2, NE2) said that valuable fundraising advice and resources (e. g., funders' contact information) were shared with an openness that would not have been possible without the foundation of trust. One member added that they were excited about this sharing opportunity given the typically competitive climate of working in this field (FA2).

At the culmination of the funding period, Cohort member responses regarding which meetings were most beneficial to their organizations varied from member to member. Though members unanimously agreed that all meetings were constructive, they identified distinct topic areas that were particularly helpful in terms of the status and unique needs of their organizations. For example, one member (FA1) indicated that the topic of board development was helpful because their organization had lacked a development director or department, and by the end of the Cohort period, they had implemented one. Another member (NE2) learned of a new fundraising model—fee-for-service—that was "way different" from other models this member had encountered. This member conveyed a hope to work deeper with the other Cohort members to consider piloting this model. And a member (NE1) stated that while succession planning was not a topic that their organization had done any work about prior to the Cohort, they now have an organization-wide process in the works for building a strong pipeline of leaders ready to step into higher-level administrative roles.

Ideas for Future Funder-Initiated Cohorts

At the end of Year 3, five of the Cohort members conveyed ideas about what they would have done differently, broadly falling into two areas: more efficiently identifying the central goals for the Cohort as a learning collaborative, and addressing the structure and allocation of meeting time. Two members (NE2 and NE3) stated that the initial months of the Cohort were an unusual time, figuring out what they wanted to do; they felt that through this discovery process they lost a lot of valuable learning time. One of the members remarked, "I am a person that needs clarity. What are we doing? What are our goals?" (NE2), and the other said, "Had I known more going in, I may have lined myself up better" (NE3).

Regarding the meeting structure and time allocation, two members had distinct opinions regarding internal staff presence at meetings. One Cohort member (FA2) wished that staff hadn't been present all the time because it tended to shift the dynamic of the meetings and suggested that perhaps staff be present for only half of the meetings. Another member (NE1) believed that other staff should have been able to attend with analogous members of other Cohort organizations. As for time for meetings, it was suggested (FA1) that more time—perhaps one and a half to two days, rather than only one—be dedicated to meetings to cover the breadth of content. They also noted that meetings needed to be paced differently, due to the intensive nature of the content.

Long-term Goals and Sustaining Relationship After Funding Period

The overall perspective of the Cohort was that a strong network was established with meaningful

personal relationships and collaborations continuing to evolve as a result of this work. However, it was believed that there was a narrow likelihood that the Cohort would continue as a formal learning collaborative with an established meeting structure. The members did not collectively delineate long-term goals at the final meeting: "We all just agreed that it would be valuable for us to continue to connect and find ways to continue working together" (FA3). One member spoke about time and capacity barriers to continue formally meeting as a group sharing; "The reality of it is that we are very busy and so without having a structure, it seems highly unlikely that the six directors would stay in touch as a group" (NE2). However, this member added, "even if we don't see each other frequently, the trust that we built over the past three years will continue to connect us."

Discussion

The evolution of this funder-initiated model revealed successes and challenges from the perspective of both the funder and grantees. How this Cohort was initially envisioned, formed, and evolved, represents an innovative but replicable model for converging the strengths of organizations that share an analogous goal of addressing food access and/or nutrition education. Lessons learned throughout this three-year process are important to share, particularly to foundations interested in pursuing a collaborative model.

An important aspect of the relationship between a grantee and funder is achieving an alignment of perspectives (Buteau, Chaffin, & Gopal, 2014). Considering the formation and beginning stages of the Cohort, the Foundation developed the capacity-building grant mechanism and conveyed a pragmatic rationale for this approach. However, the grantees shared that during the application process there was not adequate communication about the vision for the Cohort. The lack of clarity during the application process persisted during the first few months of the Cohort's existence, presenting a challenge for both the members and the Foundation. Regardless of the type of collaborative relationship, it is integral that the grantee and foundation achieve an alignment of perspectives (Buteau et al., 2014), which can be challenging when different players are involved (Fairfield & Wing, 2008). Despite this initial lack of clarity and challenge to establishing goals, both the Foundation and the grantees immensely valued the formation of trust in the following months upon which they could build.

Interestingly, the grantees shifted their perspectives towards the challenge of time commitment and travel from Year 1 to Year 3. Over the course of the funding period, the Foundation made concerted efforts to plan meetings around the Cohort members' schedules and base meetings in convenient locations, but during Year 1 a few Cohort members felt that it would have helped to have had flexible meeting options, such as webinars. By Year 3, they acknowledged the importance of in-person meetings and found physical presence immensely valuable. Further, some said that they wished for more time to explore meeting topics. The meaningful personal connections and collaborations that evolved from in-person participation may suggest that virtual learning models are not conducive to in-depth member engagement. For example, a virtual learning collaborative consisting of webinars, conference calls, and online surveys, which was found to be successful for promoting quality improvement in other settings (John et al., 2014), may not be effective for this type of Cohort.

The major success expressed by the Foundation and grantees was the formation of trust and being able to share openly with one another. Ultimately, this level of trust served as the basis for forming a learning collaborative and evolved across the three years to become a feature of the Cohort that all members immensely valued. The importance of these characteristics to the Cohort success is supported by evidence from community coalition research, which shows that determinants of member satisfaction include shared decision making and a positive organizational climate (Butterfoss, Goodman, & Wandersman, 1996). The benefits of the learning collaborative also extended to other staff of Cohort organizations. The value of these topics went beyond the meeting space and impacted how the Cohort members run their organizations.

As for the future of the Cohort, it appears that these relationships will continue to evolve and lead

to other types of collaborations, specifically collaborations aimed at boosting community impact and making progress with salient food systems issues. The group agreed, however, that it would be difficult to continue having formal meetings as a learning collaborative without the infrastructure guided by the funder. Consensus on this topic was primarily established at the final Cohort meeting, which may not have provided sufficient time to identify what sorts of options for sustainability were feasible or desirable. However, it appeared that members were highly confident that they would sustain the personal connections they had established. This is consistent with other public health literature that has identified factors including a history of collaboration, a clear vision and clear operation guidelines, and sufficient funding as key factors that contribute to the sustainability of collaboratives (Rog et al., 2004).

Lessons Learned

The formation of the Nutrition Cohort as a funder-initiated but grantee-driven collaborative may be an effective model in food systems development and public health. This in-depth case study provides insights for bringing together organizations with proven models for success and similar goals for addressing food access and nutrition education on a national scale. There are four primary recommendations this study identified for those considering a funder-initiated collaborative model:

1. The application phase can help potential members better comprehend what their involvement may entail.

The Foundation did not know at the time of the application what form the Cohort would take, as it was meant to be grantee-driven. However, having general expectations delineated during the application process could help the members plan accordingly for their potential commitment. The application phase could also serve as an opportunity to obtain feedback from participants up front regarding preferences for meeting content and structure.

2. Carefully consider the organizations that will be working together.

The Foundation excelled at selecting a group of organizations that were similar in their scope, reach, leadership, and vision in the areas of nutrition education and food access. The combination of the organizations' record of success and desire to increase capacity positioned them as ideal candidates for this type of cohort. The Foundation had funded many of these organizations in the past, bolstering their confidence in their leaders' capacity to work together effectively.

3. Keep the size of the cohort small and identify how to structure meetings in a way that complements the dynamics of the group.

The size of the Nutrition Cohort was perceived to be a major advantage, especially in terms of its effect on supporting partnerships formed across the grant period. Another important feature enhancing the success of this type of collaborative was dedicating sufficient time to meetings, emphasizing in-person attendance, and critically evaluating how to engage other members of the Cohort organizations most effectively.

4. Dedicate sufficient time to relationship and trust-building.

Before conversations about the mission and goals of the Cohort occurred, the members needed to establish a foundation of trust to allow for comfortable, realistic, and transparent working relationships. It was essential that the funder did not try to steer the Cohort in any specific direction during this initial phase. The establishment of the Cohort as a learning collaborative towards the end of the first year was perceived as a central success, and feedback from the Cohort members supports the perception of the model's merits. Building off the leadership of the group and continuing with a Cohort-driven approach worked well for the members. The funder put the onus on the grantees to spearhead each meeting topic and incorporate other Cohort members to ensure peer-to-peer learning. An important aspect of the learning-collaborative direction was that it was manageable and realistic for the Cohort to accomplish. It was quickly realized that a more long-term project would not be achievable, so more feasible goals were established in order not to set the Cohort up for failure.

Conclusion

Culminating with the development of a learning collaborative, this case study of the Nutrition Cohort's evolution highlights lessons learned and the makings of a successful model for a grant period and beyond. Though the beginning stages of the Cohort were challenging for both the grantees and the funder, the development of trust both among the Cohort members and between the Cohort and the funder represented a major success. The funder-initiated, grantee-driven learning collaborative model supports two promising outcomes for the Cohort members: applying what they learn from one another to strengthen and expand the work of their respective organizations, and strengthening personal relationships and exploring potential collaborations for community impact during the Cohort period and beyond.

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Soil contaminant concentrations at urban agricultural sites in New Orleans, Louisiana: A comparison of two analytical methods

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Abstract

Along with the many benefits of urban agriculture comes the possible exposure to contaminants not typically seen in rural soils. Through the use of standard laboratory analyses (ICP-AES and CVAAS) and a field-portable X-ray fluorescence spectrometer (XRF) calibrated for soil analysis, this study quantified contamination levels at urban agricultural sites throughout New Orleans, Louisiana. The results of the standard laboratory analyses were compared to the results from the XRF. We collected soil samples at 27 urban and suburban farm and garden sites from the Greater New Orleans area. We analyzed the soil samples for arsenic, cadmium, chromium, cobalt, copper, mercury, lead, nickel, and zinc using the XRF and standard methods. Most sites had median concentrations significantly below Louisiana's soil standards. Paired soil samples showed XRF results were significantly higher than laboratory results for all metals but copper. Only lead (ϱ=0.82, p<0.0001) and zinc (ϱ=0.78, p=0.0001) were highly correlated. Poor correlation of results between XRF and standard methods make the standard methods preferred.

Keywords

Urban Agriculture; Soil Contamination; Arsenic; Lead; XRF; ICP-AES

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Disclaimer

The researchers have no financial interests in any companies that produce XRF products.

Introduction and Literature Review

Urban agriculture can provide numerous benefits to people and communities by improving food security and local food economies, reducing transportation costs, and revitalizing blighted neighborhoods (Brown & Jameton, 2000; Cohen, 2011; Hagey, Rice, & Flournoy, 2012; Kim, Poulsen, Margulies, Dix, Palmer, & Nachman, 2014; Mougeot, 2000; Patel, 1991; Rose, Bodor, Swalm, Rice, Farley, & Hutchinson, 2009; Smit & Nasr, 1992; Sommers & Smit, 1994). However, exposure to soil contaminants can pose a potential health hazard to those involved, and cities, having generally higher anthropogenic contamination levels, pose a greater risk. (Szynkowska, Pawlaczyk, Leśniewska, & Paryjczak, 2009). Several studies have shown that gardeners' concerns relating to possible soil contamination at urban agricultural sites can possibly prevent them from developing a site themselves (Cohen, 2011; Kaufman & Bailkey, 2000; McLaughlin, Parker, & Clarke, 1999). Kim et al. (2014) have shown that lead and other metals are the primary contaminants of concern among growers. This study specifically examines soil contamination of urban agriculture in New Orleans, Louisiana.

Cities such as New Orleans with historic and current industrial activity, high-traffic, and lead-painted houses often have higher levels of soil contamination (Brown & Jameton, 2000; Finster, Gray, & Binns, 2004; Grubinger & Ross, 2011; Laidlaw & Filippelli, 2008; Meuser, 2010; Mielke, Wang, Gonzales, Le, Quach, & Mielke, 2001; Mielke & Reagan, 1998; Wu, Edwards, He, Liu, & Kleinman, 2010). Studies examining New Orleans have shown high levels of soil contamination from metals (Mielke et al., 2001; Mielke, Wang, Gonzales, Powell, Le, & Quach, 2004; Mielke, Gonzales, Smith, & Mielke, 2000). Past lead levels in New Orleans have been found to range from non-detectable levels to 190,980 parts per million (ppm), with a median of 120.4 ppm (Mielke, Gonzales, Smith, & Mielke, 2000).

Unique to New Orleans is the sediment layer that Hurricane Katrina deposited throughout the city in 2005 (Adams et al., 2007). Arsenic and lead are prime examples of how the flood and rebuilding efforts covered, deposited, or redistributed contaminants throughout the city (Rabito, Iqbal, Perry, Arroyave, & Rice, 2012; Rotkin-Ellman, Solomon, Gonzales, Agwaramgbo, & Mielke, 2010). A study focused on arsenic concentrations sampled within 10 months after the hurricane showed that post-flood soil concentrations of arsenic increased on average by 19.7 ppm (Rotkin-Ellman, Solomon, Gonzales, Agwaramgbo, & Mielke, 2010). Information on lead contamination is mixed. In one study, lead levels in many areas were found to have decreased after the flooding due to a less-contaminated sediment layer covering up older and more contaminated layers (Natural Resources Defense Council [NRDC], 2011). Another study showed that 61.4% of residential yards sampled after the flood had at least one sample that exceeded the federal soil lead standard. The study also showed that, compared to pre-flood measurements, the median lead levels increased by 37.2 percent (Rabito et al. 2012).

Because of the potential for soil contamination, the U.S. Environmental Protection Agency (U.S. EPA) stresses the importance of testing soil before performing any urban agriculture (U.S. EPA, Office of Superfund Remediation and Technology Innovation, 2011). Kim et al. (2014) found that while many gardeners had a wide range of information on soil contamination and testing, some expressed concern that many gardeners are not aware that testing should be done prior to growing. Furthermore, for those growers that are interested in testing, there are limited testing options available in New Orleans. The Louisiana State University (LSU) Agricultural Center Extension for Orleans Parish offers soil testing through the LSU AgCenter Soil Testing and Plant Analysis Center. Sampling information and kits are available in every parish through the local agricultural extension program; however, these kits only test for soil nutrient content and pH, not for contamination (LSU AgCenter, n.d.). The Centers for Disease Control and Prevention (CDC) and the Agency for Toxic Substances and Disease Registry (ATSDR) provide soil contamination information and screening through their soilSHOP program. However, the soilSHOP program is currently only operating in 13 states, Washington, D.C., and Puerto Rico (ATSDR, n.d.).

The purpose of this study is to quantify the levels of soil contamination at urban agricultural sites in New Orleans. Although widespread contamination in New Orleans has been documented, environmental contamination is still highly variable at both the citywide scale and at individual sites (Mielke et al., 2004; Romic & Romic, 2003). This study examines arsenic, cadmium, chromium, cobalt, copper, lead, mercury, nickel, and zinc; These substances are all soil contaminants of concern to human health (Bruker, n.d.).

We compared two analytical methods that quantify metal contamination in soil: Inductively coupled plasma-atomic emission spectrometry (ICP-AES) and an analysis using an X-ray fluorescence spectrometer (XRF). ICP-AES is one of the EPA's standard methods for metal analysis in soils. However, ICP-AES does have several drawbacks. It is relatively expensive, potentially costing hundreds of dollars per sample depending on the number of analytes, and can take days to weeks to receive results.

A newer analytical instrument that is not currently EPA-certified is the field-portable X-ray fluorescence spectrometer (XRF). Multiple companies that produce handheld XRF equipment explicitly state that lab-quality metal soil screening is an intended use (Bruker, n.d.; Olympus, n.d.; ThermoFisher Scientific, n.d.). XRF technology has been used widely and effectively in the mining industry, but its application in urban agriculture has been relatively limited (Suh, Lee, & Choi, 2016). However, according to Weindorf, Zhu, Chakraborty, Bakr, & Huang (2012) the XRF is capable of accurately quantifying some metals in soils sampled from a peri-urban agricultural setting. While the instrument is expensive due to its technical complexity, it can provide near real-time results for the analysis of several metals. Because the only costs associated with the XRF are the one-time expense of purchasing or renting the device with modest expenses for maintenance, the use of an XRF can possibly make widespread or repeat sampling over time more affordable compared to ICP-AES analysis. While, the expense of ICP-AES increases with each sample analyzed by the lab, the XRF only incurs an expensive for the purchase of the device itself. Furthermore, multiple users can share the XRF across numerous sites. If the XRF proves to be reliable, it is expected that there will be a point where the scale of the sampling becomes large enough to justify the costs associated with renting or purchasing an XRF. This could lead to widespread use of the XRF in urban agriculture and other applications where low to moderate concentrations of contaminants are possible.

An additional aim of this study is to determine the level of correlation between lead and the other contaminants. Copper, lead, and zinc concentrations have been found to be correlated in roadside soils contaminated by heavy traffic (Yan, Zhang, Zeng, Zhang, Devkota, & Yao, 2012). Lead could be used as a proxy for other contaminants if similar correlations are found in this study. Because lead tests are often widespread and cheaper than tests for other contaminants, using lead as a proxy for other contaminants could help to reduce sampling costs.

Applied Research Methods

Site Selection

The majority of owners or managers of sites were contacted through the email listserv of Parkway Partners, a local urban agriculture group. An advertisement offering soil testing was sent to members and respondents were informed of the project's scope and sampling process. Other owners or managers were recruited directly by phone or email. Representatives from a total of 27 individual local sites responded to the email. Most of the sites were community or backyard gardens that grow produce intended primarily for personal consumption by the growers (93%, n=25). The remaining 7% (n=2) of the sites in our study were small businesses. Sites were located throughout most of the city. They were located in urban and suburban neighborhoods, including locations in Uptown, Central City, Mid-City, the Marigny, Seventh Ward, Downtown, New Orleans East, and Algiers. Some sites used raised beds while others planted in-ground.

Soil Sampling and Analyses

To determine the extent of metal contamination at urban agriculture sites in New Orleans, Louisiana,

we performed soil analyses to identify and quantify metal contaminants present in the soil. A systematic sampling plan was developed for each site. A majority of sites had the farm or garden organized in rows, and a linear sampling strategy was used for these sites. For sites using raised beds, physical soil samples were collected randomly while the XRF was used in every raised bed. Sampling was limited to areas that were currently producing food or were slated for future production.

Sample analysis consisted of two general methods, field-portable and laboratory-based. The field-portable analyses were conducted using a hand-held XRF calibrated for surface soil analyses (Innov-X Systems, INC; Woburn, MA USA; Delta Dynamic Premium XRF; Model DP-6000). The XRF provides real-time analyses of metal concentrations, and, with each sample, the XRF will report the limit of detection (LOD: the lowest possible concentration that the instrument can accurately report). Researchers were instructed by a company representative to place the device on top of a clear plastic bag on the desired sampling location (to protect the lens from contamination) and pull the trigger. Three different wavelengths were emitted for 15 seconds each, for a total of 45 seconds per sample. The XRF analyzes an area of 10 mm^2 and penetrates to a depth of 2 mm (Kalnicky & Singhvi, 2001; Olympus, n.d.). The minimum density of XRF soil analyses for each site was approximately one analysis per 300 ft^2. There were only seven samples taken at the two smallest sites, 42 samples were taken at the largest site, and an average of 22 samples were taken at each site.

Soil samples were collected from the exact location where an XRF reading was conducted to allow for correlation analyses between the two instruments used in this study. The sample was collected by removing the top 13 cm by depth and placing the soil in a 237 mL jar. Each sample was geo-coded, and the jars were then delivered to Pace Analytical Services Inc., (St. Rose, LA) using a chain-of-custody approach. Laboratory analyses consisted of the EPA 6010 method (ICP-AES) to analyze for arsenic, cadmium, chromium, cobalt, copper, lead, nickel, and zinc. Mercury was analyzed using the EPA 7471 Cold Vapor-Atomic Absorption Spectrometry (CVAAS) method. Further use of the term "laboratory analyses" will be in reference to ICP-AES and CVAAS. Pace Analytical Services Inc., certified by the Louisiana Department of Environmental Quality (LDEQ), conducted all laboratory analyses. Sites smaller than 1,000 ft^2 only had two samples taken, while all other sites larger than this had four samples taken. The majority of the sites (23) had four soil samples taken and analyzed by Pace, while the remaining four sites only had two soil samples analyzed, generating a total of 100 paired samples.

Statistical Analyses

Statistical analyses were performed using Prism version 6.0 (GraphPad Software, La Jolla, CA). For all analyses, a p-value of 0.05 was used to determine significance. The concentration distributions were not normally distributed as determined by the D'Agostino and Pearson omnibus normality test. Spearman's correlation was used to examine the relationship between XRF analysis and ICP-AES or CVAAS, linear regression was used to determine how well the XRF predicted ICP-AES results, and the Wilcoxon matched pairs test was used to determine if the paired groups were significantly different. A correlation matrix was developed to determine if one or more metals could be used as a proxy for other contaminants to reduce overall sampling costs. Samples below the limit of detection were calculated by dividing the LOD by the square root of two.

Results

Soil Concentrations

The XRF consistently showed higher results compared to the laboratory analyses. The XRF reported a higher minimum and median concentration of all metals, and a higher maximum concentration of all metals but lead (Table 1).

The percentage of sites with a sample above the LDEQ standard varied greatly as well. The XRF reported concentrations that exceeded the LDEQ standard much more frequently than the standard laboratory methods. The XRF reported at least one concentration that exceeded the LDEQ standard for cadmium, chromium, and mercury at all 27 sites (Table 2).

Table 1. Summary Statistics of Metals Analyzed by XRF and Laboratory Analyses

	XRF (ppm)			Laboratory Analyses (ppm)		
Metal (LDEQ Standard ppm)	Median	Minimum	Maximum	Median	Minimum	Maximum
Arsenic (12.0)	4.95	1.70	231.0	3.0	0.7	61.7
Cadmium (3.9)	13.4	9.19	28.0	0.318	0.248	8.80
Chromium (23.0)	31.0	3.89	562.0	7.85	2.20	51.3
Cobalt (470)	31.1	5.66	107.0	3.10	0.629	11.0
Copper (310)	22.0	6.36	7,774	20.6	2.20	200.0
Lead (400)	57.0	2.76	6,138	38.4	1.40	9,540
Mercury (2.3)	3.25	2.19	8.49	0.062	0.009	1.80
Nickel (160)	14.9	10.6	64.0	7.50	2.55	61.1
Zinc (2,300)	129.0	5.80	10,254	91.5	17.8	7,330

Table 2. Percentage of Sites that had at Least 1 Reported Concentration Above the LDEQ Standard by Method of Analysis

Metal	Percentage of Sites with 1 Concentration Exceeding LDEQ Standard	
	XRF	Laboratory Analyses
Arsenic	59%	18%
Cadmium	**100%**	7%
Chromium	**100%**	22%
Cobalt	0%	0%
Copper	15%	0%
Lead	48%	30%
Mercury	**100%**	0%
Nickel	0%	0%
Zinc	11%	7%

Table 3. Median Concentration Differences Between XRF and Laboratory Analyses for Each Metal Analyzed

Metal	Median Concentration Difference (ppm)	Significance
Arsenic	1.6	< 0.0001
Cadmium	13.1	< 0.0001
Chromium	24.4	< 0.0001
Cobalt	28.1	< 0.0001
Copper	1.1	**0.17**
Lead	8.4	< 0.0001
Mercury	3.1	< 0.0001
Nickel	7.1	< 0.0001
Zinc	34.3	< 0.0001

T-tests and Correlation Analyses

Wilcoxan T-tests showed highly significant differences between XRF and laboratory analyses for all metals except copper. A summary of the median concentration differences can be seen in Table 3.

The XRF produced higher results for all metals and, except in the case of copper, the results were all significantly higher (Figure 1). Zinc, chromium, and cobalt had the largest differences between the two methods. Lead and zinc, while both significantly different, had the strongest correlation between methods.

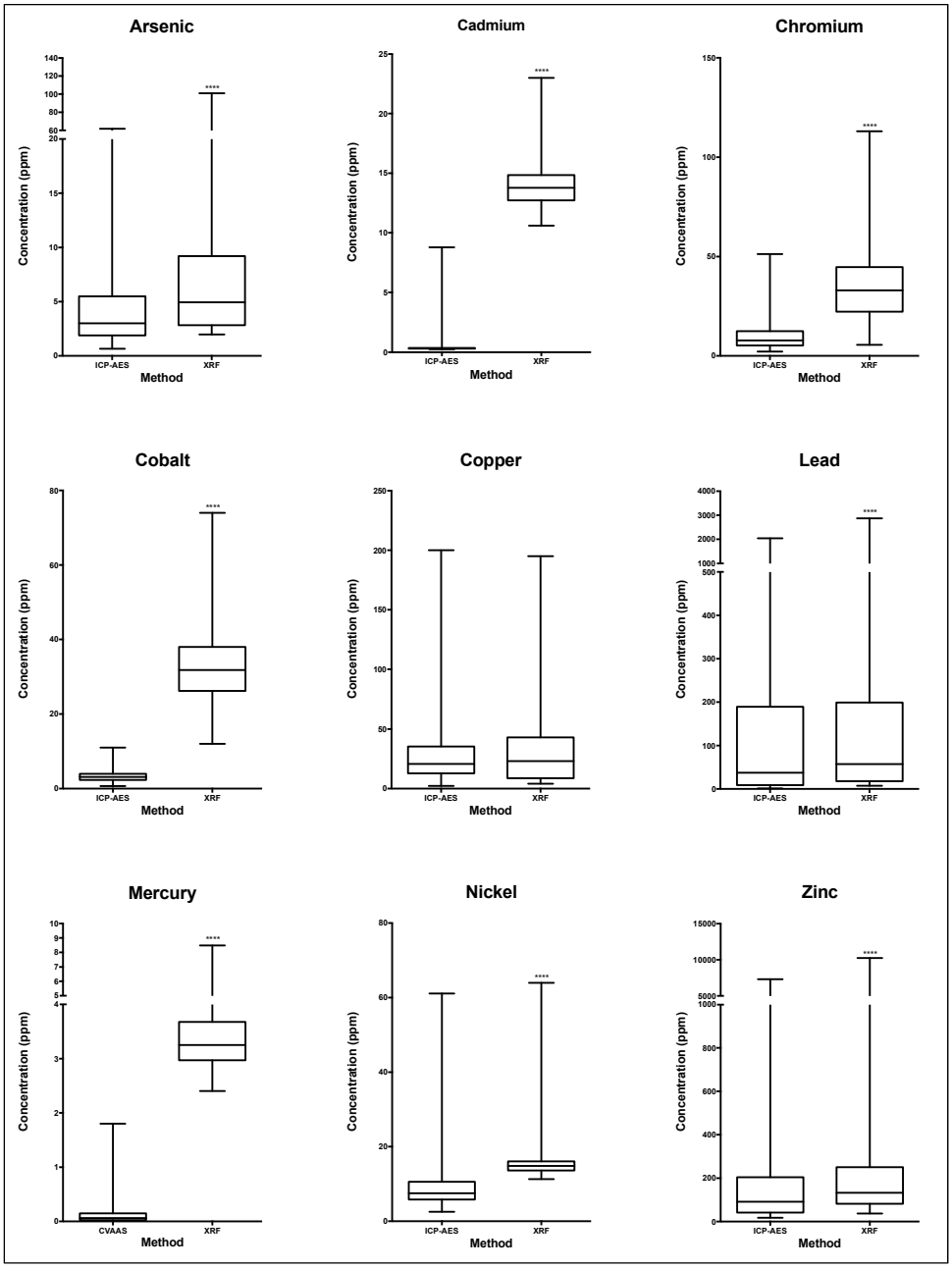
To measure agreement between the two testing methodologies, two tests of correlation were run comparing paired samples for each metal: Spearman ϱ and linear regression. Correlations between the XRF and laboratory analyses were significant ($p<.05$) for all metals, albeit with varying degrees of correlation. The least correlated metal was cadmium ($\varrho=0.27$, $p=0.0058$) while lead was the most correlated metal ($\varrho=0.82$, $p<0.0001$). Zinc was also highly correlated ($\varrho=0.78$, $p<0.0001$). However, most metals showed poor to moderate correlation ($\varrho<0.6$) (Table 4).

Correlation across instruments and metals was relatively poor, and lead does not appear to be a strong candidate to be used as a proxy for any of the other contaminants other than zinc. The least correlated pair was between copper measured by the XRF and cobalt measured by ICP-AES ($\varrho=-0.003$). The highest correlation was between nickel and cobalt when both were measured by ICP-AES ($\varrho=0.89$) (Table 5).

Cost Analyses

A month-long XRF rental (US$4,000 per month; metals only) is equal to 50 samples of laboratory analyses. For two and three month rentals, it would take 100 and 150 samples, respectively, of laboratory analyses to equal the rental cost. Purchase of the XRF is a possibility as well. In order for sampling costs to equal the outright purchasing price of the XRF, 438 samples would need to be analyzed. Hypothetical costs for an individual in a cooperative showed that sharing a one-month rental of the XRF between five people would cost US$800, the equivalent of 10 samples of laboratory analyses. A ten-person cooperative would require each individual to pay US$400, the equivalent of five samples of laboratory analyses. A 20-person cooperative would be required to pay US$200 for a month-long XRF rental, which would be equivalent to 2.5 samples analyzed in the laboratory.

Figure 1. Wilcoxon T-test Results for All Metals Comparing Laboratory Analyses and XRF Reported Concentrations



Asterisks indicate significant difference (****=p<0.0001)

Discussion

The majority of the soil had contaminant levels below their respective standards and should be considered safe for gardening and consumption. However, the results were highly variable when comparing the concentrations between methods. The XRF generally reported higher soil concentration levels for the metals in our panel than laboratory analyses. Overall the XRF reported signifi-

Table 4. Correlation and Linear Regression Results for Each Metal Between the Two Analytical Instruments

Metal	Spearman ρ	R^2	Slope
Arsenic	0.5306	0.5555	1.319 +/- 0.1192
Cadmium	0.2738	0.0582	0.3527 +/- 0.1433
Chromium	0.4019	0.2322	1.133 +/- 0.2080
Cobalt	0.5597	0.3020	3.844 +/- 0.5965
Copper	0.6628	0.4919	0.7508 +/- 0.0771
Lead	0.8237	0.7409	1.042 +/- 0.0632
Mercury	0.6160	0.2414	1.351 +/- 0.2419
Nickel	0.5317	0.0040	0.0580 +/- 0.0922
Zinc	0.7804	0.8185	1.098 +/- 0.0522

cantly higher concentrations for all metals except copper. This result is similar to that seen by Suh et al. (2016), where the XRF consistently reported higher concentrations than their validated methods. Few metals in our study showed a strong enough correlation between XRF and laboratory analyses to validate the XRF as an accurate screening field tool. Lead and zinc were the only metals that had an R^2 higher than 0.74.

These weak correlations between methods have important implications in terms of soil screening that must meet health-based and actionable regulatory standards. For example, most sites had no samples that exceeded the Louisiana Department of Environmental Quality (LDEQ) standard for all nine metals when using standard laboratory methods, whereas, in at least half of the sites, the XRF had at least one sample concentration that exceeded the LDEQ standard for four different metals. False positives when measured by the XRF could trigger further testing or unnecessary remediation efforts.

There are two primary factors likely affecting the accuracy of XRF screening: spectral effects and matrix effects. Spectral effects are caused when elements with similar spectral signatures are present in the same sample, and matrix effects can

Table 5. Spearman Correlation Coefficient Matrix Comparing Matched Sample Concentrations for Each Metal and Method of Analysis

Methods are indicated as X (XRF), I (ICP-AES), and C (CVAAS). Correlation coefficients of 0.6 or higher are **boldface**.

Method		As		Cd		Cr		Co		Cu		Pb		Hg		Ni		Zn
		I	X	I	X	I	X	I	X	I	X	I	X	C	X	I	X	I
As	X	0.53																
Cd	I	0.38	0.25															
	X	0.21	0.40	0.27														
Cr	I	**0.72**	**0.62**	0.29	0.17													
	X	0.41	0.58	0.20	**0.64**	0.40												
Co	I	0.56	0.35	0.26	0.48	0.42	0.50											
	X	0.44	**0.62**	0.32	0.52	0.49	**0.61**	0.56										
Cu	I	0.53	0.48	0.42	0.08	0.58	0.20	0.16	0.34									
	X	0.31	0.42	0.21	0.00	0.44	0.05	-0.01	0.28	**0.66**								
Pb	I	0.51	0.58	0.45	0.31	0.52	0.36	0.47	0.45	0.57	0.25							
	X	0.38	**0.80**	0.35	0.40	0.53	0.52	0.38	**0.61**	0.50	0.39	**0.82**						
Hg	C	**0.60**	0.56	0.36	0.40	0.54	0.47	0.58	0.54	0.54	0.25	**0.84**	**0.70**					
	X	0.45	**0.69**	0.36	**0.74**	0.48	**0.78**	**0.63**	**0.79**	0.33	0.17	0.57	**0.69**	**0.62**				
Ni	**I**	0.57	0.40	0.25	0.47	0.47	0.52	**0.89**	0.58	0.16	0.00	0.56	0.48	**0.62**	**0.62**			
	X	0.31	0.52	0.22	**0.69**	0.35	**0.62**	0.58	**0.72**	0.22	0.14	0.38	0.47	0.48	**0.83**	0.53		
Zn	**I**	0.48	0.55	0.49	0.30	0.53	0.35	0.42	0.50	**0.71**	0.39	**0.80**	**0.70**	**0.68**	0.57	0.42	0.36	
	X	0.40	**0.67**	0.40	0.35	0.59	0.44	0.36	0.58	0.57	0.59	**0.65**	**0.79**	0.54	0.59	0.36	0.39	**0.78**

enhance or absorb the signal. A matrix without homogeneity can affect the accuracy of the readings as well (Schatzlein, 2015). The high LOD of the XRF is another reason for the high number of samples and sites that exceeded the LDEQ standard. For example, while ICP-AES readily detects cadmium at levels below the LDEQ standard, the LOD for the XRF was nearly four times higher than the state standard.

Further sample preparation could help improve the accuracy of the XRF. A study conducted by Hu, Huang, Weindorf, & Chen (2014) had similar XRF results to ours when sampling *in situ*. However, when they removed the sample and performed further preparation and analysis *ex situ*, they saw the accuracy of the XRF improve to levels deemed acceptable by the EPA. While performing these extra sample preparations could have improved the accuracy of the results seen in our study, it would also raise the barrier for a layperson with minimal training to perform sampling, a potential major benefit of the XRF.

Correlation analyses between metals and instruments were not accurate enough to warrant any consideration of lead as a proxy for other contaminants. Most of the highest correlated results were within the same testing method, and some of these were artifacts of the high LOD, such as the correlation between mercury and chromium concentrations using the XRF.

The cost comparison between the XRF and laboratory methods was initially conducted assuming the accuracy of the results would be similar. Had that been the case, the XRF would serve as the more cost-effective solution for sampling as the number of samples increased. Given the relatively poor accuracy of the XRF compared to standard laboratory methods, cost should not be considered as a primary variable in deciding which method to use.

The interest shown by the growers in this study to have their soil tested indicated a great need in the urban agricultural community to provide testing that goes beyond soil nutrient and pH testing. To assist growers, agricultural extension programs should expand their capabilities in three ways. First, there is a need to provide resources for growers that address proper sampling strategies. This would allow growers to determine the range of contaminants in their soil with statistical certainty. Second, they need to expand their capability to include testing for common contaminants. Standard testing typically includes nutrients, pH, and lead. Third, educators need to provide information that explains to non-scientists what the results mean and how to minimize exposure. Kim et al. (2014) found that many growers were concerned about their ability to interpret soil contamination test results. Expansion of the CDC and ATSDR's soilSHOP program could help to provide resources to growers in underserved areas. However, the soilSHOP program only uses XRF technology for soil screening; results from our study indicate that the XRF is currently not accurate enough when used *in situ* (ATSDR, n.d.).

This study sought to quantify contamination in urban agricultural soils using XRF and to determine the accuracy of the XRF when compared to standard laboratory methods. However, there were limitations that should be addressed in future studies. First, the sampling of sites was driven by requests from producers in response to the study advertisement. This could have led to self-selection bias in the sites sampled and possibly caused us to select more heavily contaminated sites due to concerns of the producers; however, producers would likely need to have some previous knowledge of contamination for that to be a factor. Second, the different depths of sample analysis corresponding to different methods could have contributed to the difference in results. Our study did not do any further preparation of the samples when sampling using the XRF. Further sample preparation, as shown by Hu et al. (2014), could have improved our correlation results. However, this would have likely made the sample analysis more complicated than what would be done by a layperson sampling their site. Finally, while not a direct limitation of our study, soil standards are often developed from limited information and are sometimes "abstract from real environment conditions and arbitrary for site-specific conditions" (Desaules, 2012). Additional studies using toxicology and epidemiology need to be conducted to improve soil standards so that they are tied to exposure and human health outcomes.

Further studies should focus on two distinct areas. First, in the area outside of the authors' expertise, there is a need for continued advancements in XRF technology. The ideal target would be the development of field-portable units that provide reliable results that meet or exceed EPA standard methods. Second, there is a need for research to inform policy in the development of health-relevant soil contamination standards. Not all standards are based on health risk models. Development of health-risk models to better determine safe contamination levels will inform government agencies, agricultural extension programs, and individual farmers and gardeners about safe exposure levels and gardening practices.

To conclude, this study found that urban agricultural sites in New Orleans were generally safe for growing produce intended for human consumption, based on standard laboratory methods of analysis. Furthermore, unless additional sample preparation is conducted, the accuracy of the XRF needs to be improved before it should be used to detect soil contamination levels in an urban agricultural setting. If improved, the ability of the XRF to rapidly analyze a great number of samples would make it an excellent tool for analyzing the safety of urban agricultural sites.

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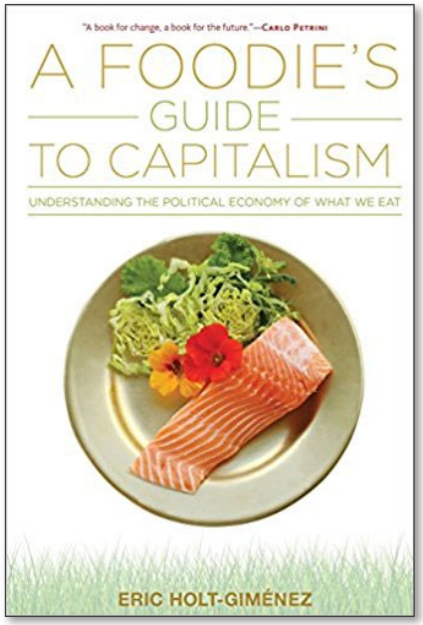
Taking on the C-word

Review by Teresa M. Mares *
University of Vermont



Review of *A Foodie's Guide to Capitalism: Understanding the Political Economy of What We Eat*, by Eric Holt-Giménez. (2017). Published by Monthly Review Press. Available as hardcover, paperback, and ebook; 280 pages. Publisher's website: https://monthlyreview.org/product/a_foodies_guide_to_capitalism/

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What role does love play in challenging the devastating impacts of capitalism on our food system? What role does hope play? For Holt-Giménez, the author of *A Foodie's Guide to Capitalism*, both love and hope are essential in building a more just and sustainable world, and his newest book is inspired by his long career of allying with those "for whom giving up was not an option" (p. 240). Concluding a treatise on understanding the inner workings and history of capitalism with a call for love and hope might seem trite at first glance. And yet, this is perhaps the best indication of the narrowness and cynicism that often dominate the thinking of those of us who consider ourselves food activists. Another world is indeed possible, and Holt-Giménez gives us the tools we need to better understand the ways that capitalism—and racism—and sexism—and classism—stand in the way of that world. This is the kind of intersectional analysis that we need in the face of climate change, the plundering and privatization of our natural resources, and the ongoing attacks on democracy and progressive politics. *A Foodie's Guide to*

* Dr. Teresa Mares is associate professor of anthropology at the University of Vermont. She is writing a book on border politics and food access issues among Latino/a dairy workers in Vermont, entitled *The Other Border: Sustaining Farmworkers in the Dairy Industry*. She is co-director of Huertas, a food-security project for Latino/a dairy farmworkers. She is devoted to experiential, transformative modes of teaching and has advised dozens of students who seek to make a difference in the contemporary food system. She can be reached at Teresa.Mares@uvm.edu.

Capitalism allows the reader to understand how these kinds of wicked problems are interrelated with the ways that food is grown, distributed, consumed, and wasted.

Holt-Giménez takes us from his the first chapter, "How Our Capitalist Food System Came to Be," and guides us through subsequent chapters focusing on the commodification of food, the birth of the private-property system amidst the growth of agriculture, power and privilege in the food system, and finally, the crises and solutions in our food system. The conclusion, entitled "Changing Everything: Food, Capitalism, and the Challenges of our Time," reminds us that it is not only the food system that needs change, but indeed, it is *everything.*

Holt-Giménez writes primarily for a U.S.-based audience, stating that this book "applies a food-systems framework to explain some of the basic workings of capitalism, and uses a basic understanding of capitalism to understand why the food system works as it does" (p. 14). This systems framework allows the author to take a holistic approach that acknowledges the interconnections between the food system and capitalism that food movement activists often overlook as they take on the immediate problems that confront them. As the author notes, this is understandable given the enormity of the problems, but it also "eclipses work to build longer-term political movements that could address the root causes of these problems" (p. 14). Combined with the fact that the political economic structures of capitalism are often taken for granted as immutable, Holt-Giménez endeavors to denaturalize capitalism by outlining the ways that it has been deliberately built by those who stand to benefit from it.

One major strength of this book is its accessibility and readability, a testament to Holt-Giménez's clear and coherent writing and narrative tone. I could equally imagine suggesting that my mother read this book in her pursuits to better understand the power of Monsanto and Cargill or assigning it to graduate students in our Ph.D. program in Food Systems who are grappling with social theory. Often overlooked in the back matter, the glossary offers a useful shortcut to the key concepts, institutions, and historical moments that are detailed in the book. The essays written by food activists like Rosalinda Guillen and George Naylor also lend a polyvocality that nicely complements Holt-Giménez's own analysis. Moreover, the sidebars that zero in on topics such as "Food Waste at a Glance," "The Pedagogy of the Oppressed," and "Women Farmworkers" outline areas that the reader can explore further with the aid of the author's helpful references.

As an anthropologist, I particularly appreciated the author's historically rooted analysis of the co-evolution (or co-devolution) of private property, the commodification of food, and the changing nature of human social structure over time. This is precisely the take on history that I attempt to teach in my classes on food and culture, and I know that my students would find this concise yet detailed analysis exceedingly useful. Knowing this history is key to understanding our contemporary food system and how it shapes and is shaped by our cultural values and priorities. At its core, *A Foodie's Guide to Capitalism* is an expertly written guidebook on how we might revalue food and those who bring it to our table as we work toward a more just and sustainable world.

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A primer on local food systems

Review by Amber A. Heckelman *
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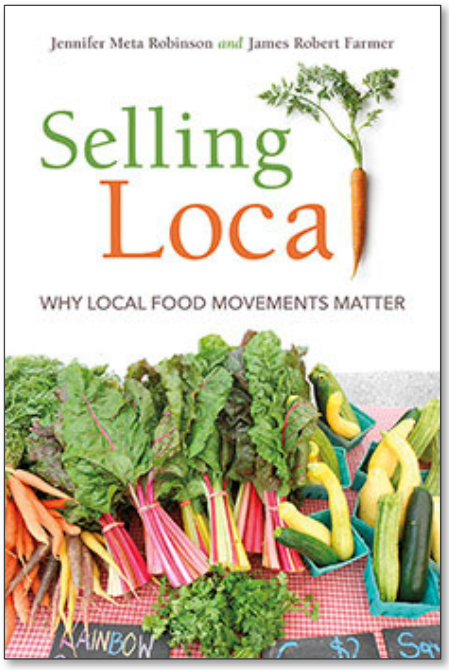

Review of *Selling Local: Why Local Food Movements Matter*, by Jennifer Meta Robinson and James Robert Farmer. (2017). Published by Indiana University Press. Available as paperback and ebook; 230 pages. Publisher's website: http://www.iupress.indiana.edu/product_info.php?products_id=808693

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Jennifer Robinson and James Farmer's *Selling Local: Why Local Food Movements Matter* consolidates decades of research on the local food movement, drawing attention to the array of local food developments in the U.S. Midwest and Appalachia regions. The authors provide a narrative that weaves together voices from various stakeholders, taking the reader from farmers markets to community supported agriculture (CSA) to food hubs, while providing a scholarly analysis of the diverse capacities and limitations of these enterprises as well as offering a framework for assessing local food initiatives.

The title and content page hint at the underlying purpose of this book, which is to support the local food movement by identifying strengths, weaknesses, and leverage points that may be tapped to improve the capacity and success of diverse initiatives—all of which are necessary and important endeavors for cultivating and expanding local food systems.

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As a food system researcher, I was pleased that the authors contextualized the local food movement as a response to the increasingly globalized political economy, reflecting concerns with resource depletion and environmental degradation and also campaigns for social justice and equity. These issues are often addressed in vague or indiscernible terms in other works, but Robinson and Farmer use this context to provide both background and foreground to their narrative. This technique serves to maintain the reader's awareness of the complexity surrounding and occupying the local food space.

It was also refreshing to read a narrative that accounts for the role of historical processes and institutional mechanisms in creating the socioecological conditions that shape communities and characterize stakeholder experiences. The reader comes away with, for example, an understanding of how neoliberal economic policies sometimes compromise the ability of people, communities, and local producers and businesses to meet their needs by limiting access to educational opportunities and support services. Or how legacies of racism and discrimination remain prominent features in the food system landscape, in the form of barriers to land access and financial services and inequitable power dynamics within communities.

The authors provide many examples that illustrate why local food matters, describing how it (re)builds important connections that are favorable to communities, the environment, and our economies by fostering accountability, stewardship, and systems thinking. For instance, the many different iterations of local markets (e.g., crossroads, propriety, farmer-organized, public grower-vendor, and city renewal) are presented as spaces for citizenship, learning, creativity, community, and social responsibility. Similarly, the diverse iterations of CSAs and food hubs are also described as serving multiple purposes. And accompanying these descriptions are color photos depicting vibrant local food systems.

Readers interested in social-justice issues might be disappointed, however, as the discussion of social justice is mostly descriptive and less oriented toward suggesting pathways for addressing the historical configurations responsible for the inequalities that persist in these regions (e.g., differences in wealth, power, privilege, and resource access). The authors' acknowledgement of white privilege is noteworthy, but deserving of a more extensive consideration given the cries for equity and diversity in alternative agrifood movements—and in light of the current political climate, which is becoming increasingly hostile toward historically marginalized populations. There are some notable exceptions to this critique, however, as the authors do discuss some of the efforts being made to attract a broader demographic (beyond the white middle class currently occupying the local food space) through food literacy and diversity, food assistance programs, and alternative and progressive payment systems, to name a few. And there is an excellent critical discussion of how grassroots development initiatives do not necessarily result in improvements in equity and inclusion. Despite these contributions, readers are likely to be left grappling with how to effectively carryout social justice campaigns within their local food systems and the wider local food movement.

What is wonderful about this book is that Robinson and Farmer provide an intimate and comprehensive account of the local food movement that is unfolding in Bloomington, Indiana, and Huntington, West Virginia. The stories and reflections shared by community members and stakeholders bring the reader into the tensions, vibrancy, struggles, rewards, shortcomings, and triumphs that characterize the experiences of many local food proponents. Missing from the narrative, though, are voices of farmworkers and workers in the food-service industry; there is a very limited discussion of how their experiences and advocacies are being incorporated into the local food discourse in these regions.

In spite of this, the authors succeed in introducing readers to the nuances and intricacies of local food initiatives. Readers will come away with an understanding of the many dimensions (e.g., temporal, scale, social, environment, economic) of *local* and why the success of a local food system depends on the ability of proponents to account for its complexity and understand the socioecological conditions in which it is embedded. Readers will also come away feeling inspired and in awe of

the many ways food shapes our lives, communities, and experiences in the world.

Robinson, a professor of practice in anthropology at Indiana University, and Farmer, an assistant professor in the School of Public Health at Indiana University, demonstrate their expertise in local food systems, providing readers with content that is both accessible and interesting to students, farmers, food system investors, and perhaps even conscious consumers. While this book likely will not satisfy veteran researchers looking for detailed statistics, it is well suited for novice researchers, educators, advocates, and anyone looking for a good primer on the evolving concept of *local* and its attributes in distinct sectors of the food system. Overall, the book is a valuable contribution to the local food movement.

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Saying yes to the precautionary principle

Review by Darcy Mullen *
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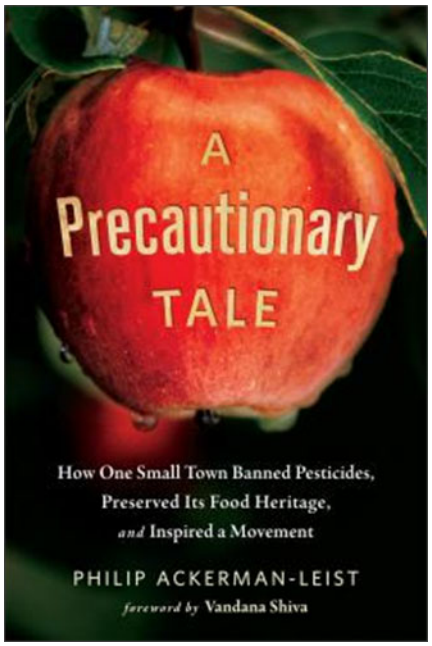

Review of *A Precautionary Tale: How One Small Town Banned Pesticides, Preserved its Food Heritage, and Inspired a Movement*, by Philip Ackerman-Leist. (2017). Published by Chelsea Green Publishing. Available as hardcover, paperback, and ebook; 280 pages. Publisher's website: https://www.chelseagreen.com/product/a-precautionary-tale/

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In *A Precautionary Tale: How One Small Town Banned Pesticides, Preserved Its Food Heritage, and Inspired a Movement*, Philip Ackerman-Leist tells the story of Mals, in Northern Italy. He does it in a way that makes the reader feel as if they have visited a very special place and an equally singular moment in time. Just as notably, this biography of place holds a steady eye to turns in elegant language. The title explains what happens in the book. The combination of the humanistic details and *how* the story is told, however, makes for a contemporary socio-agricultural fairy-tale (if such a genre can exist), complete with a supplemental chapter at the end of the book called "An Activist's Primer: How To Push Back on Pesticides At Home" (pp. 195–199).

Snapshots from the book could be easily confused with contemporary literature or prose. The last chapter ("*Ja!*"), the end of the story, concludes with the aphoristic, "sometimes the future is dependent upon what we save from the

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Darcy Mullen, Ph.D., is a 2017 Postdoctoral Marrion L. Brittain Fellow at Georgia Institute of Technology. Mullen received her PhD at the University at Albany, with a strong interdisciplinary focus on the Rhetoric of Food, and Social Movement Studies. Her current book project, The Food and Drink of Atlanta, is forthcoming with Rowman and Littlefield's "Big Food Cities Biography" series.

past, and sometimes it's more about what we decide to leave behind" (p. 192). This sentence is reminiscent of writings from authors like the award-winning Kazuo Ishiguro, the most recent Nobel Prize winner in literature. Ishiguro won the prize for writing that "…has uncovered the abyss beneath our illusory sense of connection with the world" (Nobelprize.org, n.d., para. 1). It is not hyperbolic to argue that Ackerman-Leist has used the case study of Mals to tell a story about our connection with the world, and the problems (ecological and political) that ensue when those connections seem so illusory that they slip into an abyss beyond our control.

In chapter 11, "Manifesto," we get a clear outline of the legal and philosophical underpinnings that Mals both fought against and worked to preserve. In the foreword by Vandana Shiva we first see the fundamental point of the manifesto: "our right to be free from harm" (p. ix). Throughout history, these ideological foundations, when created in good faith, have provided an ethos to help us navigate the illusory sense of connection we may feel with the world. The manifesto starts with "*Primum non nocere*: First, do no harm," bringing us into the discourse of modern medicine (p. 154). From there it moves to a recognition "that the principles of regenerative agriculture and holistic medicine were parallel in philosophy and approach" (p. 154).

Next, we get the full manifesto created by scientists and activists in Mals. The "premise" section of the manifesto concludes with the following: "The age-old principle of law must apply to all: 'The freedom of the individual is limited by the rights of our neighbors'" (p. 155). Ackerman-Leist further explains that the manifesto was intended to address the problem, in our sense, of "crop protection"—that it "had somehow taken priority over the protection of humans and their environment" (p. 156). He bridges 18th century European philosophy (Kant's *Metaphysics of Morals*) with the contemporary concept of "the precautionary principle" (pp. 156–161). In other words, this puts the onus for "proof for safety upon those who create or manufacture elements of risk" (p. 156), not on citizens. This is a highly anti-neoliberal principle that is at odds with the politics of blame-the-consumer in our food system. Mals' resistance, then, is not just a matter of maintaining healthy and safe connections between humans and the environment. It is the blueprint for resisting neoliberal regulations that seek to encourage disconnection from our environment.

Toward the end of chapter two, "Roots of a Rebellion," I found myself Googling, printing, and annotating a map to try to figure out the geographic intersections of Mals. My familiarity with the geography of Northern Italy is minimal. The absence of a map orienting the reader with very tiny towns in Northern Italy, and surrounding towns and landmarks, unfortunately distracted from the reading while I was generating a map for myself.

In the end-matter of the book, we see the full possibilities of this book as a metatextual project, with its companion website.[1] At the time that I first read the book, the website was still under construction. Ackerman-Leist emphasizes that the story of Mals' resistance relies on visual rhetoric that I very much wanted to see. For example, in the chapter "Bufferless," we get the following description of agricultural scope: "with an average of thirty pesticide sprayings per year in those orchards, it's not just the apples that are spreading. It's hard to picture what it looks like. Until you photograph it, that is" (p. 43). I was salivating for a photograph, because he is right—it is hard to picture what *this* looks like. I felt this often, wanting to see an image of the '"resistance sunflowers" (p. 171), or one of the bedsheets that had been turned into a protest banner that was the subject of chapter 10 (pp. 141, 149–151).

The companion website delivered on the multimodal possibilities with this book and its larger project. It offers the visuals and extratextual materials that show the importance of visual communication in this movement. Moreover, this rich website would make this book an excellent addition to a higher-education classroom.

The thing I keep returning to from this book is the value Malsers put on the logic of aesthetics in their rhetoric of resistance. Early on, the resistance adopted a strategy of "yes" vs. "anti" in order to

[1] http://www.topplinggoliath.org/

"focus on what you want, not what you oppose" (p. 149). That is, it called to *promote health* rather than *oppose sickness*. Rhetoric alone is not what made this movement successful, but it is an element that cannot be ignored. The last sentence of the book declares, "It's hard to say no to yes" (p. 199). This rhetoric for resistance surely is not a one-size-fits-all approach. As we work in our different communities to build sustainable and valuable connections between ourselves and our environment, it is worth examining the rhetoric of our resistance, and ask where we may have opportunities for "yes." 

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The food sovereignty project: Advancing theory and practices

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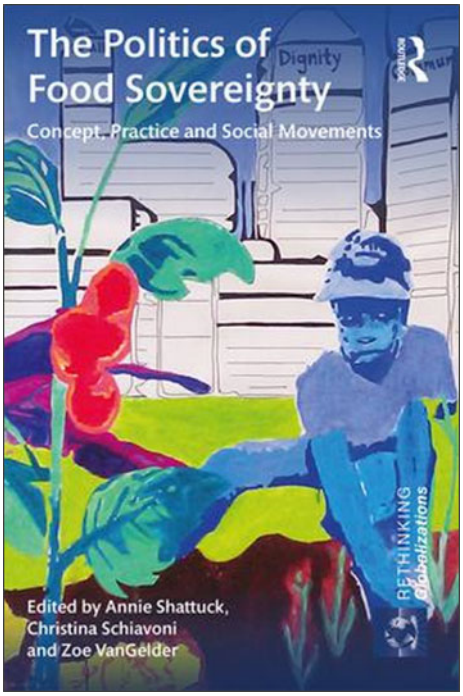

Review of *The Politics of Food Sovereignty: Concept, Practice and Social Movements*, edited by Annie Shattuck, Christina Schiavoni, and Zoe VanGelder. (2017). Published by Routledge. Available as hardcover; 162 pages. Publisher's website: https://www.routledge.com/The-Politics-of-Food-Sovereignty-Concept-Practice-and-Social-Movements/Shattuck-Schiavoni-VanGelder/p/book/9780415787291

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In *The Politics of Food Sovereignty: Concept, Practice and Social Movements*, editors Annie Shattuck, Christina Schiavoni, and Zoe VanGelder bring together some of the seminal contributions of the Yale McMillan Center Agrarian Studies Program's 2013 conference focused on food sovereignty ("Food Sovereignty: A Critical Dialogue"). These proceedings were originally published in a special issue of the journal *Globalizations* (volume 12, issue 4, 2015). This book is valuable in general as it discusses the upcoming challenges and contradictions of food sovereignty, a rising concept and political movement in the Global South and North. Contrasting with the food sovereignty literature to date, which has mainly focused on the Global South (from which food sovereignty movements have emerged), this book shows how the original idea has expanded to encompass the Global North and urban communities. This book includes cases

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studies from the U.S., Canada, Russia, Peru, and Venezuela, demonstrating that many types of sovereignties may exist and coexist at different scales, which is a big challenge.

The book is structured as follows. In the first chapter, the editors set the stage for the rest of the book by bringing up the real challenges of the food sovereignty movements, namely, the contradictions surrounding scale (local vs. national; communal vs. individual), power relations (sovereignty for whom), gender issues, the disconnect between ideas from the rural south and those from the urban north. Then, the authors highlight the research gaps and issues faced by practitioners when operationalizing food sovereignty.

Chapter 2 and 3 present complementary views on food sovereignty from a human rights perspective. In chapter 2, Philip McMichael, who has published widely on the "agrarian question,"[1] presents the multiple issues faced by the food sovereignty movements from the land user's point of view. In chapter 3, Priscilla Claeys presents the work over the last 20 years of La Via Campesina to institutionalize both "rights to food sovereignty" and "peasant's rights" as human rights. She shows how the human-rights perspective has the benefit of bringing together activists from different realities, although the human rights perspective's focus on the individual can have limited effects against capitalism and neoliberalism. La Via Campesina emphasizes an alternative conception of human rights that stresses the collective dimension of the peasants' demands and focuses on the different scales of decision-making.

In chapter 4, Christina Schiavoni draws on Raj Patel's concept of multiple and competing sovereignties to develop a conceptual framework and apply it to an example in Venezuela to examine the *competing sovereignties* practices through the lenses of scales, geography, and institutions. The different conceptions of scales enable her to emphasize the importance of looking at food sovereignty from a relational perspective as developed in the next chapter. Indeed, some of the most interesting insights of the book are surely those of Alastair Iles and Maywa Montenegro de Wit in chapter 5. They use the concept of relational scale, "the spatial and temporal relationship among processes at different levels, as well as the processes connecting elements between levels" (p. 66), to suggest practical strategies to achieve food sovereignty. What is particularly important with the relational scale approach is that strategies to achieve food sovereignty occur across scales and not solely at the local level. Using the example of the Potato Park in the Peruvian Andes, they show how multiple sovereignties are reached by negotiating and forging partnerships through different scales effectively enabling the Potato Park to gain legitimacy and be recognized as sovereign. This makes food sovereignty a practice of creating connectivity as well as autonomy (p. 74).

Moving from issues of scales in relation to food sovereignty to everyday practices across local contexts, Meleiza Figueroa proposes in chapter 6 to shift from a food-focused analysis to a people-centered approach using the example of an urban initiative in the Global North. In other words, she argues that the daily practices of individuals are informed by their resources, histories, knowledges, and personal goals, all of which can be harnessed to advance alternative solutions, gain autonomy, and foster resilience. The people-centered approach then helps us envision political trajectories of food sovereignty considering specific geographical and historical contexts.

Building from chapter 6, the next four chapters (7 through 10) provide examples of how food sovereignty is necessarily place-based, rooted in unique histories and geographies that produce the very circumstances of contestation and activism: in Russia, food sovereignty is somewhat "quiet" since contestation is weak or seen as such (chapter 7); in Hawaii, anti-GMO struggles are also a place-based food sovereignty movement (chapter 8); in California, "occupy the farm" is a way to promote new norms for land access and food sovereignty in the Global North (chapter 9); and in Manitoba, a community-based food program is seen as way to reinforce food sovereignty in an indigenous context (chapter 10). What is valuable about these four chapters is that they provide examples of

[1] Rooted in Marxist political economy, the agrarian question seeks to answer why family farms have persisted despite increased capitalistic pressures and conflicts over land access.

greater theorization and conceptualization of food sovereignty.

The main contributions of this book are the conceptual developments, such as multiscale food sovereignties, relational scales, and everyday life practices, as well as the examples that move beyond the global focus of food sovereignty (which nevertheless remains important) to subnational and/or regional levels and from the peasant and rural focus to consider urban experiments. Together, the conceptual development and examples enhance our understanding of the powerful potential of food sovereignty as a project and as a movement. For those who posit that food sovereignty is mostly an ideology or a utopia, this book provides concrete scientific evidence toward sustainable and just ways to transition. A major drawback of the book is that despite the complementarity of the chapters, the editors of the book did not provide a conclusion. Such a conclusion would not only provide an answer to the key interrogations of the book, but would also highlight a research agenda calling for a broadening of food sovereignty research beyond the current focus on the Americas. Indeed, from a European viewpoint, an open call for more comparative research across geographies is urgent to provide more consistency in the exploration of food sovereignty to lead to a greater understanding and stronger theories and conceptualizations across contexts. Thinking about the audience for this edited book, it seems most suitable for graduate students and researchers who already have a grounding in the concept of food sovereignty.

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Food systems leadership: A neglected field

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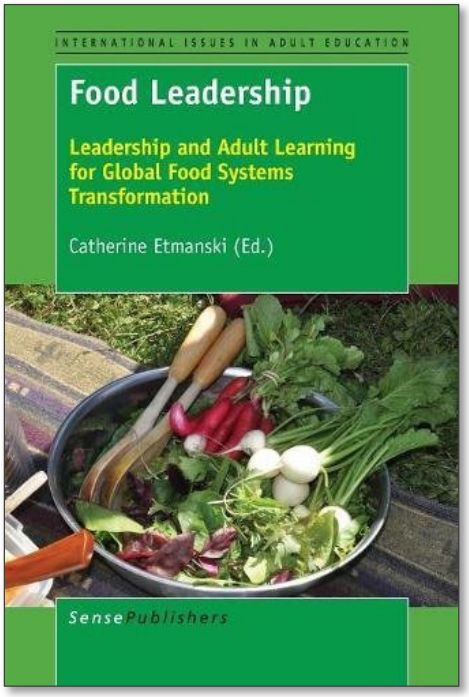

Review of *Food Leadership: Leadership and Adult Learning for Global Food Systems Transformation*, edited by Catherine Etmanski. (2017). Published by Sense Publishers. Available as hardcover, paperback, and ebook; 190 pages. Publisher's website: https://www.sensepublishers.com/catalogs/bookseries/international-issues-in-adult-education/food-leadership/

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Food Leadership: Leadership and Adult Learning for Global Food Systems, edited by Catherine Etmanski (2017), consists of eight papers in three sections: Indigenous food systems, leadership in global food system transformation, and learning in global food system transformation. Leadership, although a contested concept (Grint, 2005), has been broadly defined by Bass and Bass (2008) as "the ability to influence, motivate, and enable others to contribute to the effectiveness and success of the organizations of which they are members" (p. 23). Global food insecurity remains a persistent problem despite decades of intervention and billions of dollars of investment (Barrett, 2010; Rosegrant, Paisner, Meijer, & Witcover, 2001); yet, very little research has focused on leadership for food system transformation (Etmanski, 2017). This

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volume presents a long overdue treatment of an important yet neglected subject.

The Indigenous food systems section begins with Adrianne Lickers Xavier's discussion of the *Our Sustenance* initiative in Six Nations, her home community. The *Our Sustenance* initiative has two main foci: food access and education. It comprises several programs, including a farmers market, Good Food Box program, a community garden, and a greenhouse. Lickers Xavier notes that, in Six Nations, food security is addressed on cultural, social, and community levels. This reflects the holistic nature of food in Haudenosaunee culture and suggests that food systems initiatives need to inhabit a range of societal domains to be successful in Haudenosaunee communities.

Lickers Xavier introduces the "Three Sisters" agriculture system common to the Haudenosaunee and other Indigenous communities in North America (Trotman Martinez, 2007). She explores the cultural and ecological significance and role of each "sister"—corn, beans, and squash—revealing the genius of the Three Sisters polyculture system. Lickers Xavier's description of the *Our Sustenance* initiative and its integration into the lives of Six Nations community members provides a snapshot of the cultural context of a fulsome and inspiring contemporary Indigenous food systems initiative.

In chapter three of the Indigenous Food Systems section, Reader and Dew Johnson describe the devastating impacts of the residential school system on the Tohono O'odham community, specifically regarding the loss of traditional food knowledge and practices. Historical trauma associated with residential schools, as the authors suggest, negatively affects contemporary Indigenous perception of, and engagement in, education. This important point, among others, justifies radical approaches to decolonizing Indigenous education. In this chapter, the authors profile the *New Generation of O'odham Farmers* program, a community-based food sovereignty program that utilizes a culturally appropriate pedagogic model to re-build the Tohono O'odham food system. The *New Generation* program consists of two farms that produce traditional foods, a wild food program, school gardens and associated curriculum, a food service social enterprise, an affordable traditional foods café, and various educational and cultural events.

The *New Generation* program employs a transformative learning model with three elements: (1) an experiential and critical approach drawing on Freire's (1970) idea of *conscientization*, which combines critical reflection and action to raise students' consciousness; (2) recognition of the complexity of Indigenous agricultural knowledge and its adaptive application to equally complex environments; and (3) experimentation to rediscover lost traditional knowledge. The authors refer to their model as transformative, and they provide evidence of the transformative impact of this work, but they do not connect their model to Mezirow's transformative learning theory (1991). It would be valuable for other educators to have a sense of the extent to which Mezirow's theory is culturally appropriate for Indigenous contexts. This well-written chapter, reporting on an exciting and innovative Indigenous food sovereignty initiative, makes an important contribution to our understanding of culturally relevant pedagogy for food system transformation.

Several themes, common to all of the chapters in this section, reveal some of the pressing issues and aspirations present in the three Indigenous cultures discussed. The impacts of culture loss on traditional food systems, the importance of informal and experiential learning, risks associated with genetically modified crops and the importance of the genetic diversity of Indigenous crop varieties, and the specificity of Indigenous agroecological adaptive cropping systems are highlighted. Finally, each article presents a hopeful vision of a future in which Indigenous communities regain sovereignty over their own food systems, revitalize traditional food knowledge, and foster healthier communities through increased consumption of traditional foods and engagement in traditional food practices.

In chapter 4 of the Leadership in Global Food Systems Transformation section, Day Farnsworth interrogates the disconnect between the food justice values espoused by food policy councils (FPCs) and the practices they enact. The author points out a key tension around structure and purpose: should FPCs operate as governmental or arms-length *de facto* "departments of food" or should they function as community-based grass-

roots organizations—or something in between? The model adopted by a given FPC impacts the organizational culture and governance approach, which can ultimately influence the extent to which food justice is enacted.

Day Farnsworth suggests that organizational governance suited to managing organizations is not always compatible with governance approaches necessary to run grassroots initiatives, and that the increasing professionalization of FPCs has resulted in the adoption of more bureaucratic governance models. Day Farnsworth advances that FPC organizational structures and processes must support grassroots needs and aspirations rather than self-serving bureaucracy. The author makes a few practical suggestions, such as offering anti-oppression training to FPC members and expanding membership categories for appointment-based FPCs.

Langer's chapter, in the final section, explores the co-option of nonprofit activities by external bureaucratic demands. He presents a sympathetic view of the harried nonprofit coordinator without time to deconstruct the implications of the various organizational frames (e.g., municipal regulations) to which the organization is subjected, which may undermine its ability to serve its client population.

Langer introduces various organizational frames or discourses that influence garden coordinators and sublimate the needs of garden clients suffering from food insecurity. A notable discourse associated with nonprofits conflates poverty and hunger. The community garden nonprofit frame is directed by a focus on hunger as a proxy for poverty and is beholden to, among other things, the bureaucratic machinery necessary for nonprofit functioning (e.g., salaries for staff). Langer draws on Freire's (1970) concept of conscientization to suggest that nonprofit coordinators should improve their critical institutional literacy, which is essentially a set of skills that allows individuals to "challenge oppressive institutional structures more effectively" (p. 126), allowing garden coordinators to refocus on the needs of their client population. The insights presented by Day Farnsworth and Langer in their respective chapters could help nonprofit actors to re-orient their work for the benefit of the communities they serve.

In the conclusion, Goodall and Etmanski profile examples of social innovation[1] and evaluation in food system initiatives. Although social innovation presents tantalizing possibilities for addressing food system inequities, it arguably does so within a neoliberal framework (Brown, 2015) that emphasizes individualist agency and accountability within a capitalist market structure. While this may be suitable for incremental food system changes, social innovation may not yield the kind of profound changes advocated by some thinkers (Akram-Lodhi, 2013) and is not necessarily compatible with Indigenous worldviews that emphasize the importance of relationality and reciprocity with the human and more-than-human community (Sheridan & Longboat, 2006; Weber-Pillwax, 2001).

Agroecology—a lens for viewing the food system that encompasses both social and ecological dimensions—has been adopted as the agronomic standard by *La Via Campesina*, a transnational network of approximately 100,000 farmers and farm activists from 69 countries (Foran et al., 2014). Goodall and Etmanski suggest employing permaculture principles to food system leadership. Permaculture, a subset of agroecology, is an approach to the design of food-producing ecosystems that has achieved a level of popularity, primarily in the alternative food system community (Ferguson & Lowell, 2014). Ferguson and Lowell (2014), however, caution against permaculture's emphasis on individual agency as playing a depoliticizing role in the food system. Several researchers have applied permaculture principles to leadership practices; Mannen et al. (2012) and Henfrey (2018) provide evidence that permaculture principles, when applied at the organizational and community levels, can increase the resilience of those human systems. Madjidi (2014) conceives of 'inner permaculture' as a leadership approach to catalyzing a transformation of the human-nature relationship. More empirical and theoretical work is required to

[1] Social innovation involves the application of a suite of tools, concepts, or services that have the potential to enhance the well-being of individuals, communities, or society (Westley, Antadze, Riddell, Robinson, & Geobey, 2014).

develop permaculture principles into a comprehensive leadership theory with the capacity to address the complex socio-ecological challenges associated with food system transformation.

This volume breaks new academic ground, building on Kaak's (2012) article on sustainable food systems and leadership. Although this may be the first volume of work on adult education and sustainable food systems, there is a wealth of research on agriculture education and leadership conducted through agriculture and agriculture education departments in the U.S. land-grant college system (e.g., Greiman, 2009; Jordan, Buchanan, Clarke, & Jordan, 2013). However, much of this research is positivist and productionist in orientation rather than focusing on holistic food systems; consequently, such research addresses different questions than those typically posed by researchers who subscribe to an alternative vision of the food system. Only one of the papers in this volume, Das Gupta's assessment of Narendra Modi's leadership style, draws from the voluminous body of leadership theory, specifically transformational leadership (Bass, 1985).

The lack of reference to broader leadership research suggests that the contributing authors are food system researchers rather than leadership, or food system leadership, researchers. A more deliberate infusion of leadership research will help the nascent field of food systems leadership to build on appropriate elements from the leadership field and/or define itself against contemporary leadership theory. *Food Leadership: Leadership and Adult Learning for Global Food Systems Transformation* lays the groundwork for further research in food systems leadership, provokes us to think about food systems leadership in new ways, and presents us with practical suggestions for enhancing leadership functions in food system organizations.

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