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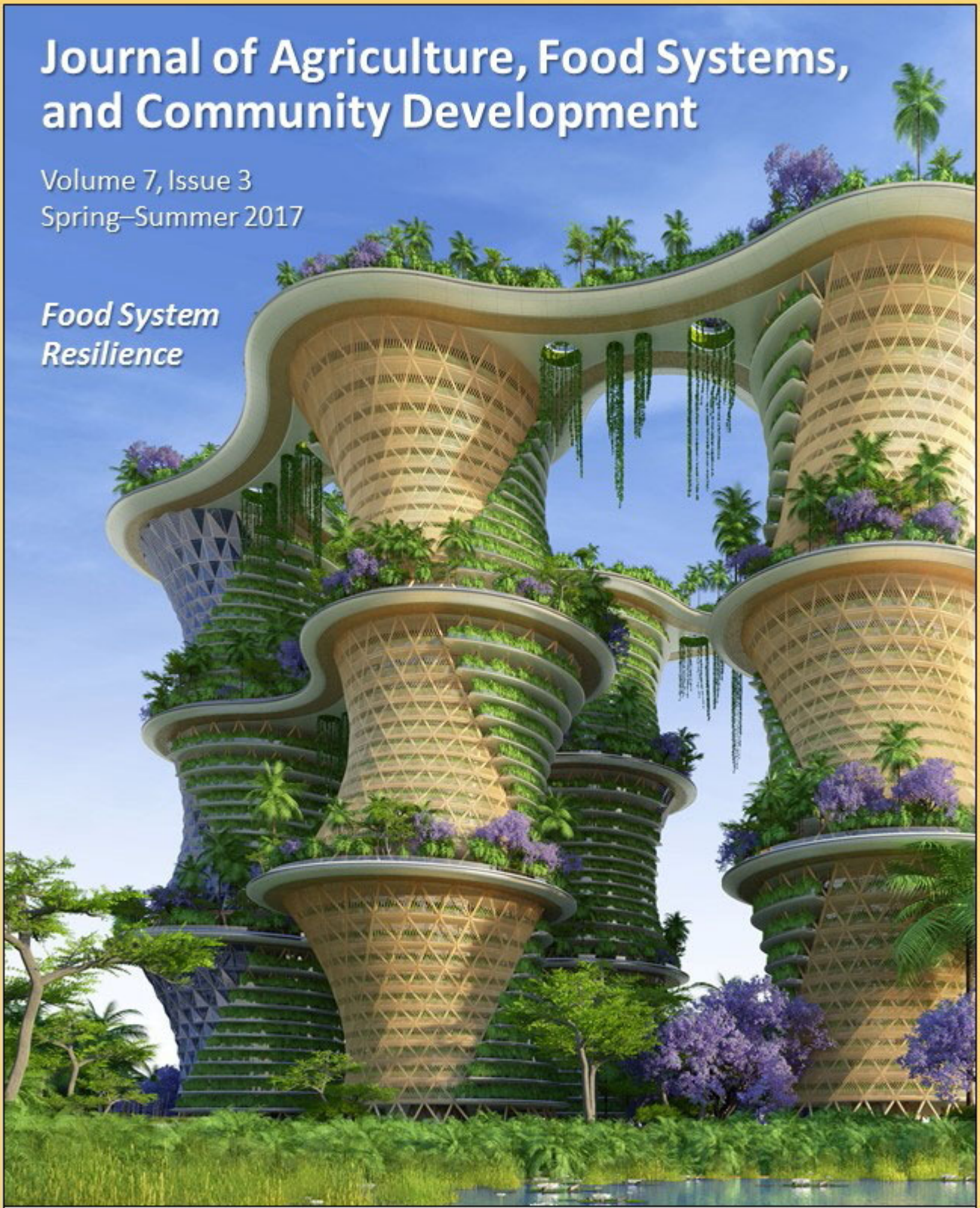
Spring–Summer 2017

Food System Resilience



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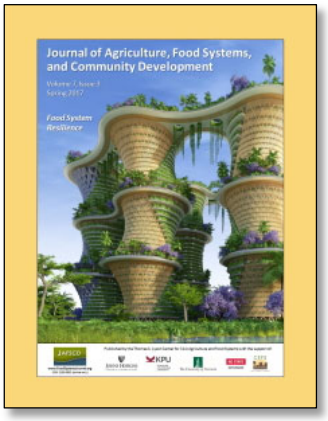

On our cover: A concept for resilience in 2020? In its schematic design phase, the Hyperions development proposed for Jaypee (a new city located in the Delhi National Capital Region, India) will include six 36-story multiuse timber towers and a site that integrate housing, co-working spaces, urban farming, agroecology, agroforestry, permaculture, aquaponics, phytopurification lagoons, and more.

(Rendering courtesy of Vincent Callebaut Architectures, Paris.)

(continued)

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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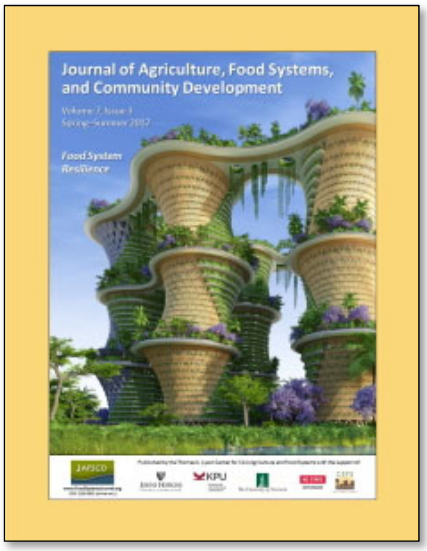
IN THIS ISSUE
DUNCAN HILCHEY

Food systems resilience



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In this combined spring and summer issue of JAFSCD we highlight the growing interest in food systems resilience, as depicted on our cover by the design of the Hyperions project by Vincent Callebaut Architectures. Strategies to promote food system resilience come in many forms, as we reveal in this issue—supporting critical organizational and physical infrastructure along with social capital; incubating new farmers; protecting farm landscapes; using season-extending technology; and supporting labor; as well as adapting to climate change and creating more and stronger connections between farmers of need and residents of need who are in close geographic proximity to each other. Furthermore, resilience can't come without the support of public- and private-sector actors, including local government and NGOs, who will need ways of measuring food system resilience as they address growing opportunities and challenges in their communities—whether in North America, Europe, or the Global South.

With this issue, we are pleased to welcome our newest columnist, **Teresa Mares**, professor of anthropology at the University of Vermont. Through her column, entitled *Cultivating* Comida: *Pushing the Borders of Food, Culture, and Politics*, Teresa will be following closely and commenting on Latinx/Hispanic issues in food systems work, and along the way introduce us to new words and ideas like *comida* and *alimento*, and perhaps even *impostura* (the peasant cultural norm of reciprocity in sharing food during both lean and not-so-lean times). Indeed, we have much to learn from our Latinx/Hispanic sisters and brothers who steadily make contributions to agriculture and foodways in the Global North; Teresa will help us understand and make the most of these rich opportunities.

On our cover: A concept for resilience in 2020? In its schematic design phase, the Hyperions development proposed for Jaypee (a new city located in the Delhi National Capital Region, India) will include six 36-story multiuse timber towers and a site that integrate housing, co-working spaces, urban farming, agroecology, agroforestry, permaculture, aquaponics, phytopurification lagoons, and more. *(Rendering courtesy of Vincent Callebaut Architectures, Paris.)*

In her column, *Freedom's Seeds: Reflections of Food, Race, and Community Development*, **Monica White** takes us on a trip down south to meet "freedom farmers" who played a critical role in the civil rights movement, and who continue to be influential.

In our final column for this issue, *The Economic Pamphleteer,* **John Ikerd** highlights the revival of urban agriculture and suggests that its full contribution to communities of need is severely under-appreciated.

Our final preliminary content is a commentary entitled *Fair Labor Practices in Values-Based Agrifood Supply Chains?* in which **Larry Burmeister** and **Keiko Tanaka** suggest that values-based agrifood supply chains could do a better job of prioritizing fair labor practices.

Our first peer-reviewed paper is *Eight Qualities of Resilient Food Systems: Toward a Sustainability/Resilience Index* by **James Worstell** and **John Green**, who continue their work on the quantitative measure of resilient food systems such as locally self-organized processing and marketing.

Next, **Diane Kuehn, Lisa Chase,** and **Thomas Sharkey** approach resilience from the perspective of maple producers in *Adapting to Climate Change: Perceptions of Maple Producers in New York and Vermont.*

Resilience is also explored in the context of farmland protection in support of sustaining farm communities in *Preserving Large Farming Landscapes: The Case of Lancaster County, Pennsylvania* by **Tom Daniels** and **Lauren Payne-Riley.**

In *Using Contribution Analysis to Assess the Influence of Farm Link Programs in the U.S.,* **Angela Hersey** and **Michelle Adams** identify factors that prevent most farm link programs from facilitating substantial numbers of farm transfers.

Next, **Karyn Stein, Miranda Mirosa,** and **Lynette Carter** explore the challenges in participatory and indigenous research methods in *It's Not Just About the Destination, But Also the Journey: Reflections on Research with Indigenous Women Food Growers.*

Sustainable Intensification, Community, and the Montpellier Panel: A Meta-analysis of Rhetoric in Practice in Sub-Saharan Africa by **Anne M. Cafer** and **Hua Qin** yields a disturbing lack of emphasis on community and food security in the sustainable intensification literature focused on sub-Saharan countries.

Krycia Cowling, **Ruth Lindberg**, **Andrew L. Dannenberg**, **Roni A. Neff**, and **Keshia M. Pollack** make the case that health impact assessments should be more widely undertaken as part of local food systems work in *Review of Health Impact Assessments Informing Agriculture, Food, and Nutrition Policies, Programs, and Projects in the United States*

In Assessing the Impact of the EQIP High Tunnel Initiative **Analena B. Bruce**, **James R. Farmer**, **Elizabeth T. Maynard**, and **Julia D. Valliant** find that, while EQIP is having its intended impact, those farmers who have self-funded their high tunnels report greater economic stability than farmers relying on the NRCS funds for their high tunnels.

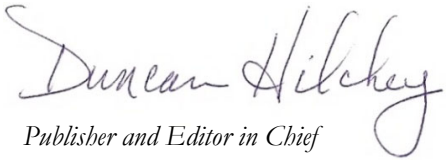
Jake C. Galzki, **David J. Mulla**, and **Erin Meier** move us closer to more realistic estimations of regional food production potential in *Mapping Potential Foodsheds Using Regionalized Consumer Expenditure Data for Southeastern Minnesota.*

In *Merging Opposing Viewpoints: Analysis of the Development of a Statewide Sustainable Local Food Advisory Council in a Traditional Agricultural State* **Molly De Marco, Leah Chapmen, Cordon McGee, Larissa Calancie, Lauren Burnham,** and **Alice Ammerman** shed light on the difficulty of launching a statewide food policy council in a commodity-driven environment.

Of course, as a double issue, we have a considerable number of book reviews. **Keith Williams** reviews *Conversations in Food Studies*, edited by Colin R. Anderson, Jennifer Brady, Charles Z. Levkoe; **Nathan Collins** reviews *Who Really Feeds the World? The Failures of Agribusiness and the Promise of Agroecology*, by Vandana Shiva; **David V. Fazzino II** reviews *Big Hunger: The Unholy Alliance between Corporate America and Anti-Hunger Groups*, by Andrew Fisher; **Carrie A. Scrufari** reviews *From Farm to Fork: Perspectives on Growing Sustainable Food Systems in the Twenty-First Century*, edited by Sarah J. Morath; and **Cassandra Hawkins Wilder** reviews *We Want Land to Live: Making Political Space for Food Sovereignty*, by Amy Trauger.

Finally, on a personal note, managing editor Amy Christian and I want to thank the JAFSCD community

for its outpouring of support after the loss of our son Tom Hilchey in June. As challenging as this has been to our own personal resilience, we have found solace in the work of this dual spring-summer issue, and greatly appreciate the patience and support of authors and reviewers in helping us bring it to fruition.



Publisher and Editor in Chief

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CULTIVATING *COMIDA:* PUSHING THE BORDERS OF FOOD, CULTURE, AND POLITICS

TERESA M. MARES

Finding *comida* in our everyday lives

Published online August 28, 2017

Citation: Mares, T. M. (2017). Finding *comida* in our everyday lives. *Journal of Agriculture, Food Systems, and Community Development, 7*(3), 5–7.
http://dx.doi.org/10.5304/jafscd.2017.073.016

As a professor, I am convinced that tinkering with a course syllabus is one of the best parts of the job. Each semester (admittedly, sometimes just a few days before it starts), redesigning the outline of required texts, assignments, and course expectations gives me a thrill that few other academic obligations do. This routine yet incredibly creative task allows me to stay up-to-date on the latest research, return to the classics, and consider what this generation of students *must know* about the anthropology of food. Over the course of ten years, from the time I was a graduate student to my current faculty position, I have had the pleasure of teaching various iterations of a class on Food and Culture. This class has ranged from a summer seminar of just 20 students to a large lecture of over 100, and from the University of Washington campus in urban Seattle to the University of

Dr. Teresa Mares *is associate professor of anthropology at the University of Vermont. Her research focuses on the intersection of food and migration studies, and particularly how diets and foodways of Latino/a immigrants change as a result of migration. She is currently examining border politics and food access issues among Latino/a dairy workers in Vermont and is writing a book on this topic, entitled* The Other Border: Sustaining Farmworkers in the Dairy Industry, *under contract with University of California Press. Recent publications include "Navigating Gendered Labor and Local Food: A Tale of Working Mothers in Vermont," in* Food and Foodways, *and a co-authored chapter, "Eating Far From Home: Latino/a Workers and Food Access in Rural Vermont," forthcoming in* Food Across Borders: Production, Consumption, and Boundary Crossing in North America.

Outside the classroom, Dr. Mares has led a number of community food projects. She is co-director of Huertas, a food security project for Latino/a dairy farmworkers connected to UVM Extension's Bridges to Health Program, and was previously co-director of the Food Justice Project for the Community Alliance for Global Justice in Seattle. 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.

Vermont, located in a state where we joke that cows outnumber people. Across these differences of time and geography, the ever-changing developments in the international movements for food justice, food sovereignty, and local food systems have provided a compelling framework for contemplating the meaning of food and our relationship to it. From the time of Mary Douglas and Marvin Harris arguing over the symbolic and ecological foundations for the pork taboo in Islamic and Jewish traditions to considering how LGBTQ rights intersects with food politics, the academic treatment of food is rarely dull.

Despite the tremendous changes in food activism and scholarship, there is a piece that has found its way on to my Food and Culture syllabus for the past eight years, and I do not anticipate dropping it anytime soon. A somewhat obtuse yet passionately argued essay, "Re-embedding Food in Agriculture" by Gustavo Esteva, is an exceptional treatise on the linguistic, philosophical, and cultural dimensions of food and agriculture. More than 23 years since it was published, and 24 years since Esteva originally delivered it as a keynote address, its underlying message remains more relevant than ever. A warning against the dangers of "modernity," a celebration of indigenous resilience, a challenge to how we define plenty and scarcity—Esteva's essay seamlessly moves between past, present, and future. As a student inspired by the food justice movement, and now as a professor who remains inspired, if perhaps a bit less idealistic, this essay speaks to me in a way that is profound, grounded, and productively disorienting. Having argued its finer points for years with students and colleagues, it seemed only natural for it to inspire this column as well.

Esteva begins, "I don't know how to say what I want to say. It is something radically new. It has been said time and again for centuries. I am not trying to justify pouring old wine into new bottles, but instead to illustrate my perplexity and the very nature of the predicament I want to discuss here" (Esteva, 1994, p. 2). This predicament, which unfolds across the following pages in twists and turns, is never precisely named, but rather revolves around the deeper contours and complexities of development and social marginality. Esteva anchors his analysis of this predicament to food, including cooking practices in rural Oaxaca, Mexico, sharing food among kin and neighbors in the Dominican Republic, and the rejection of food aid in the El Tepito barrio of Mexico City following the 1985 earthquake. In these cases, all located in communities assumed to be mired in poverty, Esteva finds a relationship to food that is fundamentally distinct from what is pervasive in the so-called "industrial world."

While it may appear on first reading that Esteva is dividing the world into a too-neat binary of modern/traditional, with an underlying signification of modern=bad and traditional=good, this would be far too simplistic. Instead, he is encouraging readers, particularly those in the industrial world, to consider what we might learn from indigenous and other socially marginalized communities. Part of this learning comes by considering the very words we use for the food that sustains us. With respect to the socio-linguistic dimensions of food and agriculture, Esteva argues,

> We must reserve the word *alimento* for professional or institutional use. To eat, to care for *comida,* to generate it, to cook it, to eat it, to assimilate it: all these are activities that belong to non-modern men and women and are, in general, gendered activities.… *Alimentarse,* in contrast, is to purchase and consume *alimentos* (edible objects), designed by professionals or experts, while being produced and distributed through institutions. (Esteva, 1994, p. 5)

Sorrowful that *comida* is not directly translatable into English, Esteva uses this term to refer to the practices of creating, sharing, and eating food that are embedded in place and culture. He opposes this to the food systems and practices found in the industrialized world; "I am talking about a general and chronic condition of industrialized societies, where people must be fed and remain totally dependent on private or public institutional apparatuses that create lifelong addictions to food services, assumed as magnificent conquests of civilization" (1994, p. 6). Here, then, lies Esteva's central argument, that those of us in the industri-

alized world have lost our connection to *comida,* and that only through regenerating this connection might we reconnect to place and to one another.

Esteva links the idea of re-embedding food in agriculture to a postmodern ethos, or more appropriately an ethos against modernism. Still, he argues against romanticizing a distant past, instead pressing readers to look for current cases where individuals and communities are cultivating more resilient food systems. In so many ways, his points echo those put forth by my fellow JAFSCD columnist Monica White in her first column of "Freedom's Seeds," where she examines the history and current forms of urban agriculture in Detroit (White, 2017). Like White, Esteva underscores that food is a powerful basis for holistic forms of community revitalization, but he argues that that it doesn't stop there:

> Re-embedding food in agri-culture is not about crops, stewardship of the land or organic agriculture, even though all of that *is* included in the endeavor. It goes beyond the movement for a regenerative agriculture after the Green Revolution. It is about the way we live. And again, it is not about healthy food or improved consumption patterns, for ecological or economic reasons. It is about people, about recovering a sense of community, about creating new commons—in every urban or rural settlement. (p. 11)

While there is much to be concerned about in today's political and economic climate, I take heart in the fact that as they read Esteva's words, the majority of my students are enthusiastic to consider new forms of social life based on *comida*—and their role in cultivating them.

Each time I lead my students through Esteva's essay, we bring his analysis together with a consideration of the work that food activists are engaged in across the U.S. and abroad. From worker-led calls for economic justice to the hundreds of community gardens that are tended in urban and rural locations, my students and I agree that *comida is indeed present* in our society, even as powerful forces push us collectively closer and closer to a world where only *alimento* is possible. In the columns to follow, I will continue to explore the distinctions of *comida* and *alimento,* examining where they relate to the food movement more broadly, and to Latino/a communities more specifically. I will take us from the border of Vermont and Canada where I work with Mexican and Guatemalan farmworkers in the dairy industry, to places further afield. In doing so, I will push the borders of how we define our food, how we politicize our food, and how we understand food to be central to our cultures.

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FREEDOM'S SEEDS: REFLECTIONS OF FOOD, RACE, AND COMMUNITY DEVELOPMENT

MONICA M. WHITE

Freedom farmers

Published online August 10, 2017

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> *If you sell a Black man a pick up truck, he'll use it to make money and buy all the land in Sumpter County, sell him a Cadillac…*
> — *Reverend Wendell Paris, member, Federation of Southern Cooperatives*

Reverend Wendell Paris is currently assistant pastor at the New Hope Baptist Church of Jackson, Mississippi. He and his brother George, and George's wife Alice, were all activists and organizers in the civil rights movement in Alabama and were early leaders of the Federation of Southern Cooperatives (FSC). I was honored to meet him at the FSC training center in Epes, Alabama, and subsequently to interview him. Like his mentor, Fannie Lou Hamer—the legendary civil rights leader of the Mississippi Freedom Democratic Party—Rev. Paris is deeply committed both to Black civil rights and to farming as a strategy to freedom.

Through Rev. Paris and his family, I was able to locate several founding members of the FSC. When I asked them to describe the contributions of farmers to the movement, they all pointed me to Lowndes County, Alabama. They told me about the Matthew Jackson family, Black landowners who allowed Freedom Riders to camp on their land during Freedom Summer of 1964. Not only did they feed and house the civil rights activists, they also offered them protection. It was on the Jackson farmland that Stokely Carmichael, H. Rap

Monica M. White earned a Ph.D. in sociology from Western Michigan University. She is an assistant professor of environmental justice at the University of Wisconsin–Madison with a joint appointment in the Gaylord Nelson Institute for Environmental Studies and the Department of Community and Environmental Sociology. She is a former Chancellor's Postdoctoral Fellow in the Department of African American Studies at the University of Illinois–Urbana Champaign. Her research engages communities of color and grassroots organizations that are involved in the development of sustainable community food systems as a strategy to respond to issues of hunger and food inaccessibility. She can be reached at monica.white@wisc.edu.

Brown, Bob Mantz, and Ralph Featherstone organized as members of the Student Nonviolent Coordinating Committee (SNCC) for what would become the nationwide black power movement. In 1965, Lowndes County was 80% African American, yet not one citizen had the right to vote. Charged up with the belief that African Americans should have the right to freedom, full participation in the political process, and the right to protect their community, they organized the Lowndes County Freedom Organization, also known as the Black Panther Party (Carson, 1981).

My interest in researching the critical role of Black farmers in the civil rights movement sprang in part from observing African Americans in my native Detroit returning to our agricultural roots as a strategy for food security and food sovereignty. By the time I spoke with him, I recognized that our people had turned to agriculture as a strategy for freedom and liberation since before plantation slavery. Yet many researchers who came before depicted the story of Black farmers as saturated with privation and suffering. I read of land loss, aging Black farmers and the concerns about retaining land in the family, blatant discrimination, and a digital divide and that often stands between Black farmers and the resources the USDA provides to White farmers (Daniel, 2013). Members of the Black community in Detroit were using agriculture as a way to rebuild, as a strategy toward liberation, making the land an ally. I knew that agriculture must have been used to uplift in the past as well, and Reverend Paris and other members of the FSC showed me how.

My goal in researching, writing about, and documenting historical and contemporary examples of *Freedom Farmers* is to challenge the persistent frame of agriculture as a site of oppression for African Americans. Slavery, sharecropping, and tenant farming do not tell the whole story. The richness and complexity that is our agricultural history can be detailed from a place of resistance.

The canonical accounting of Black freedom struggles reveals the key role of charismatic leaders, preachers, students, and Black social and political institutions like the church; sites and locations of resistance like employment, lunch counters, schools, and the voting booth; and gendered

Reverend Wendell Paris.

(Photo by Monica M. White)

experiences and contributions. It says almost nothing about Black farmers—no stories of the families who were proud Black farmers like that of Mr. Ben Burkett.

Reverend Paris had just made the statement at the start of this column, about selling the Black man a pick-up truck, when Mr. Burkett pulled up to the FSC training center in Epes where we were talking. Mr. Burkett had a truck bed filled to the brim with sweet potatoes from the Indian Springs Farmers Cooperative. As he told me, Mr. Burkett has never filled out a job application because he has always worked for the family business, for himself. As a fourth-generation farmer from Petal, Mississippi, he now runs the family business on almost 300 acres of land that has been in his family since 1889. Named "B&B Farms" by Mr. Burkett's parents in 1939, Benny and Bessie, his father started Indian Springs Cooperative along with eight other farmers in 1977 as a way to pool their resources, purchase materials, and collectively

Mr. Ben Burkett.

(Photo by Monica M. White)

market their harvests to save on expenses and boost profits. Mr. Burkett says that it is only because of the cooperative that he has been able to maintain the land and continue the legacy of his great-grandparents. They, like many African Americans during the time, saw farming as "a way of life. That's all they knew. They grew up on the farm and that was all that they knew to do." The knowledge of food production, the pride of growing for themselves and their families and their community, and a love of the land were all passed down to Mr. Burkett. He in turn has shared this with his daughter, Darnella Burkett-Winston, and his granddaughter, Denver. These legacies are not separate from the Black freedom struggle, and I am determined that they should not be lost.

I have had to undertake significant digging to find the records of agricultural cooperatives that date back to the late 1880s, when the Colored Farmers' Alliance was founded. I learned that W. E. B. Du Bois was a major booster and investor in agricultural cooperatives, and that singer and activist Harry Belafonte raised money for Fannie Lou Hamer's cooperative, Freedom Farms Cooperative.[1] I discovered that FSC had once had many chapters throughout the American South.

The Freedom Farmers I interviewed spoke about the self-determination of the farmer, the autonomy and the freedom to take a stand that agriculture conferred. They told me that agricultural cooperatives made it possible for Black farmers to find communal success. Black landowners played a critical role in their communities throughout the South through social and political institutions. They built schools, banks and other lending arrangements, health care clinics, and newspapers —which were often used for teaching literacy in the under-resourced school systems. They shared resources and bought land together, shared tools, and planted on the moon cycle to get the biggest harvest for the highest profit. Agricultural cooperatives helped Black farmers care for their families and build their communities. They lived the statement of Fannie Lou Hamer: that as long as she had "a pig and a garden," no one could tell her what to do.

I had long suspected that contemporary Black farmers are working in a proud tradition; through research I have learned that was right. Our ancestors lived, breathed, planted, and harvested dreams of freedom and self-sufficiency on their farms; they live again through us.

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[1] I started this research project before I met Dr. Jessica Gordon Nembhard, whose path-breaking 2014 book *Collective Courage: A History of African American Cooperative Economic Thought and Practice* documents the centuries-long effort of African Americans to participate in collective action and economic cooperatives as a strategy of Black freedom, with special attention to W. E. B. DuBois's scholarship.

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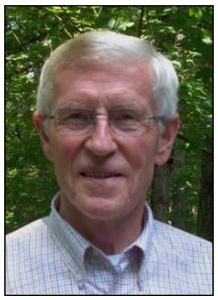

THE ECONOMIC PAMPHLETEER
JOHN IKERD

The urban agriculture revival

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Some critics of urban agriculture see its growing popularity as a superficial response to public concerns about urban food deserts. However, urban agriculture could evolve instead to become an important part of the U.S. food system, as it already is in much of the rest of the world. The United Nations estimates that more than 800 million people worldwide cultivate fruits and vegetables or grow livestock in cities (Food and Agriculture Organization of the United Nations [FAO], n.d.). The World Watch Institute estimates that urban agriculture produces 15 to 20 percent of the world's food (n.d.). The U.S. Department of Agriculture doesn't yet collect data on urban agriculture, but urban gardens are becoming an increasingly important source of fresh vegetables and fruits in some cities. This is particularly true in the inner-city communities of old post-industrial cities such as Detroit, Philadelphia, and Camden, New Jersey (Royte, 2015).

The skeptics contend that food production moved out of cities for sound economic reasons and that those reasons are still valid.

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*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.*

The geographic specialization of large-scale, industrial agricultural operations has proven to be the most effective means of minimizing the costs of food production. With growing specialization and globalization of food production, there seems little prospect of economic survival for the urban agriculture movement. A recent critique of urban agriculture in the *Journal of Agriculture, Food Systems, and Community Development* (JAFSCD) concluded: "It would be misleading to pretend that urban gardening could significantly improve food security and affordability" (Hallsworth & Wong, 2013).

However, critics fail to recognize the importance of the non-economic benefits provided by urban agriculture. A set of rebuttals to the JAFSCD critique focused on the quality-of-life benefits to individuals and the social benefits to urban communities, including the potential for fresher and more nutritious food in inner cities (Colasanti & Hamm, 2013) and revitalized urban communities around community gardens (Lavid, 2013). Such public benefits justify publicly funded economic investments in urban agriculture, as well as zoning of urban and peri-urban land to encourage local food production (Evans & Miewald, 2013). As one defender pointed out, "The growing movement is not predicated on false hopes of its productive potential, but recognizes urban cultivation as one of many approaches to address inequalities in the conventional food system" (Weissman, 2013, p. 24).

Critics fail to recognize the importance of the non-economic benefits provided by urban agriculture.

Urban agriculture is not a new phenomenon. In earlier times, residents of cities either grew their food or bought most of their food from local farmers, by necessity. Even as U.S. cities grew during the 19th century, many urban dwellers continued to rely on backyard gardens and orchards. The "truck farmers" who settled and farmed on the urban fringes met most remaining fresh food needs. They trucked fresh vegetables, fruits, milk, meat, and eggs into city neighborhoods for home delivery, street vending, or for sale at city markets. As cities continued to grow, however, less space was left for urban gardens and peri-urban truck farms.

Early city planners seemed to have had little concern for preserving land for food production within either cities or urbanizing areas. Green spaces were largely planned as parks where people could retreat to shade trees, scenic lakes, and spacious lawns to make bearable the harsh realities of the old industrial cities. By the late 1800s, however, a few progressive city planners were becoming concerned about the social and environmental desecration of industrial cities.

In 1898, Sir Ebenezer Howard initiated the Garden City Movement in Great Britain. His basic idea was to replace large industrial cities with cities of modest size, ideally around 32,000 people. An inner core of industry would be surrounded by residences, and an outer green belt would be reserved for farms to provide food for the city (The Garden City Movement, n.d.). In 1902, Howard published his classic book, *Garden Cities of Tomorrow,* which expresses his grave concerns about uncontrolled industrial urbanization, including the loss of urban food security (Howard, 1902). However, his garden cities movement never gained widespread popularity, and by 1930 only two model cities had been developed.

Howard's concept of garden cities was reframed during the 1920s by Lewis Mumford of New York, a noted scholar, writer, and advocate for ecologically sound urban planning (Wojtowicz, 2001). Mumford's attempts to revive urban agriculture became more appealing during the Great Depression of the 1930s. The stage was set for the victory gardens of World War II, when individual and community gardening accounted for about half of total U.S. vegetable production (Victory Garden, n.d.). Mumford's ideas are most notably expressed in his 1961 book, *The City in History, Its Origins, Its*

Transformations, and Its Prospects.

The post-war economic boom of the 1950s brought new employment opportunities that transformed cities, and new chemical and mechanical technologies that transformed agriculture. Suburbs replaced inner cities as the focus of urban economic growth. As cities expanded, peri-urban farms were replaced with commercial and residential developments. The food from urban gardens and orchards and peri-urban truck farms was replaced by food from large industrial produce farms, mostly in California and Florida. People no longer raised food; they bought food. At least those who could afford it did.

The urban agriculture movement is as much about restoring urban quality of life as improving urban food security.

The popularity of urban agriculture in the U.S. has tended to be cyclical—growing during times of food scarcity and shrinking during times of abundance. It grew during the economic depressions of the 1890s and 1930s, and again during the recession of 2008, as well as during the two world wars. A 2001 United Nations report confirms a global tendency for urban agriculture to surge in popularity during times of domestic food scarcity (Smit, Nasr, & Ratta, 2001/2011). However, the same report noted the consistent global pattern of decline in urban agriculture in response to economic and agricultural industrialization.

The current revival in urban agriculture in the U.S. does not appear to be a typical cyclical surge because it is occurring during a time of agricultural abundance. Far more than enough food is available in the U.S. to provide everyone with food security, and U.S. farmers have the capacity to produce far more. For example, Americans waste as much as 40 percent of the food produced in the U.S., and significant acreages of U.S. farmland are being devoted to producing biofuels rather than food (U.S. Department of Agriculture, Office of the Chief Economist, n.d.). The industrial food system in very productive, but it simply does not make enough nutritious food available in places where people need it most, notably inner cities. Rather than a response to general food scarcity, the current growth in urban agriculture seems much more like a reversal of the previous decline resulting from economic and agricultural industrialization.

The industrialization of agriculture caused agriculture to move out of urban areas, but now its failure appears to be a primary motivation for returning agriculture to urban areas. The recent urban agriculture movement has coincided with the organic farming, sustainable agriculture, and local agri-food movements. All of these movements are rooted in a rejection of the current industrial agri-food system. Furthermore, the decimation of inner cities resulting from industrial abandonment now appears to be a primary motivation for urban residents joining together to not only to grow their own food, but also to rebuild their communities. The urban agriculture movement is as much about restoring urban quality of life as improving urban food security. Ecovillages, transition towns, eco-municipalities, and hyperions are 21st century version of the early-20th century garden cities. The current surge in popularity in urban agriculture could mark an urban ecological, social, economic, and cultural revival that is rooted in the continuing quest for enough good food.

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Fair labor practices in values-based agrifood supply chains?

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Abstract

This research commentary reviews our exploratory study of the incorporation of fair labor practices into the business models of values-based agrifood supply chains (VBSCs) studied in the USDA-sponsored "agriculture-of-the-middle" (AOTM) regional research project. We examined what the certification affiliations of AOTM enterprises signaled about their values priorities as described in AOTM case study documents and in the enterprises' website advertising outreach. While we found weak evidence for prioritization of the fair labor practices value in these case study materials, our analysis suggests that characteristics of VBSC lead enterprises—whether the VBSCs are producer-, consumer-, or aggregator-driven—provide a promising focus for future research into possibilities for fair labor practices in these types of alternative agrifood enterprises. In an effort to advance research on this important but relatively neglected topic in the alternative agriculture literature, we note the need to develop effective, ethical research strategies to investigate sensitive labor issues in alternative agrifoood supply chains and to identify labor-intensive VBSCs as future case study targets.

Keywords

Alternative Agriculture; Agriculture of the Middle; Certification; Fair Trade; Labor; Social Justice; Values-Based Agrifood Supply Chains

Commentary

The *Journal of Agriculture, Food Systems, and Community Development*'s (JAFSCD's) recent issue on the topic of "Labor in the food system, from farm to

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table" (volume 6, issue 2, winter 2015–2016) provides a fortuitous backdrop for our research commentary. In an effort to explore possibilities for fair labor practices in the contemporary American agrifood system, we look toward values-based agrifood supply chains (VBSCs) as potential sites of positive development. VBSCs have emerged as entrepreneurial efforts among farmers and other supporters (wholesale aggregators, consumer cooperatives, etc.) to develop and market high-quality products that offer economically viable niches for midsized family farm enterprises (the so-called disappearing middle in American agriculture). These VBSC enterprise strategies are rooted in values prioritized in the alternative agriculture critique of the conventional agrifood system. Examples of VBSC values priorities include unadulterated (reduced chemical and antibiotic input), "natural," or organically produced foodstuffs; environmentally and ecologically sustainable production practices; humane animal treatment; relational buying and selling (where consumers know where their food comes from and how it is produced); and local/regional provenance of foodstuffs with its positive cultural (e.g., place identity), ecological (e.g., limited food miles), and local/regional economic development promotion implications. In one of the foundational statements of VBSC business principles, fair labor practices for workers are also identified as aspirational values (Stevenson & Pirog, 2008).

As highlighted in the JAFSCD issue referenced above, many farmworkers face work environments characterized by low wages, lack of benefits, dangerous and difficult working conditions, lack of adequate housing, and abusive worker treatment on and off the job (Bon Appétit Management Company Foundation & United Farm Workers, 2011; Gottlieb & Joshi, 2010; Liu & Apollon, 2011). Workers in the processing and food service links in the food chain often suffer similar economic hardships and workplace indignities. The irony of high levels of food insecurity among those who labor to produce, process, prepare, and serve America's food attests to ongoing social justice concerns regarding the labor regime throughout the food chain (Brown & Getz, 2011; Fox, 2013). Within the food justice movement, fair labor practices (defined as providing living wages, adequate health care benefits, safe working conditions, and guarantees of worker rights to challenge employer abuses) are considered essential attributes of a more socially just alternative food economy (see Gottlieb and Joshi, 2010, and International Labor Organization [ILO], 2017). Yet attempts to create regimes for fair labor practice have emerged more prominently in fair trade arrangements negotiated within global agrifood supply chains. As Allen (2004) and Brown and Getz (2011) have emphasized, the alternative agriculture movement in the United States has, for the most part, elided labor issues, creating a major social gap in its agrifood system transformation efforts.

Have concerns from the fair trade movement about just labor practices influenced VBSC business models? This question motivated us to review case studies of exemplary VBSC enterprises documented in the USDA agriculture-of-the-middle regional research project (see http://www.agofthemiddle.org). While much of the AOTM case study literature highlights the collective responsibility of supply chain actors to implement and maintain values-based standards, third-party certification is advocated as a quality assurance mechanism (Stevenson & Pirog, 2008). As Brown and Getz (2008) point out, certification systems have proliferated in the past decade as mechanisms for strengthening transparency in fair trade and other alternative agricultural product chains that claim adherence to particular product standards (e.g., quality, environmental sustainability, social accountability, etc.). Certification systems may help identify and resolve internal difficulties in realizing values-based production objectives. In addition, certification represents an significant marketing tool for enterprises producing for value-added market niches, as it provides important assurance information to consumers that the product conforms to advertised standards. Examining certification affiliations of the AOTM cases, we surmised, might signal which values priorities, including fair labor practices, appear most prominently in AOTM VBSC business models.

In our review of the eight AOTM case studies, we found that seven affiliated with one or more certification agents. While four of the VBSCs had

certification agency affiliations that reflect fair trade movement concerns about labor conditions in the food chain, more prominent were affiliations that focused on assurances of "good food quality" (organic, non-GMO) and "environmentally friendly" production practices that are emphasized in the alternative agriculture movement. Certification affiliations, when emphasized in AOTM VBSC branding narratives, seemed primarily aimed at packaging values that appeal to food-conscious consumers interested in the taste, health, and ecological attributes of their food purchases. Fair labor practice values were not prominent in AOTM VBSC case study descriptions of business practices or in their advertising campaigns.

To the extent that mention of fair labor practices did surface in case study documents, our analysis points to the VBSC lead enterprise type as a heuristic explanatory factor. AOTM supply chains were created by lead enterprises such as producer cooperatives, consumer cooperatives, and wholesale intermediaries in order to effect a stable farm-to-market flow of values-based products. Our typology of lead enterprise structure borrows Gereffi and Korzeniewicz's (1994) seminal distinction between producer- and consumer-driven supply chains. We expand their typology by adding a third "aggregator-driven" supply chain possibility. These three distinctive types of lead enterprises are situated in different power positions vis-à-vis supply chain partners, with important implications for integrating fair labor practices as prominent values in their supply chain operations.

Take the case of producer-driven supply chains, the most frequent type in the AOTM case study portfolio. Farmers organized these supply chains with the explicit goal of developing premium quality products (that they project will command a price premium) for discerning consumers seeking alternatives to conventionally produced foods. Economically viable values-based production requires supply-chain entrepreneurship, i.e., the forging of alliances with downstream partners who maintain lead enterprise product quality standards in their operations. These partners often have powerful positions in the supply chain, as they fill essential nodes necessary for the lead producer–driven enterprise to process and sell a marketable product. These are often marriages of convenience with more conventional agrifood system partners, in the sense that AOTM enterprises do not have the resources to build from the ground up entire supply chains in their values-based image. If producer-driven lead enterprises were to incorporate fair labor practices into their values-based models (for instance, by committing to living wage policies for their employees), critical supply chain partners might not be able to implement them due to company-specific economic or other constraints. Conversely, our case study review suggested that a powerful downstream retail partner (e.g., a major buyer) with fair labor practice values could exert considerable upstream pressure among producer-driven enterprises for compliance with their values.

In contrast to the producer-driven scenario, we found that aggregator-led VBSCs are in a position to implement their values proactively, especially in the upstream producer end of the supply chain. Aggregators can provide robust market channels for premium-priced, high-quality products (with fair labor practices as one of the marketed quality attributes) *if* producers can meet quality standards. Aggregators may offer farmers a cost-plus price point that ensures economic viability for smaller, midscale operators.

Similarly, consumer-driven supply chains, such as those organized by consumer cooperatives, are in a favorable power position to influence upstream supply chain partners to meet the values-based product preferences of cooperative members. The very limited survey research on consumer rationales for purchasing value-based food products, such as organics, highlights health and environment concerns as paramount, with little evidence that fair labor practices in the food chain figure in purchasing decisions. Looking forward, the leadership of consumer cooperatives could be an important factor in educating their members about the labor justice component of fair trade principles. Perhaps the increased attention to inequality in American society provides an entry point for enhanced consumer cooperative dialogue about food justice concerns in their sourcing policies.

It is important to remember that VBSCs are embedded in a larger, competitive food market

structure. Stark economic realities make it difficult for VBSCs to prioritize fair labor practices in their business models, especially when they are uncertain about whether consumers will pay extra for a product with a food justice label. As Martin (2013) notes, labor is one of the most controllable costs in production agriculture. The omission of farmworkers from protections encoded in the National Labor Relations Act (the Wagner Act) and legislation on fair labor standards means that VBSCs implementing fair labor practices would operate on an uneven playing field with competitors. Conventional production agriculture's reliance on undocumented immigrant farmworkers, who are often subject to exploitative treatment due to their problematic legal status (see Gray, 2013, and Holmes, 2013), enhances labor cost disadvantages for VBSCs adhering to fair labor standards.

As emphasized in the literature, in fact, VBSCs are often created through hybrid (Bloom & Hinrichs, 2011) enterprise coalitions. Our AOTM case study review reveals that values-based agrifood businesses often partner strategically with enterprises that are part of the conventional agrifood system in order to process, distribute, and sell their product. In effect, they are often integrated into downstream components of the larger conventional agrifood system within which they lack the countervailing market power to impose their fair labor practice values on partners. This structural reality constrains lead enterprises' values-based attempts to implement fair labor practices throughout the supply chain.

Critics of the alternative agriculture movement argue that the economic and supply chain power imbalance constraints noted above may reflect only one (the materialistic) side of the weak adherence to fair labor practice values we have noted in the AOTM VBSC case studies. Allen (2004), for example, argues that attention to social justice issues for agrifood system workers is muted due to ideological biases within the alternative agriculture movement. These biases are particularly likely to surface in the values priorities of producer-driven (farmer-organized) VBSC supply chains. Allen identifies conservative biases within the movement—agrarianism and farm-centrism, individualism and self-reliance, economic liberalism, ideologies of class and merit, and fetishization of the environment—as key ideational underpinnings that mitigate against the incorporation of fair labor arrangements into movement practice (Allen, 2004). The ideological barriers to implementing fair labor practices, even within fair trade regimes that explicitly proclaim this value, are noted in a recent review of the fair trade movement (Terstappen, Hanson, & McLaughlin, 2013). This review acknowledges that the international fair trade movement, like the alternative agrifood movement in the U.S., is decidedly farmer-centric in terms of values priorities. The focus on farmers' economic welfare and the the assumption that most farm labor is provided by family members divert attention from conditions for hired labor in fair trade production.

As argued by Alkon and Agyemon (2011), certain key components of the alternative agriculture vision—food localism, fair trade, slow food, etc.—are socially exclusionary. Guthman (2011) sees decided class and racial biases in the social construction of vision authority. DuPuis, Harrison, and Goodman (2011) call for more focus by the movement on the processes through which visions are constructed, a reflexive, democratizing approach to expanding the food justice dialogue to include eaters and workers who have heretofore been left out of the defining process. Initial attempts to initiate this dialogue are evident in the work of organizations like the Domestic Fair Trade Association (http://www.thedfta.org), a diverse, membership-based group of actors (growers, farmworkers, consumer cooperatives, food service workers, NGOs, academics, etc.) working to promote a fair trade regime in the American agrifood system.

Further exploration of the materialistic and ideological constraints to incorporating fair labor practices into values-based supply chains requires more systematic efforts to design studies to probe these concerns. A major limitation of the AOTM VBSC case studies was the lack of directed inquiries regarding labor in the interview protocol. Case study researchers used open-ended interview techniques to explore the range of values priorities in VBSC business models as articulated by key informants who had been instrumental in the

founding of the businesses. It is possible that key informants were much less willing to talk about sensitive labor issues that highlighted contradictions in business practices designed to support the economic welfare of all supply chain actors. After all, in the American political economy context, labor issues within the agrifood system remain contentious and largely unresolved (Martin, 2013). One can envision potential legal ramifications if problematic labor issues (e.g., undocumented workers) are revealed in research reports. Unless a labor dispute has already become public, information about business practices relating to labor issues is unlikely to surface in the type of research instrument employed in the AOTM VBSC project. Furthermore, the vulnerability of many VBSC enterprises in the dynamic, competitive American agrifood system raises ethical questions about how to study problematic labor aspects of VBSCs without damaging their hard-won progressive reputations.

Our aim in this commentary is to spark discussion of how to bring labor into the analysis of ongoing efforts to create a more just, sustainable agrifood system. Among producers of values-based products, these is much uncertainty about securing the labor necessary to sustain their production operations. Assurances of fair labor conditions may offer an important strategy for alternative agrifood enterprises to secure the labor they need. We need case studies of VBSCs that have successfully integrated fair labor practices into their business operations. One possibility is that some of the AOTM VBSC cases or other cases mentioned in attempts to document VBSC development (Lerman, 2012; Lerman, Feenstra, & Visher, 2012) have made progress in instituting fair labor practices. A re-study of the more labor-intensive VBSC enterprises with a focus on enterprise approaches to dealing with labor supply issues seems warranted.

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Eight qualities of resilient food systems: Toward a sustainability/resilience index

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Abstract
The concept of ecological resilience fills lacunae in sustainability. Solving the world's wicked problems is undermined by the fact that defining sustainability itself is a wicked problem. Traditionally, sustainability is defined by a focus on social, economic, and environmental criteria. In contrast, the ecological resilience perspective on sustainability focuses on continuing adaptation and innovation of complex adaptive systems rather than any evaluation criteria. Prominent among the qualities enabling such resilience is local self-organization. Locally self-organized processing and marketing has long been recognized as a crucial component of sustainable agricultural systems. Ecological resilience research focuses on understanding qualities such as the local self-organization necessary for systems to withstand and overcome disturbances (for example, climate change). This study seeks to determine the common qualities of such resilient locally organized food systems and compare them with those proposed by the most prominent resilience frameworks in the literature. Our case studies of resilient food systems in recalcitrant areas of the U.S. South result in eight common qualities that are consistent with the most prominent frameworks. This study is part of a long-term effort to define qualities of ecologically resilient systems that are universal across as many scales as possible. Toward that end, this article discusses those eight qualities in order to lay a foundation for future establishment of quantitative indicators and thus form a sustainability/resilience index (SRI). Such a quantitative index enables investigation of the relationships between agricultural system resilience and economic and social demographic indicators.

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Keywords
Agroecosystems; Food Systems; Resilience; Sustainability; Self-Organization

Introduction and Literature Review

For nearly three decades, sustainability has been the goal of people focused on the world's "wicked" problems, including environmental degradation, overpopulation, endangered species, poverty, food insecurity, and climate change (World Bank, 2014). Wicked problems are characterized by interconnected issues and polarized stakeholders with conflicting values, which precludes easy agreement on criteria to determine when a solution is found (Rittel & Webber, 1973). Achieving consensus around policy incentives to create social change and substitute technologies was assumed by those working in sustainability to eventually lead to a lasting equilibrium between our planet and our social systems (e.g., Forrester, 1971; Curry, 2013). Despite valiant efforts to find sustainable solutions, the world is increasingly out of balance: the wicked problems are becoming more intractable. A revised perspective on sustainability appears needed.

Achieving sustainable agricultural systems has long been a goal internationally (World Commission on Environment and Development, 1987) and in the U.S. (Food, Agriculture, Conservation, and Trade Act 101-624, 16 U.S. C. § 1603, 1990). However, definitions of sustainable agriculture and sustainability assessment tools focus on whether systems meet a range of other criteria. rather than viewing sustainability as a naturally occurring phenomenon —in contrast to ecological resilience, which is defined as the ability of a system to withstand and overcome disturbance without being destroyed (Holling, 1973). Sustainability assessment tools have been developed for various scales of the food system, including farm, community, ecoregion, and nation (Van Passel & Meul, 2012). These tools range from indicator sets (Grenz, 2011) to simulation models (e.g. Cerf, Jeuffroy, Prost, & Meynard, 2012; Van Meensel, Lauwers, Kempen, Dessein, & Van Huylenbroeck, 2012). All definitions of sustainability seek to move agriculture and food systems toward achieving social, economic, and environmental goals that are agreed on and valued by and defined by particular segments of society. Sustainability as a social movement (Wezel et al., 2009) must maintain focus on these valued societal goals. When focused on such goals, however, defining sustainability itself becomes a wicked problem (Paulson, 2010).

Including societal goals in the definition of sustainability has led to co-optation and antipathy from those who do not share those values. Co-optation of sustainability has been seen with Nestlé, Unilever, Danone's Sustainable Agriculture Initiative Platform (SAIP, 2016), and Monsanto's Global Harvest Initiative (Crossfield, 2009). Holt-Giménez and Altieri (2016) have delineated the deep roots of such co-optation. Direct antipathy is shown by the introduction in 26 U.S. state legislatures of legislation opposing sustainable development as proposed in the United Nations Agenda 21 (Frick, Weinzimmer, & Waddell, 2014). Along with co-optation and antipathy, a recent study indicates "flat-lined public interest in sustainability" since 2004 (Andrew et al., 2016, p. 138). Focusing on understanding the qualities that help systems become resilient appears to be a means of removing sustainability from this wicked situation by defusing political tensions and clarifying the dynamic, systematic nature of human-environment relationships,

Though defining sustainability is fraught with problems, having a legal definition (Food, Agriculture, Conservation, and Trade Act 101-624, 16 U.S. C. § 1603, 1990) enabled a systematic attempt, known as the State of the South, in the early 1990s to prioritize sustainable agriculture research and education interventions, which was commissioned by the USDA-supported Southern Sustainable Agriculture Research and Education. Through agroecoregion focus groups, a regional survey, and secondary database analysis, the study concluded that locally owned and organized processing and marketing systems were crucial to develop sustainable agricultural systems (Worstell, 1995). (The study included the first documented "local food systems" workshop, in Williamsburg, Virginia.)

Since the study, encouraging processing and marketing cooperatives, farmers' markets, and community-supported agriculture (CSA) has become extremely popular in much of the United

States. Several state and federal programs have been implemented to facilitate this effort, including the Value-Added Producer Grant program, the Farmers Market Promotion Program, the Local Foods Promotion Program, the Kentucky Agricultural Development Board, Know Your Farmer, Know Your Food, Food Compass, and many other national, regional, and local programs (Low et al., 2015). The USDA has progressed from dismissing as trivial the likely impact of local foods (USDA, 2001) to trumpeting loudly the importance of local foods (Martinez et al., 2010). The trend toward local food systems is broad and deep. When a conservative Arkansas Congressman says, "The future of food is local" (R. Crawford, personal communication, 2013), Walmart pledges to increase local food to 15 percent of its sales by the end of 2015 (Wenninger, 2013), and it is claimed that every church seems to want its own farmers' market (e.g., C. Sheffield, personal communication, May, 2013), the trend seems ineluctable.

Merely being local, however, does not meet the traditional definition of sustainability (Vermeulen, Campbell, & Ingram, 2012; Weber & Matthews, 2008). The State of the South project (Worstell, 1995) concluded that a very specific type of local food system is needed for sustainability, one which is locally organized and locally owned. In the language of ecological resilience, this quality is referred to as self-organization (Holling, 1973). Although all ecologically resilient systems self-organize with the components available locally, we have chosen the term *local self-organization* (LSO) to underscore the well-established importance for sustainability of processing and marketing that are organized and owned by locally self-organized groups.

The polarization typical of wicked problems can be eliminated when opposing groups build on more basic principles on which they do agree. An ecological resilience approach to sustainability focusing on qualities which enable a system to withstand, adapt, and transform itself in the face of disturbance may be able to reduce polarization while indirectly achieving the goals of the movement. Thus, viewing sustainability from the perspective of ecological resilience may help provide a route out of this wicked problem.

Emergence of Ecological Resilience Perspective on Sustainability

The concept of ecological resilience emerged from failure to develop stable, sustainable yields in many managed ecosystems, coupled with observations of adaptive cycles that maintain natural ecosystem relationships and functions (Holling, 1973). Resilience first arose as a scientific concept in materials engineering: the "ability of a material to absorb energy when deformed elastically and to return to [the original state] when unloaded" (Total Materia, 2001). Similarly, as developed by Holling, ecological resilience has a specific biological reality: how much disturbance a system can withstand. Resilient systems last; nonresilient systems do not. This definition is widely used, especially in climate change studies (e.g., U.S. CCSP, 2008).

The ecological resilience perspective also differs from many sustainability perspectives in distinguishing resilience from stability. In his seminal resilience paper, Holling (1973) noted that stability is the ability of a system to return to equilibrium after a temporary disturbance. Also called engineering resilience (Holling, 1996), this is the ability of a system to bounce back to its original form, as in materials science. However, societies throughout human history have sought to sustain unsustainable systems (Lowdermilk, 1948). Many societies have striven to eliminate the vagaries of nature and create what today we might call a well-engineered mall (Raskin, 2014). Many "fear that we may be clever enough to create a world that is grievously biologically impoverished, but nevertheless sustainable" (May, 2002, p. 141). Such conceits do not reflect the ecological resilience perspective on sustainability, which emphasizes not so much stability as the ability of the system to absorb change and still persist (Holling, 1996). Resilient systems can fluctuate wildly and change abruptly, to reshape, reform, and adapt themselves.

Explaining and predicting ecological resilience requires understanding the complex adaptive systems people interact with over time. A multitude of frameworks have been developed for these social-ecological systems. However, the complexity of interactions within each social-ecological system (SES) make each SES unique and render impossible accounting for every factor

that conditions resilience now and in the future. Any framework will focus on a few of these factors, as none can encompass all factors (Binder, Hinkel, Bots, & Pahl-Wostl, 2013).

Seeing the impossibility of predicting interaction within and between innumerable complex adaptive systems, many researchers have focused on defining the basic qualities that appear in all resilient systems. There are both similarities, especially in terminology, and differences between them (listed in Table 1; these are addressed later in relation to the framework proposed in this paper). One of the earliest attempts formulated a set of nine necessary qualities for a resilient world (Walker & Salt, 2006): diversity, ecological variability, modularity, acknowledgment of slow variables, tight feedbacks, social capital, innovation, overlap in governance, and ecosystem services. Carpenter et al. (2012) clarified the distinction between specific resilience, involving particular disturbances, and general resilience that confers the ability to cope with any disturbance. They posited nine qualities that enable general resilience: diversity, modularity, openness, reserves, feedbacks, nestedness, monitoring, leadership, and trust.

Frankenberger, Mueller, Spangler, and October (2013) built on previous resilience frameworks to include community interactions, in their influential discussion of resilience in the context of international community development. This framework posits seven central "community social dimensions": preparedness, responsiveness/flexibility, learning and innovation, self-organization, diversity, inclusion, and aspirations. The Rockefeller Foundation (2014) expanded resilient systems work to cities. Their City Resilience Framework posits seven qualities of resilient systems: reflective, robust, redundant, flexible, resourceful, inclusive, and integrated. Integrating much of the previous work on resilience frameworks, the most well-known center for study of ecological resilience, the Stockholm Resilience Center (2015), developed a set of "seven principles that are considered crucial for building resilience in social-ecological systems": maintain diversity and redundancy, manage connectivity, manage slow variables and feedbacks, foster complex adaptive systems, encourage learning, broaden participation, and promote polycentric governance.

Specific to agroecosystems is the framework developed by Cabell and Oelofse (2012), who describe 13 categories of indicators shown to be associated with resilience: social self-organization, ecological self-regulation, appropriate connectedness, functional and responsive diversity, optimal redundancy, reflective and shared learning, spatial and temporal heterogeneity, exposure to disturbance, coupling with local natural capital, global autonomy and local interdependence, honoring of legacy, building human capital, and being reasonably profitable.

In contrast to these ecological resilience frameworks, some conceptualizations of resilience include external assistance to assist systems in becoming resilient. These approaches to resilience include those developed by the UN Food and Agriculture Organization (FAO) and the University of Florence (e.g., Alinovi, Mane, & Romano, 2009; Alinovi, D'Errico, Mane, & Romano, 2010; Ciani & Romano, 2013; FAO, 2014), Oxfam (Hughes & Bushell, 2013), and the Livelihood Vulnerability Index (e.g., Hahn, Riederer, & Foster, 2009). The Alinovi-FAO effort has produced a household resilience index, which posits that resilience is a function of "IFA=income and food access; ABS=access to basic services; AA=agricultural assets; NAA=non-agricultural assets; APT= agricultural practice and technology; SSN=social safety nets; CC=climate change; EIE=enabling institutional environment; S=sensitivity; AC= adaptive capacity" (FAO, 2014, p. 4). Oxfam (Hughes & Bushell, 2013) maintains that resilience is the weighted sum of five factors: livelihood viability, innovation potential, contingency resources and support access, integrity of natural and built environments, and social and institutional capacity. The Livelihood Vulnerability Index (Hahn et al., 2009) is composed of seven factors: socio-demographic profile, livelihood strategies, social networks, health, food, water, and natural disaster and climate variability.

Many parameters in these three indices are consistent with those of ecological resilience frameworks. The admirable goal of the FAO,

Oxfam, and Livelihood Vulnerability indices, however, is to assist aid agencies in helping households survive with a combination of external assistance and modification of household qualities. Thus, if resilience is a measure of ability to withstand disruption external to the system, and aid agency assistance programs are part of the system, then the indices do not measure resilience at the household level, but at the scale of the aid agencies assisting the households. Resilience at the household or community level, however, would incorporate the ability to withstand fluctuations in aid agency policies, along with disruptions from policy, market, input supply, and other systems beyond the household or community level. As Levine (2014) discusses at length, resilience indices that incorporate measures at various scales can only estimate resilience at the highest scale each addresses.

Since the ecological resilience approach focuses on defining the qualities that are necessary for systems to achieve general resilience, resilience must be measured at specific scales for specific types of systems. Resilience at the household scale, community scale, and aid agency scale can even be contradictory (Levine, 2014). This is apparent when we look at a crucial component of resilience: self-organization.

Local Self-organization (LSO) Is Necessary But Not Sufficient for Resilience To Emerge

Self-organization refers to the emergence of new structures and systems from systems already present in a locality (Camazine et al., 2003). An aid agency organizing a community and its households for resilience can be considered self-organized at the scale of the aid agency, but not at the scale of the household. Systems highly influenced by external organizations are at least somewhat dependent on those entities. All prominent frameworks of ecological resilience contend that self-organization is one of the necessary qualities of any resilient system.

In some regions, systems of LSO processing and marketing of food survive and thrive; in others they do not. The Southern U.S. is a region that generally ranks low in LSO and in local food system activities more broadly. One prominent 2016 index (Strolling of the Heifers, 2016) puts only Virginia of all Southern states in the top half of states in presence of local food systems. South Carolina is 27th, North Carolina 34th, and the other ten Southern states are ranked in the lowest 13 states. Except for the top four Southern states (Virginia, North Carolina, South Carolina and Kentucky), all others have been declining in rankings in each of the last three years. Yet in each of the lowest ranked states, some LSO food systems have proven resilient. Study of the food systems that have survived and thrived in recalcitrant areas should provide insight into the qualities of resilient systems beyond LSO.

This study seeks to determine the common qualities of such resilient LSO food systems and compare them with those proposed by the most prominent resilience frameworks. Obtaining a defined set of qualities of resilient Southern systems lays the foundation for exploration of indicators for each of these qualities. Combining scores on indicators across all the qualities could then result in a sustainability/resilience index, which can be correlated with social demographic characteristics such as poverty, health, and education. Then it will be possible to determine the extent to which levels of sustainability/resilience are associated with the societal goals often measured by sustainability assessments. The work described here has accomplished the first step by identifying the common qualities of resilient food systems.

Applied Research Methods

The lead author for this article led a team to conduct case studies. We used standard case recruitment and selection methods (Lauckner, Paterson, & Krupa, 2012) to choose the subjects for our case studies. In addition to being from one of the three states with few LSO processing and marketing systems (AR, TN, and MS), but similar geographically and demographically to states with many such systems (VA, NC, KY, SC), the primary selection criteria were that the system must be attempting to integrate ecologically sound production, processing, and marketing; must have lasted for a minimum of five years; must have originated and be located in an area where few such systems have developed; and key managers involved in the system had to demonstrate willingness to

participate in all aspects of the study. A multiple case study design was chosen in order to study our topic from several perspectives and contexts (Yin, 2014). We examined systems where agricultural system managers worked independently in different contexts and communities, providing the opportunity to identify common and distinct processes. Such resilient systems proved difficult to find, but through our extensive contacts in the region, especially Southern Sustainable Agriculture Working Group, we found three systems in each state, nine in total, that fulfilled our criteria.

The case study protocol outlined the key information to be gathered from each case and primary sources (Yin, 2014). Initial issues for exploration were extrapolated from project leader experience, previous ecological resilience research, and related literature. These initial issues were points of departure to guide interview questions and preliminary analysis. The initial researcher-identified issues were influenced by issues raised by study participants. Particular issues were developed and explored in each case to guide data collection and analysis for the individual case descriptions. The emerging issues from each case were then examined to identify shared issues, which then directed the cross-case analysis. Regularly revisiting and refining these issues during data collection and preliminary analysis provided an emergent theoretical structure from the data collection processes.

As is consistent with case study design, data collection methods in this study included in-depth semi-structured interviews, document review, direct observation, and participant observation. At least four interviews of key system managers were conducted for each case study. Forty-three interviews in total were conducted for the nine case studies. Each interview was written up as a vignette for later analysis. The vignettes and related information were then integrated to create each of the case studies. Information was gathered from the inception of the initiative to the time of data collection, to capture process changes.

Data analysis occurred in three stages. Stage 1 involved the independent, in-depth analysis of each case. The major determinants of resilience in each case were identified through consensus by the three interviewers who participated in each case study interview. Stage 2 involved a cross-case analysis of the nine cases. In Stage 2, each case's main processes were compared to explore how different contexts and processes varied across the cases. The key qualities that were identified for each case as described previously were re-examined to distill common qualities that were addressed differently across the nine cases. Finally, case-specific qualities were identified that were present in all cases. In Stage 3, conclusions from the case studies were compared to each of the six prominent resilience frameworks discussed above.

Results and Theory Elaboration

Nine case studies of resilient food systems in Tennessee, Arkansas, and Mississippi were developed and analyzed in the context of the frameworks noted above, resulting in a theoretical framework applicable to all cases. The case studies are available on our resilience website (Worstell, 2016). They describe:

1. An Arkansas system uniting Ozark farms through online marketing and cooperative processing.
2. An Arkansas family of a father and two sons with independent direct marketing ventures through farmers markets and permanent storefronts.
3. An Arkansas social organization uniting farmers, restaurants, and wholesale markets.
4. A Tennessee college and associated farmers and food hub.
5. A Tennessee system of farmers, restaurants, a foundation, and a butchery.
6. A Tennessee biodynamic grower network with a CSA and restaurants.
7. A Mississippi system of three competitive markets and their growers.
8. A Mississippi cooperative and its growers and market.
9. A Mississippi association of farmers conducting joint marketing.

Eight qualities were found to be common to to all nine case studies and consistent with the qualities identified by the most prominent resilience frameworks. These eight qualities are compared to the six frameworks in Table 1. We

Table 1. Comparison of the Eight Qualities of Resilient Systems in Six Prominent Frameworks for Analysis of Resilient Systems

	Cabell & Oelofse (2012)	Carpenter et al. (2012)	Rockefeller Foundation (2014)	Stockholm Resilience Center (2015)	Frankenberger et al. (2013)	Walker & Salt (2006)
1. Modular connectivity	Appropriately connected	Modularity, openness, feedbacks, monitoring, leadership, and trust	Integrated (connected), robust (modularity)	Manage connectivity, manage slow variables and feedbacks	Social capital	Modularity, tight feedbacks, social capital
2. Locally self-organized	Socially self-organized; globally autonomous and locally interdependent	Nestedness	Inclusive	Promote polycentric governance systems (nestedness)	Self-organized, inclusive	Overlap in governance
3. Increasing physical infrastructure			Robust		Community assets, preparedness, aspirations	
4. Responsive redundancy/Back-ups	Optimally redundant	Reserves	Redundant	Maintain redundancy		
5. Complementary diversity	Functional and responsive diversity; spatial and temporal heterogeneity	Diversity		Maintain diversity	Diversity	Diversity
6. Conservative innovation	Builds human capital, honors legacy, reflected and shared learning	Openness	Reflective, flexible, resourceful	Encourage learning	Learning and innovation; responsiveness/ flexibility, memory	Innovation
7. Ecologically self-regulated (works with nature)	Ecologically self-regulated, coupled with local natural capital		Integrated			Ecological variability, ecosystem services
8. Embracing disturbance for transformation	Exposed to disturbance, temporal heterogeneity		Reflective	Foster complex adaptive systems thinking	Responsiveness	

describe these qualities with examples from the case studies and from other resilience frameworks.

Locally Self-organized (LSO)

The case studies were chosen because they were locally self-organized food systems, which we define as food systems where farmers, marketers, and processors in one agroecoregion have developed a system owned and managed by those same farmers, marketers, and processors. The systems studied ranged from farmers-restaurants-butchers-philanthropists in Southeast Tennessee to

farmers-meat processors-aggregators-food store operators in north central Arkansas.

Ecosystems unmanaged by man are finely attuned to local conditions; farms and food systems often are not. Frankenberger et al. (2013) and Cabell and Oelofse (2012) have an especially strong focus on the LSO quality. Cabell and Oelofse (2012) use the term socially self-organized, and specifically cite the example of community supported agriculture (CSA) systems and farmers' markets. They make a distinction echoed in many other frameworks, that LSO networks can be more responsive and adaptable to changing conditions than can larger groups. Top-down initiatives can fail if the timing is wrong, if the needs are misinterpreted, or if there is no buy-in from stakeholders. Frankenberger et al. (2013) and Rockefeller Foundation (2014) refer to "buy-in from stakeholders" as inclusiveness.

Other frameworks are less specific about the need for LSO, but imply its importance in the qualities labeled overlap in governance (Walker & Salt, 2006), nestedness (Carpenter et al., 2012), and polycentric governance (Stockholm Resilience Center, 2015). These three frameworks emphasize need for governance above the farm and community level to be focused on resilience. Since, as we discussed earlier, resilience indices that include measures at higher scales can only measure at the highest scale where indicators are measured, regional, national, and world governance must be examined at their own scales. All ecosystems are nested, since every system is composed of systems. Every resilient system contributes to the resilience of subsystems of which it is composed. Those subsystems are resources or assets for the larger system that must be enhanced and maintained, as addressed with the next resilience quality.

Responsive Redundancy or Back-ups

Resilient systems have back-ups and replenish their components. Ecologists use the term redundancy to mean that several of each component of a system are present and they are replaced when lost. (This should not be confused with uses of the term in other fields, such as labor redundancy or redundancy in grammar.) Redundancy that promotes resilience is responsive to needs of the system. The resilient system has mechanisms to control excessive fecundity. Skills, abilities, and functions are also reproduced and passed on to the next generation to insure that that generation survives and multiplies.

All the resilient case study farmers and entrepreneurs had family and friends who were deeply involved in the system and able to take over functions as needed. One Arkansas system is a five-generation family farm where the two most recent generations have maintained and expanded a LSO food production and marketing system in existence for more than 25 years. A Mississippi system showed high levels of redundancy when members of the group continued farm and market operations when the husband and wife managers were absent for months with a sick child. A farm in one of the Tennessee case study systems is transitioning its enterprise to an employee and the founders' children.

Redundancy, the ability of a system to replace as needed its components, is seen as crucial in all resilience frameworks, though Frankenberger et al. (2013) does not explicitly use the term. Their term, reserves, as noted above, has a similar definition as redundancy in our framework. Cabell and Oelofse (2012) use the term "optimally redundant," which highlights the crucial qualification that redundancy inevitably increases inefficiency of the system.

Accumulating Reserves and Physical Infrastructure

As they developed, all our case studies systems saw an increase in physical infrastructure, including natural capital, human-made environmental capital, and technological capital as defined by Stokols, Lejano, and Hipp (2013). Managers in these systems delayed consumption and profit-taking to build infrastructure and reserves. This quality is reflected in such indicators as increasing water harvesting capability, increasing soil organic matter, making trees and permanent pastures part of the production system, increase on-farm storage, and increasing value-added processing capacity. Every farm in all nine case studies reported gradually increasing soil quality, water harvesting capacity, and on-farm storage. Six of the nine showed increases in on-farm processing infrastructure.

The Rockefeller Foundation (2014) is most

explicit of all the frameworks about the need for physical infrastructure. They use the term "robust" to describe well-conceived, constructed, and managed physical assets, which enable a system to withstand the impacts of hazard events without significant damage or loss of function. Cabell and Oelofse (2012) emphasize that resilient systems are coupled with local natural capital—the slow variables such as soil organic matter, hydrological cycles, and biodiversity. The Stockholm Resilience Center (2015) also notes the importance of managing slow variables, though without emphasis on building up such infrastructure, perhaps because their focus is not primarily agroecosystems.

Frankenberger et al. (2013) are explicit about the necessity of building infrastructure for resilient systems. In other frameworks, this quality seems to be assumed in such terms as reserves (e.g., Carpenter et al., 2012) that contribute to recovery from disturbance. Reserves cannot be established without the productive infrastructure needed to create them. Frankenberger et al. (2013) highlight community assets, which are resources that enable communities to meet the basic needs of their members and reduce vulnerability to shocks. However, the broad definition of assets—including both tangible and intangible assets, involving social, human, financial, natural, physical, and political capital—makes measurement of this quality difficult in their framework (Frankenberger et al., 2013). They propose two other qualities that are not explicitly stated in other conceptualizations, but are related to increasing assets or infrastructure: preparedness and aspiration. Preparedness refers to the community resources needed to cope with disturbance. Aspirations are the underlying personal traits that induce people to make investments needed to cope with disturbance. Most clearly of the frameworks, Frankenberger et al. (2013) point out that actors in resilient social agroecosystems display an ability to delay gratification and a desire to create infrastructure to accumulate reserves.

Modular Connectivity

In all case studies the farmers and entrepreneurs were independent, but highly connected to many other farmers, marketers, and suppliers. Sensitivity and responsiveness to feedback of other systems does not, however, undermine modularity in resilient systems. High levels of connectivity mean resilient systems are sensitive and responsive to feedback, though in a modular fashion. Modular subsystems have enough independence that damage or failure of even a key sub-system has low probability of generating failure throughout the system. Such subsystems could be a farm in a network of connected farms or an individual enterprise on one farm, depending on the scale at which resilience is examined. Yet each component of the system is connected enough to detect and respond to changes throughout the system. Resilient connectivity has a few strong connections and many weak connections. Successful individual businesses only lead to resilient development when they are part of a collaborative network of businesses and organizations.

All case study systems were connected to an abundance of marketing and production sources, while not being solely dependent on any one of these connections. One Mississippi system was a 40-year-old cooperative of almost 100 members that is part of state and national collaborations of cooperatives. Another Mississippi system features a nonprofit that facilitates connections between thousands of farmers, marketers, processors, and policy experts. One Arkansas case study system has farmers, marketers, processors, and aggregators among its over 500 members.

All prominent frameworks for resilience recognize the importance of connectivity and modularity. Some who are mainly concerned with human systems make social capital a separate category. While recognizing the vital important of social capital in the Community Capitals Framework (Flora, Flora, & Gasteyer, 2015) and the Sustainable Livelihoods Framework (e.g., Scoones, 1998), social capital can be seen as a subset of the connectivity which occurs in all systems, not just human systems.

Carpenter et al. (2012) have a strong focus on modular connectivity, but they split this quality into several separate areas: modularity, managing feedback, monitoring, openness, and development of trust. Cabell and Oelofse (2012) call the quality "appropriately connected." They extol connectivity, but do not address situations where high

connectivity leads to low resilience to disturbance. If components of the system are not modular or independent, it cannot be resilient when disturbance floods though systems. Frankenberger et al. (2013) see the vital importance of social capital, but discuss other aspects of connectivity in less detail, and do not discuss modularity. The Rockefeller Foundation (2014) uses slightly different terminology. Instead of connectivity, they refer to resilient systems as integrated, when exchange of information between systems enables them to function collectively and respond rapidly through shorter feedback loops. Instead of modularity, they use the term robust to refer to well-designed systems that actively avoid over-reliance on a single asset, cascading failure, and design thresholds that might lead to catastrophic collapse. The Stockholm Resilience Center (2015) focuses on managing connectivity and feedbacks, but with less emphasis on modularity than other frameworks.

Complementary Diversity

The peculiar diversity of resilient systems is complementary in function. For example, resilient systems are composed of diverse complementary systems that turn wastes of one system into valuable inputs to other system. Complementary diversity is characterized by a variety of crops, markets, sources of inputs, and spatial heterogeneity. Heterogeneity of features within the landscape and on the farm—diversity of inputs, outputs, income sources, markets, pest controls—all reflect this diversity in resilient systems. One Mississippi system included dozens of farmers marketing together with complementary products. Collaborating with multiple suppliers, marketing outlets, and fellow farmers to encourage symbiosis and mutualism is evident in all the case studies.

All resilient food system case study farmers and entrepreneurs had a diversity of enterprises. One Tennessee system combined a dairy and fruit and vegetable operations with sales to farmers markets and restaurants, and direct to consumers. One farm in an Arkansas case study system included dozens of crops grown nowhere else in Arkansas. The diversity of the case studies was characterized by complementarity. While diverse, each enterprise was complementary to other enterprises. The managers recognized that lack of complementarity could compromise resilience.

Diversity is extolled by nearly all resilience frameworks. Some frameworks—e.g., Carpenter et al. (2012), Stockholm Resilience Center (2015), and Frankenberger et al. (2013) —do not address the need for diversity to be complementary or the fact that diversity can undermine resilience if, for example, enterprises compete for time and resources. Cabell and Oelofse (2012), in contrast, make this distinction explicit. They also include, as a separate quality, spatial and temporal heterogeneity; that is, lack of uniformity across the landscape and through time. We see this as a measure of diversity, and not a separate quality from diversity.

Ecological Integration (Working with Nature)

The diverse managed components of resilient systems are complementary not just to each other, but to unmanaged ecosystem services. Ecological integration means using natural ecological processes to increase productivity and decrease imported inputs. Basic examples include reduced tillage, integrated pest management, and use of cover crops—practices many farmers have embraced. This aspect of resilience places a value on the preservation of minimally managed or uncultivated land, left to the natural cycles of insects, birds, and other beneficial organisms. Farms that maintain plant cover and incorporate more perennials provide habitat for predators and parasitoids, use ecosystem engineers such as soil fauna, and align production with local ecological parameters are naturally more resilient than farms that stress the use of increasing amounts of chemical fertilizers and pesticides, excluding nature as much as possible for the sake of monocultures. Rotational grazing to build soils, inoculating soils with beneficial microorganisms, and various agroforestry practices are more advanced methods of ecological integration. Permaculture is an applied example of ecological integration in resilient systems, as we have discussed elsewhere (Worstell & Johnson, 2015).

The myriad studies on ecological integration are summarized in our online book that gives a plethora of practical tips for increasing that quality of resilience (Worstell & Johnson, 2016). Each

farmer in our case studies has found ways of using local ecological systems to increase productivity, whether through biodynamic farming (the Central Tennessee case study) or organic methods (the Central Arkansas study), rotational grazing (case studies in all three states), or integrated pest management (case studies in all three states).

Of the most prominent resilience frameworks, Cabell and Oelofse (2012) are the most explicit in recognizing the value of ecological integration, stating that the more intact and robust the regulating ecosystem services are, the more resilient the agroecosystem. They further suggest that more resilient systems are more capable of self-regulation. The Rockefeller Foundation's discussion of integration (2014) and the importance placed on diversity by other frameworks make this quality implicit in all the frameworks. Our analysis of LSO food systems indicates that the quality should be explicitly measured and induced.

Conservative Innovation and Flexibility

Resilient systems are open to new ideas—innovation—while retaining ideas that work from the past. Practical learning is valued, as are elders and heirloom seed varieties. Moore, McCarthy, Byrne, and Ward (2014) call this quality reflexive resilience. Innovation also applies to the whole system where it is manifested in the transformation quality discussed below.

Since resilience requires the ability to come up with uniquely appropriate responses in diverse situations, a system needs a variety of approaches. Ecologically resilient systems stress multiple, overlapping strategies rather than single solutions. Collaboration between universities, research centers, and farmers, and cooperation and knowledge sharing between farmers reflect the quality of flexibility in resilient systems.

All case study systems were highly innovative, but in a very conservative fashion. All their innovations fit their existing systems and maintained successful traditions. An Arkansas farmer in one case study manages both his organic farm and a conventional farm that is gradually incorporating innovative organic methods. All case studies were innovative for their area, but had chosen innovations that were working successfully in similar regions in other parts of the world. For example, one case study system in Arkansas has introduced various crops grown only in similar microclimates in California and China, for discerning local customers.

Innovation is a necessary quality of resilient systems in nearly all frameworks. Carpenter et al. (2012) discuss it under their term openness; the Rockefeller Foundation (2014) under the quality "flexible, resourceful, reflective"; Cabell and Oelofse (2012) under the quality "build human capital and reflected and shared learning"; Stockholm Resilience Center (2015) under the quality "encourage learning"; Frankenberger et al. (2013) under the quality "responsiveness/ flexibility and learning and innovation." Many frameworks, however, are not as explicit about the dangers of innovation that do not honor legacy, as Cabell and Oelofse (2012) put it. Legacy is the memory component of a SES. Frankenberger et al. (2013) refers to this quality as a strong community memory of traditions, practices, past disasters, and changing conditions which supports a community's abilities to draw on experience to prepare for and respond to similar challenges.

Periodic Transformation: Reorganizing, Reforming, Embracing Disturbance

Resilient systems are continually reforming themselves. In a SES, this is reflected in regular turnover of leadership, lack of authoritarian leaders, inheritance taxation, and mandatory retirement. Reformation is intimately related to self-organization and innovation. Innovation at one scale is transformation at another scale.

The resilient food systems in our case studies all had undergone regular transformations and sought out means of transforming their systems. One Arkansas system moved from traditional cotton production, to a farmers market and agritourism center, to inclusion of a restaurant and grocery stores, and then to direct marketing of highly diverse crops including organic production. A Tennessee system changed from direct marketing fruits and vegetables, to sales to restaurants, to a U-pick operation coupled with a cheese dairy.

Of the prominent resilience frameworks, Cabell and Oelofse (2012) most explicitly state that

exposure to disturbance is a quality of resilient systems. Their indicator of temporal heterogeneity also recognizes the transformation over time of resilient systems. Frankenberger et al. (2013) notes the importance of transformative capacity.

Though innovation within a system is transformative on a smaller scale and is a quality all recognize as necessary to resilience, most frameworks do not make the leap to recognizing that sometimes the innovation required might be so extensive as to transform the entire system. This limited embrace of transformation is illustrated by the Rockefeller Foundation (2014) emphasis on reflective systems, which notes that resilient systems have mechanisms to continuously evolve, but does not go so far as to say that periodically they are totally transformed. Our work with LSO food systems indicates that transformation is a quality necessary to resilience and must be explicitly included.

Qualities That Do Not Distinguish Resilient from Nonresilient Systems

Nearly all the factors deemed necessary by other frameworks are incorporated in the eight qualities of resilience found consistently in LSO food systems. Two are not, however. The Stockholm Resilience Center is the only framework that includes the quality of "fostering" complex adaptive systems (CAS). A CAS does embrace and use disturbance for transformation. As all living systems are complex adaptive systems (Levin, 1998), however, fostering a CAS does not distinguish a resilient from a nonresilient system. Similarly, "sufficient profit," one of the 13 indicator categories of Cabell and Oelofse (2012), is not a quality that distinguishes between resilient and nonresilient systems. A resilient system will be generating sufficient profit, but profit is not necessarily an output that leads to resilience. Excess profit can certainly lead to nonresilience if it is extracted by undermining system qualities that promote resilience. Other systems may not be profitable for several years due to expenses related to increasing resilience. Resilient systems, by definition, withstand economic disturbances and shocks due to the qualities inherent in the system. However, using resilience to economic disturbances as a defining characteristic of resilience makes the definition circular.

Which Set of Qualities Is the Most Useful?

Each of the eight qualities we present appears to be necessary for resilience in our case studies of resilient food systems in recalcitrant Southern states. Those who arrived at the other sets of qualities likely feel that their set fits the systems they know best. The best way to decide between the frameworks would be to attempt to induce resilience in a particular system following the predictions of each framework. This requires operationalizing these concepts, that is, defining specific ways of inducing and measuring each of the qualities espoused by each framework.

In Table 2 we have generated activities and measures at various scales which could be used to test whether the eight qualities we identified in studies of resilient food systems improve resilience and sustainability, and whether each is necessary and whether together they are sufficient to induce resilience in systems at various scales. If those espousing alternative frameworks attempt to operationalize their concepts as well, then alternative models can be tested to see which predicts resilience most fully. The goal of this table is to stimulate those interested in an ecological resilience perspective on sustainability to examine agricultural systems at various scales to determine what qualities lead to systems which survive and thrive in response to disturbance, as well as to generate measurable indicators of these qualities.

Combining the Eight Qualities into an Overall Index of Sustainability/Resilience

Operationalizing the qualities of resilience such that they can be quantified lays the foundation for creating an overall index of sustainability/resilience. If such an index is a good predictor of resilience, it would help managers of a system—farm, community, food system, etc.—improve resilience and be able to track changes in resilience. Indicators of the qualities of resilience are publicly available at the county level in databases such as National Census of Agriculture, Decennial Census, American Community Survey Five-Year Estimates, Net Migration Patterns for U.S. Counties, County Health Rankings, USDA Food Atlas, and USDA Farm to School Database. Aggregate county-level data from these sources could be used to test the

Table 2. Resilient Food Systems Three-dimensional Matrix: Scale, Qualities, Time

	Modular connectivity	Local self-organization	Infrastructure (e.g., soil, water, increasing)	Responsive redundancy	Complementary diversity	Conservative innovation	Integration of natural ecological systems	Periodic transformation
Federal policy system	Cooperative development programs (RCDG)[a]	VAPG, FMPP, LFPP, F2S implemented with planning funds for local projects	NRCS support for increasing assets (soil, water catch and conserve, equipment, fence)	BFRDP focused on training a new generation of farmers	Opportunity workshops to encourage diversification of crops and markets	On-farm innovation trials of tools incorporating traditional methods, tools and products	Workshops to increase use of ecological services (beneficial uses, cover crops, MIG)	Support for new leader training in farm and cooperative groups
Regional network	Bridging contact maintained to all member groups	Bring contacts which facilitate local control	Increasing capability to improve local infrastructure	Network recruits new groups from across region	Accesses new markets, practices for farmer groups	Local traditions celebrated while new ideas embraced	Wilderness reserves maintained	Regular turnover in governing officials
Community	Facilitates communication between all members	Local firms encouraged, outsiders must partner	Increasing infrastructure for services	Community maintains and replaces all needed services	Increased diversity dedicated to local heritage	Community embraces innovation and new practices as preserves heritage	Increasing area of parks and woodlands	New and young leaders encouraged
Group of farmers	Farmers trust and value other members of group	Local ownership of processing and marketing	Processing/ market equipment and facilities growing	Group recruits new members	Many different markets maintained for products	Variety of processing methods used as markets change	Support refuges and local heritage products	New processing/ marketing systems and products adopted
Farm and farm family	All systems on farm are independent but connected	Local managers make land decisions	Farm assets, equipment, inventory	Family and friends ready to help manage farm	Variety of systems (e.g., crop and livestock) integrated	Farm uses old and new tools to produce heritage and new products	Wild refuges maintained on farm	*Kaizen (*continuous improvement) of farm systems
Soils	Feedback tight btw soil and soil cover systems	Soils need few inputs to maintain productivity	Soil health increasing	Soil systems, soil cover reproduce selves	Diversity of soil organisms, and plants maintained	Soil systems adapt to changing conditions	Native flora, fauna, EM increasingly relied on	More systems for ↑ soil organic matter and topsoil depth
Water	Water resource and need have tight feedback	Local water harvest meets local need	Water capture increasing	Water sources steady to increasing	Multiple water sources available	Variety of water sources developed/ maintained	Water systems enhance wilderness	New systems employed to harvest and store local water
Person	Bonding and bridging, social capital	Internal locus of control	Maintains equipment, soil, water catchment	Heals quickly, helps others learn	Has variety of approaches, attitudes	Changes approach when need to	Follows natural cycles, eats seasonal foods	Regularly tries new patterns, breaks old habits

[a] RCDG=Rural Cooperative Development Grant program, VAPG=Value-Added Producer Grant program, FMPP=Farmers Market Promotion Program, LFPP=Local Food Promotion Program, F2S=Farm to School, NRCS=Natural Resource Conservation Service, BFRDP=Beginning Farmer/Rancher Development Program, MIG=Management Intensive Grazing

validity of the eight qualities of resilient systems by integrating the nine case studies of resilient local food systems in recalcitrant areas of the Southern U.S. with previous frameworks or the qualities espoused by other frameworks.

We are attempting to create quantitative measures of each of the qualities and an overall sustainability/resilience index. In our approach, available data from every county in the 13 Southern states are united in an overall sustainability/resilience index (SRI) that provides estimates of sustainability/resilience for each county in the South. These data are presented in draft form online (Worstell, 2016), along with practical tips for increasing resilience. We urge all other developers of resilience frameworks and models to consider quantification of their concepts to accompany their case study efforts. Such quantification can permit researchers to test whether their frameworks predict resilience. For example, Tsai, Wilson and Rahman (2015) used some of the data sources mentioned above to test resilience of rural counties to the 2007-2008 Great Recession. Their dependent variable, rebound in employment after the recession, was highly correlated with their resilience measures.

Relating SRI to Social Demographic Variables

As discussed above, ecological resilience avoids the polarizing aspects of other perspectives on sustainability with a measurable biological reality, the amount of disturbance a system can take before it dissolves without being able to reconstitute itself. The resilient system survives, the nonresilient does not. Ecological resilience assessment differs from sustainability assessment in one basic area: resilience assessments do not incorporate indicators unless they are associated with the ability of a system to withstand disturbance. An ultimate goal of resilience measurement is a set of indicators of the key qualities of ecological resilience across scales and types of systems, including soils and wildlife systems. Indicators of human social development are not available at the scale of soil or field.

Furthermore, if we are to determine whether sustainable and resilient local food systems contribute to broader goals of improving quality of life and wellbeing (Food, Agriculture, Conservation, and Trade Act 101-624, 16 U.S. C. § 1603, 1990; Toman, Lile, & King, 1998; Exec. Order No. 13, 693, 2015), a crucial proposition of sustainable agriculture movements and policies, it is critical that our theoretical and analytical frameworks not confound them. Frameworks that incorporate all desired outcomes in measures of resilience cannot measure the contribution of the system to these desired outcomes. Because of this, we intentionally do not include traditional poverty or health indicators. It is not because they are not part of broader social resilience, but rather because we want to be able to measure the extent to which they are associated with the ecological indicators of system resilience.

Approached from the standpoint of ecological resilience, quantitative measures of sustainability/resilience allow correlation of food system resilience with the variety of social indicators included in many traditional definitions of sustainability. Such analyses show the relationship of resilience to socially desirable characteristics that are only indirectly reflected in the fundamental qualities of resilience.

This approach enables examination of correlations of quantitative measures of resilience (such as our SRI) with measures of poverty, health, population, and other human social demographic variables. Determining the effect on such variables is crucial to determining whether ecologically resilient systems meet the quality of life or social criteria established by the various definitions of sustainability. We do have preliminary data (Green & Worstell, in preparation) that show that indicators of poverty appear highly negatively correlated with our sustainability/resilience index. Others, such as health indicators, are highly positively correlated. One tentative conclusion of these studies being prepared for publication is that resilient systems, at least at the county level as measured by SRI, generally are accompanied by low poverty and high health outcomes. Some basic data is presented in draft form online at Worstell and Grand (2016).

Other social demographic variables such as education level or population trends, though not included in most definitions of sustainability, also have interesting relationships to SRI. Correlations of these various social demographic indicators with

resilience are in preparation (Green & Worstell, in preparation). We urge all other resilience analysts to consider the relationships of health, poverty, and other social-demographic variables as efforts to quantify resilience. If low levels of poverty and high levels of health outcomes are correlated with resilience, an ecological resilience approach to sustainability may achieve the societal objectives of sustainability while establishing roots in biological and ecological sciences.

Conclusions

Living systems survive and thrive when their integrated components work together to adapt and transform in response to similar adaptation and transformation of other complex adaptive systems. Those that survive and thrive are called ecologically resilient. Viewing sustainability from a resilience perspective offers a means of reducing polarization and solving wicked problems due to the simple and observable definition of resilience. Defining and measuring the qualities of resilient systems should facilitate design and enhancement of similar systems.

We have identified eight qualities consistently shown in our case studies of uniquely resilient food systems in conjunction with examination of six prominent frameworks of ecological resilience. Identifying these qualities of resilient food systems was our first step toward a quantitative index of sustainability and resilience. We are using the resulting sustainability/resilience index to assess and help entrepreneurs and other managers to improve resilience at the community and farm level. Our continuing mission is to refine the index and our toolbox and extend it to various scales. We seek a set of descriptive statements that apply to multiple levels. For example, below is a set of statements summarizing our findings with food systems, but expressed at the community level by substituting community for food system.

- C: A resilient community is independent yet tightly connected to other communities, markets, and government policy systems.
- L: A resilient community has many LSO processing and marketing enterprises.
- A: A resilient community accumulates reserves and physical infrastructure that enable withstanding disturbance.
- R: A resilient community establishes back-ups and redundancy.
- D: A resilient community has a diversity of complementary enterprises.
- I: A resilient community encourages regular innovation that conserves the tried and true qualities that built it.
- E: A resilient community works with nature to minimize imported manufactured inputs, moving toward ecological integration.
- T: A resilient community embraces disturbance and periodically transforms itself.

The acronym CLARDIET expresses the eight qualities consistently found in systems that last. The eight qualities can also be expressed in a conceptual model expressed as SRI = f(C, L, A, R, D, I, E, T). Future research will define these qualities and their relationships to better explain, predict, and facilitate resilient sustainability.

Our framework lays a foundation for a virtually unlimited set of studies that will help increase resilience to climate change, economic change, technological change, political change, or any of a vast set of potential disturbances of our social agroecosystems.

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Adapting to climate change: Perceptions of maple producers in New York and Vermont

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Abstract

Maple production is an important part of local food systems in the Northeastern U.S. and Canada, where producers rely on maple as a source of income and as the basis for longstanding family and community traditions. Like many other sectors of the food system, maple production is vulnerable to climate change because of its potential impacts on forest type, tree health and vigor, and timing of sap flow. Since maple producers depend on the health of sugar maples for their livelihood and cultural traditions, adapting to changes in maple production will likely be necessary in the future and will require planning. The goal of this study is to assess the perceptions of maple producers and engage them in the development of strategies for adapting to the potential impacts of climate

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Authors' Notes

Basic results of the interviews for this study have been presented at the Northeastern Recreation Research Symposium (see Sharkey, Kuehn, & Chase, 2015). Most of the interview information presented herein has not been previously presented.

Results from this study have also been made available through an online ESF report (see Kuehn, Chase, Sharkey, & Powers, 2016).

change. The mixed methods research approach for this study included interviews and a survey of maple producers in the Northern Forest region of New York and Vermont. Results indicate that more than half of the maple producers who responded to the survey expressed concerns about climate change, and more than two-thirds had already made or were planning to make modifications to their businesses. Two factors that were identified as most important to respondents when assessing adaptability to climate change are resiliency of the maple producers' sugar bush and the producers' ability to adopt new technologies. These findings are not just relevant for maple production; they have important implications for climate change adaptation of food systems.

Keywords
Adaptability; Climate Change; Demographics; Business Characteristics; Maple Production

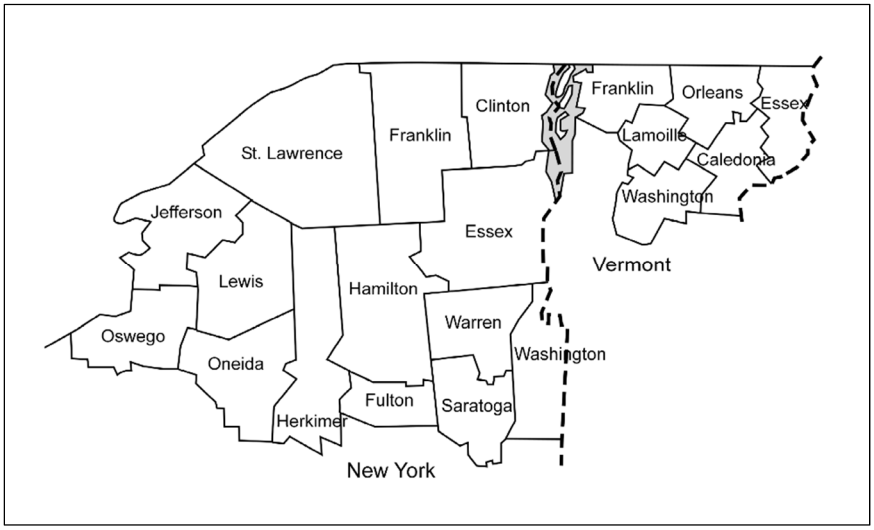
Introduction

Maple production is an important part of local food systems in the Northeastern United States and Canada, where it is a longstanding cultural tradition as well as a source of income for family-based businesses. Vermont and New York are the two highest maple-producing states in the U.S. (U.S. Department of Agriculture, National Agriculture Statistics Service [USDA NASS], 2017). The Northern Forest (NF) region of these states (Figure 1) is home to over 1,000 commercial maple production operations, primarily small businesses that depend on maple products (e.g., maple syrup and sugar) as a source of revenue. Many of these businesses have been in operation for decades (even generations), and there is substantial potential to expand maple production in several states in the Northeast and Midwest in the future (Farrell & Chabot, 2012).

Climate change is expected to impact the entire food system (Miller et al., 2013), and maple production is no exception. Predictions of climate change impacts regarding levels of sap production from maple trees vary, with some models suggesting that the season will be shorter in the Northeastern U.S., and others that the season will start significantly earlier (Skinner, DeGaetano, & Chabot, 2010). Skinner et al. indicate that the number of days on which sap flows from maples will not change through 2100; however, maple production business owners will need to collect sap earlier in the season to "maximize the number of sapflow days" (2010, p. 685). Climate data for the northeast indicate that the sugaring season has shortened by about 10% over the past 40 years (*Global Warming Mountaintop "Summit,"* 2007). Changes in precipitation and temperature are forecasted to create shifts in forest type from sugar maple to oak-hickory-pine in the next 50 to 100 years (*Global Warming Mountaintop "Summit,"* 2007). Maples stressed by climate change may be more susceptible to invasive pests and diseases, further reducing their vigor (Wilmot, 2012).

Because maple producers depend on the health of sugar maples for their economic well-being and as the foundation of family and community traditions, adapting to and planning for changes in maple production will likely be necessary in the

Figure 1. Northern Forest Region of NY and Vermont



Map based on a Northern Forest and Counties Map by Conservation Advisory Services, 1994.

future. Past research indicates that understanding the factors, including perceptions of climate change, that affect the ability of producers to adapt to change is essential (Jemison, Hall, Welcomer, & Haskell, 2014; Ogalleh, Vogl, & Hauser, 2013). A range of views exist on climate change in the United States, from those who believe action must be taken to reduce carbon emissions, to those who do not believe climate change is occurring. Ten percent of the general public does not believe the climate is changing and is opposed to actions that address climate change through adaptation or mitigation (Chase & Grubinger, 2014; Leiserowitz, Maibach, Roser-Renouf, & Hmielowski, 2012). A survey of farmers in Iowa found similar results: 5% of the respondents did not believe in climate change and did not wish to address climate change (Arbuckle, 2011). To date, no studies have assessed maple producers' beliefs about climate change, their ability to adapt to change, or the mechanisms in place within their families, communities, and industry to plan for change. This study seeks to provide a better understanding of these beliefs for maple producers in the Northern Forest Region of New York and Vermont.

The goal of this study is to identify strategies that help maple producers plan for and adapt to the potential impacts from climate change. In order to accomplish this goal, the objective is to identify the elements influencing the ability of businesses to adapt to climate change. We hypothesize that there will be significant relationships among business characteristics, demographics, perceptions concerning climate change, and producers' perceptions of their ability to adapt to climate change; we use a path analysis to identify significant relationships. While this research focuses on maple production, the methods and results have broad implications for other sectors of agriculture and food systems.

Literature Review

Adaptability is a business's ability to respond technologically to change, to be flexible in terms of its customer base (i.e., its market focus), and to have a management structure that can respond to change (Tuominen, Rajala, & Möller, 2004). According to Walker and Ruekert (1987), a high degree of adaptability in a business is essential since firms unable to adapt and innovate often fail. Resiliency (i.e., "the capacity of a system to absorb disturbance and reorganize while retaining essentially the same function" [Folke, Carpenter, Walker, Scheffer, Chapin, & Rockström, 2010, p. 3]) is important to business adaptability since it can determine how quickly businesses "bounce back" from catastrophic events such as severe weather. Research on small-business resilience during an economic downturn suggests that firms with high levels of adaptability and flexibility are more likely to be successful (Smallbone, Deakins, Battisti, & Kitching, 2012). For maple producers, resource-base resiliency (i.e., how quickly a maple forest or "sugar bush" can recover from catastrophic events) and flexibility in management and customer base are likely crucial to the long-term success of the business.

Adapting to the changing climate is a challenge for small businesses, particularly those as important to the traditions and economy of the Northern Forest Region as maple producers. Previous studies have used "adaptability scales" to measure (on a five-point scale) business owners' perceptions of their businesses' level of adaptability (Lansberg & Astrachan, 1994; Tuominen et al., 2004). This study uses this type of scale to study maple producers' perceptions concerning adaptability to climate change. Four components of adaptability are considered: customer base, management, technology, and resource base.

In addition to the components of adaptability, an understanding is needed of demographic, business, and social system (i.e., connections between individual businesses and family, community, and industry) characteristics. Previous studies have shown that the owners of small, family-based businesses, such as maple production businesses, need more than basic management and marketing skills to be successful. Eberle, Milliman, Peterson, and Rendleman (2004) found (for the dairy industry) that understanding family and community relationships is critical for successful transitions in times of uncertainty. Davis and Stearn (1981) emphasize the importance of being able to differentiate between business operations and family dynamics, since the two are often closely integrated in family-based businesses. Björnberg

and Nicholson (2007) found that family businesses are dependent upon the ability of the family running the business to work effectively together and to adapt to change.

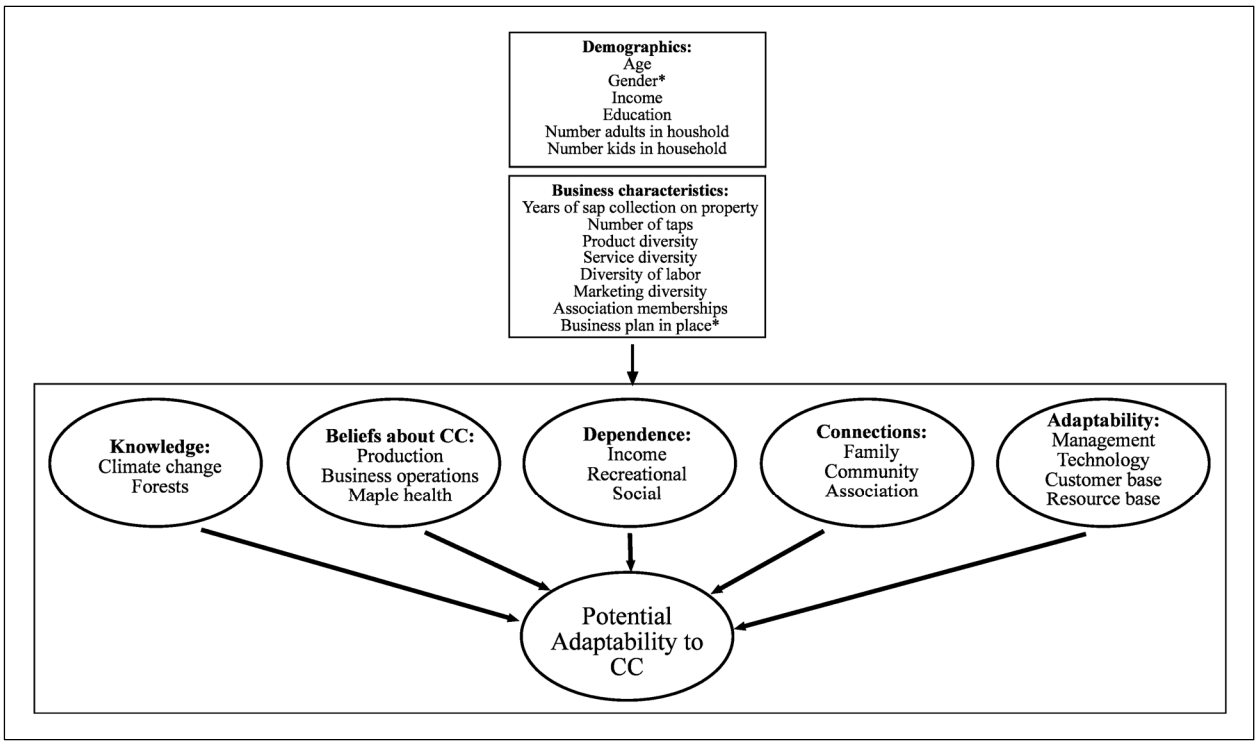
Because of the importance of family dynamics to business success, it is essential that these elements also be considered for maple producers. In addition, business success has been linked to managers' knowledge and perceptions of new technologies, demographics (education and age), business characteristics (e.g., firm size [Peltier, Zhao, & Schibrowsky, 2012]), business-related experience (Richbell, Watts, & Wardle, 2006), and the existence of a written business plan (Rue & Ibrahim, 1998). In order to provide a comprehensive understanding of business adaptability, this study integrates these elements as well as measures of adaptability in its theoretical framework (Figure 2).

Applied Research Methods

This study was composed of two components: interviews with a sample of maple producers, and a survey of all identified maple producers in the Northern Forest region of New York and Vermont (Figure 1). Information from online sources (e.g., New York State Maple Producers Association (NYSMPA), the Vermont Maple Sugar Makers Association (VMSMA), and business websites) and from the University of Vermont Extension program was used to create a contact list for all known maple producers in the Northern Forest Region of New York and Vermont.

Fourteen telephone interviews were conducted with 15 maple producers in the Northern Forest region of New York and Vermont in 2014 and 2015 (one interview was conducted with two business partners). The list of key contacts was used to randomly select producers for interviews. Interviews were scheduled by sending out e-mail requests. Interviews were recorded (with interviewee permission) with an Olympus DS-5000 digital voice recorder and transcribed using Dragon

Figure 2. Business Adaptability Model Related to the Potential Impacts of Climate Change (CC) on Maple Production Businesses



Note: An asterisk indicates that the item was not included in the final analysis.
Source: Kuehn, Chase, Sharkey, & Powers, 2016.

Dictate 4.0 software (Nuance Communications, 2014). Interviews ranged in length from 16 to 45 minutes.

The interview guide included questions about maple producers' perceptions of climate change, the characteristics and structure of their businesses, their businesses' products and services, the use of up-to-date technology, and the adaptability (i.e., resiliency) of their sugar bush. Interview questions related to adaptability, dependence, and connections (Table 1) were identified from Bélanger, Vanasse, Parent, Allard, & Pellerin (2015); Björnberg and Nicholson (2007); Eberle et al. (2004); Peltier et al. (2012); Tuominen et al. (2004); and Walker and Brown (2004). Questions regarding business characteristics and maple production were derived from an interview guide provided by Dr. Brenda Murphy of Wilfred Laurier University, Ontario, Canada. The interviews were structured so that the most contentious subjects (i.e., perceptions of climate change and how maple producers deal with change) were addressed only after rapport had been built between the interviewer and interviewee. Comments expressed by interviewees were transcribed verbatim. These transcriptions were then used to identify concepts relevant to interviewees' perceptions of climate change and the elements influencing their business' ability to adapt to change (Figure 2).

Interview data were analyzed by the first and third authors for reoccurring concepts related to the themes identified through literature review (Table 1). In addition, grounded theory techniques (Creswell, 2009) were used to identify themes previously unidentified for business owners' perceptions of climate change (e.g., beliefs concerning climate change, knowledge of climate change and of forests, and adaptability of the resource base (i.e., sugar bush resiliency; see Table 1). We identified the number of respondents indicating each concept within each theme. Intercoder agreement (i.e., cross-checking concepts identified by two different researchers [Creswell, 2009]) was calculated for each concept using ReCal online software (http://dfreelon.org/utils/recalfront/) (Freelon, 2010). An intercoder agreement percentage of 80% is usually considered an adequate indication of consistency of the data (Miles & Huberman, 1994); however, since the closest percentage to 80% that could be obtained mathematically based on the number of interviews in this study was 79%, this percentage was considered an adequate indication of intercoder agreement.

The themes confirmed and/or identified through analysis of the interview data were used to write a questionnaire for the mail and online survey (Table 1). The questionnaire included questions related to the characteristics of respondents' businesses; respondents' demographic characteristics; their knowledge of climate change and northeastern forests; their beliefs related climate change; their dependence on their business for economic, recreational, and social reasons; the connection of their business to family, community, and the maple production industry; perceived adaptability of their business with regard to management, technology, customer base, and resource base (i.e., sugar bush resiliency); and potential adaptability to climate change (Figure 2). Questions were in multiple choice, fill-in-the-blank, and five-point scale formats. For questions related to the perceptions of maple producers, the questionnaire used a scale ranging from –2 (strongly disagree) to 0 (neutral) to 2 (strongly agree). Lists of services and marketing and promotion techniques were also included on the questionnaire. "Diversity of services provided" was calculated as the sum of all services identified on the questionnaire; "diversity of marketing" was calculated as the sum of all marketing and/or promotion techniques implemented by the respondent.

The survey was conducted by mail and online in the fall of 2015 using a modified tailored design method (Dillman, 2007). We distributed four mailings of the questionnaire to the 1,322 maple producers identified in the Northern Forest Region of New York and Vermont via first-class mail. The first and third mailings contained a cover letter, full questionnaire, and postage-paid return envelope; the second and fourth mailings were reminder postcards. An identical online version of the questionnaire was provided using SurveyMonkey (San Mateo, CA) for those respondents who prefer submitting responses via the Internet. A link for the online survey was included in the questionnaire mailings; respondents were required to enter a

number from the back of their mailed questionnaire to participate in the online version.

Following completion of the full survey, a short, one-page survey was mailed to all of the maple producers who did not respond to the full survey. Comparisons were made between the respondents to the full and to the short surveys to identify any significant differences ($p \leq 0.05$) in a few important variables. Finding a significant difference between the two groups could indicate that the population of maple producers is somehow different than the group of individuals who responded to the full survey.

Data were entered into PASW Statistics version 18.0 (SPSS, Inc.). Following data entry, a confirmatory factor analysis was conducted using EQS 6.1 software (Bentler, 2010) to confirm the arrangement of variables into factors (Hair, Anderson, Tatham, & Black, 1998). Because some variables were written on the survey "in the negative" or opposite of how other variable statements were written, these variables were reverse coded before the factor analysis was conducted. The variable means for the reverse-coded questions shown in the tables in Appendices A and B do not show the reverse coding (i.e., the means of the actual responses are included in each table); however, the factor means shown in these tables were calculated using the reverse-coded data. For the confirmatory factor analyses, a root mean square error of approximation (RMSEA) of less than 0.05 (Byrne, 2006, p. 100) and a comparative fit index (CFI) of "close to 0.95" (Byrne, 2006, p. 97) were used to identify adequate fit of the variables into factors. The reliability of factors was checked by calculating the Cronbach's alpha. Alphas above 0.7 are considered to have good consistency and can be used for statistical analyses such as path analysis (Hair et al., 1998). Following these tests, the responses for the questions composing each factor were averaged together for each respondent, creating the summated scales used in the path analysis (Hair et al., 1998). The summated scales for all respondents were then averaged to identify the overall factor means for all respondents reported in tables in Appendices A through D.

A path analysis was used to identify significant relationships ($p \leq 0.05$) among the factors (the relationships tested are indicated with arrows in Figure 2). Variables related to demographics (e.g., age, years of education) and business characteristics (e.g., number of taps or holes put in the trees to extract the sap) were also included. The path analysis utilized robust methods as suggested by Byrne (2006); good fit was attained when the CFI was near 0.95, the RMSEA was less than 0.05, and the Satorra-Bentler chi square reached a *p*-value of greater than 0.05 (Byrne, 2006).

Results

Interviews

Fourteen in-depth telephone interviews were conducted with maple producers after obtaining interviewee permission. Eight interviews were with New York producers and six were with Vermont producers; one interview included both owners of the business. Seventy-two percent of the interviewees thought climate change was occurring; two respondents indicated that climate change has been accelerated by humans, two had no clear idea about climate change, and one considered it to be a political and marketing ploy (Sharkey, Kuehn, & Chase, 2015).

Themes related to business management and climate change were identified from previous literature and from the interviews. "Knowledge of climate change" and "knowledge of forests in the northeast" were two of the constructs identified from interview results (Table 1). Knowledge of climate change was indicated by interviewees' comments concerning the "slow global warming of the world" (indicated by 36% of respondents; intercoder reliability (ICR)=93%), "extreme or odd weather patterns" (50%; ICR=86%), and "warmer weather, less snow, early spring" (29%; ICR=86%).

> Interviewee #8 (male, in business 5 years): "The ocean temperatures are changing, and the ocean temperatures and the currents are actually what dictates weather patterns everywhere else. So as the ice caps melt, the water gets warmer, which is what creates the wind, and the wind actually dictates how the whole atmosphere revolves and conducts itself. So yes, the climate is changing."

Table 1. Themes Used to Write the Mail and Online Survey

Themes	Source
Knowledge of climate change	Interview results
Knowledge of forests	Interview results
Beliefs about impacts of climate change on production	Interview results
Beliefs about impacts of climate change on business operations	Interview results
Beliefs about impacts of climate change on maple health	Interview results
Dependence on maple production for income	Walker & Brown, 2004; Interview results
Dependence on maple production for recreational purposes	Interview results
Dependence on maple production for social purposes	Bélanger et al., 2015; Walker & Brown, 2004; Interview results
Connections of business to family	Eberle et al., 2004; Interview results
Connections of business to community	Eberle et al., 2004; Interview results
Connections of business to industry	Eberle et al., 2004; Interview results
Adaptability of business in management	Björnberg & Nicholson, 2007; Tuominen, et al., 2004; Interview results
Adaptability of business in technology	Peltier, Zhao, & Schibrowsky, 2012; Tuominen, et al., 2004; Interview results
Adaptability of business in customer base	Tuominen, et al., 2004; Interview results
Adaptability of resource base (i.e., sugar bush resiliency)	Interview results
Ability of business to adapt to climate change	Interview results

Knowledge of forests was indicated by interviewees discussing the potential reduction of maples in forests in the southern portion of the sugar maple range (21% of interviewees; ICR= 93%), as well as the observation that maples on north-facing slopes might do better as temperatures increase (14%; ICR=86%).

> Interviewee #14 (male, in business 10 years): "I think that some producers may see an effect if they have a southerly aspect slope on their sugar bush. But if they have a northerly aspect slope, like I do, it may take longer for those effects to impact their business."

Three belief-related themes concerning climate change were identified from the interviews: production, business operations, and maple health. Fifty percent of interviewees indicated beliefs concerning production by indicating that there would be an impact on production levels in the future due to climate change (ICR=86%); 57% believed that this impact would not occur in their lifetime (ICR=86%).

> Interviewee #14 (male, in business 25 years): "Looking forward 100 years, if the temperatures are steadily increasing, we will see declines in maple syrup production."

Beliefs concerning business operations were mainly related to changes made to operations such as tapping trees earlier (43% of interviewees; ICR= 79%) and being flexible about when tapping begins (21%; ICR=79%).

> Interviewee #13 (male, in business 4 years): "The big things are in terms of when to tap the trees.…When the season begins to how the sap is flowing. I think that's being affected by changing temperatures in the climate."

Beliefs concerning maple health were indicated by comments about the future health and vigor of maple trees due to potential impacts from climate change. Thirty-six percent of interviewees discussed changes they thought would occur in maple forests due to climate change. Five (36%) indicated that maples would no longer be able to thrive due to the warmer weather conditions (ICR=79%).

> Interviewee #1 (male, in business 1 year): "If it gets hotter and drier it will affect species that can't adjust to the extreme conditions. And I don't know enough about our species to know which ones will be affected most, but obviously maple is the one that is closest to home and the species that we will watch the most."

Four interviewees (29%) indicated that the changing temperatures could encourage the spread of invasive species and tree diseases (ICR=86%).

> Interviewee #13 (male, in business 4 years): "As for the health of the maple trees, I do worry about changing temperatures and how that'll affect the winters here, and potentially new invasives that are going to affect my maple trees and new diseases."

Three themes were identified concerning the interviewees' "dependence" on their business for financial, recreational, and social purposes. All interviewees indicated that they use their syrup within their family and to give to friends (ICR= 100%); 79% use their maple business as a supplemental source of income (ICR=79%).

> Interviewee #2 (male, in business 17 years): "It's a nice additional source of income. It helps us pay our taxes, and also gives us a bit of spending money."

"Recreational dependence" was indicated when interviewees mentioned that they liked being outdoors (21% of interviewees; ICR=93%), the physical exercise involved with being out in their maple forest or "sugar bush" (29%; ICR=86%), that maple production was a hobby for them (36%; ICR=79%), and/or that they "love" or enjoy making syrup (43%; ICR=79%).

> Interview #10 (male, in business 4 years): "It's a healthy activity to produce it, and we enjoy it because of that. I think that's the simplest answer."

"Social dependence" was shown when interviewees discussed socializing with other business owners or with customers (14%; ICR=100%), and that maple production was "in their blood" or an important part of their heritage (36%; ICR=93%).

> Interviewee #8 (male, in business 5 years): "Well, of course you've got to make money, but I'm not really doing it for the money, because I'm never going to get rich doing this. I guess it's just one of those things that you have in your blood."

Three themes related to "connections" of the interviewee and his or her business to family, community, and the maple industry were identified in the literature and confirmed through the interviews. "Connections to family" were shown by the integration of family members into the production process. Seventy-nine percent of interviewees indicated that their spouse or significant other was either an employee or partner in their production business (ICR=100%); 21% indicated that their children or grandchildren help during sugaring season (ICR=86%). Five businesses (41%; ICR= 86%) indicated that their business has been passed down through the generations.

"Connections to community" were identified by the interviewees' involvement in community-based events, farmers markets, and open houses (64% of interviewees; ICR=93%); 29% indicated that they did not have a strong connection to their community for business purposes (ICR=100%).

> Interviewee #4 (female, 20 years in business): "It's really made us be more active in the local community as a small business. We're part of the chamber of commerce and actively involved in the local community thanks in large part to our maple business."

"Connections to the maple industry" were primarily shown by involvement in maple producers associations; 93% of interviewees indicated that they are members of a maple producers association (ICR=93%).

> Interviewee #9 (male, in business 30 years): "I do a lot of work with the state association working with government officials and things like that."

Interviewees felt that association involvement was important because it kept them up-to-date on the industry (36%; ICR=86%), provided opportunities for networking with other producers at conferences and association meetings (50%; ICR= 79%), and provided important promotional tools (36%; ICR=79%).

Three themes identified through literature review were confirmed through the interviews in relation to "adaptability" in management, technology, and customer base; a fourth theme, "adaptability of the resource base," was identified through analysis of the interview data (Table 1). "Adaptability in management" was shown through the flexibility of maple producers with regard to decision-making. Seventy-nine percent of the interviewees had businesses that were adaptable with regard to management because all decision-making was done either by themselves or in conjunction with their spouse (ICR=79%). Decisions were also made by 29% of interviewees based on input from professionals such as accountants, Cooperative Extension agents, and foresters (ICR=93%). The family-based system used by most producers seemed to provide further adaptability in that if an employee quit or was unavailable during sugaring season, family members or the owner would complete the needed tasks (86%; ICR=86%).

> Interviewee #4 (male, lifelong involvement in business): "That actually did happen a few years back. My wife's father was really sick and she had to fly out to take care of him during production season. When that happened, my parents came to the farm and helped pick up some slack."

"Adaptability in technology" was expressed by interviewees when they discussed the adoption of new sugaring technology. Thirty-six percent of interviewees indicated that they have already installed new technologies to adapt to climate change (ICR=93%), while 29% indicated that they plan to do so in the future (ICR=86%). The majority of owners (79%) indicated that the financial expenses associated with adopting new technologies influences their adoption to some degree (ICR=79%); 29% indicated that they need to see a relatively quick return on investment to make the adoption of new technologies feasible (ICR=86%). Only two interviewees indicated that nothing stops them from adopting new technologies; both were the owners of larger businesses with high profit margins (ICR=100%).

> Interviewee #4 (male, lifelong involvement in business): "It's really all about the numbers and how fast it will get a return on our investment. So we just sit down with a calculator and crunch the numbers. If we think we can make our money back say, in five years, then we might move forward with buying new equipment or something like that."

"Adaptability in customer base" was related to the diversity of visitor markets served by interviewees, and the geographic breadth of the customer base. Thirty-six percent of interviewees served local customers only (i.e., customers within the immediate geographic region of the maple production business; ICR=100%); 57% served local customers as well as customers from elsewhere in the state and out-of-state (ICR=93%). Only one interviewee sold products via the Internet.

Finally, "adaptability of the resource base" was identified through the interviewees' perspectives on how they would react if severe damage to their sugar bush occurred due to a catastrophic event. Twenty-nine percent indicated that they would harvest timber if needed to generate income (ICR= 93%), 21% would replace sap lines as quickly as possible (ICR=79%), and 36% would buy sap from other producers (ICR=86%). Many of the actions indicated by interviewees indicated the limited resiliency of the sugar bush itself.

> Interviewee #2 (male, in business 17 years): "There was a bad windstorm back in '98, and it put us out of business for a year. We lost a lot of customers during that year, but we bought more sap and tried to keep as many customers as possible."

Mail Survey

Response Rate

The full survey was mailed to 1,322 businesses in the Northern Forest Region of Vermont and New York. Undeliverable addresses, deceased individuals, and noncommercial maple producers were removed from the contact list, leaving a qualified sample of 1,011 maple producers. Of this qualified sample, 269 maple producers returned a completed questionnaire for a response rate of 27%. Of the usable questionnaires (N=264), 86 were completed by New York producers and 178 by Vermont producers (Kuehn et al., 2016).

A short survey was sent to the 742 individuals who did not respond to the full survey; 70 maple producers returned this short survey. Comparisons between responses to the full and short surveys revealed no significant differences ($p \leq 0.05$) between full survey and short survey responses to questions concerning number of taps, willingness to make business changes, having the financial resources necessary to adopt new technologies, catering to diverse clientele, and having back-up strategies in place to deal with sugar bush (i.e., resource base) damage. The age and years of education of respondents were also compared; no significant differences were found, indicating that the respondents to the full survey are likely representative of maple producers in the Northern Forest region (Kuehn et al., 2016).

Demographics

The age of respondents ranged from 18 to 88, and the average respondent was 61 years of age (n= 261). The average respondent had 14.5 years of education (includes 12 years for high school; n= 249). Most (94%) were male (n=261). Nearly half of the respondents had an annual household income between US$26,000 and US$75,999. Eighty-seven percent of respondent households were home to two or more adults; 19% of households had at least one child (n=261; Kuehn et al., 2016).

Business Characteristics

Maple syrup had been produced on the land of respondents for an average of 82 years in NY and VT combined (an average of 51 years in NY and 97 years in Vermont; n=256). Producers in NY had an average of 2,576 taps in 2014, and had added an average of 681 taps between 2010 and 2014 (n=86); Vermont producers averaged 4,876 taps, adding an average of 1,470 taps in the same five-year period (n=175). The average producer made 1,337 gallons (5,062 liters) of syrup in 2014 (n=248); the maximum amount produced by a single producer was 32,500 gallons (123,026 liters). Most respondents (91%) did not have a written business plan in place, although 5% indicated that they were currently writing one (n=255; Kuehn et al., 2016).

Diversity in Products, Services, and Marketing and Promotions

Although all the maple producers surveyed provide maple syrup, 36% of respondents provide other products as well. Maple cream, maple candy, and maple granulated sugar were the products most commonly mentioned by respondents. Eighty-one percent of respondents sell only maple products; 13% sell maple products plus one non-maple product, and 6% sell maple products plus two or more non-maple products (n=258; Kuehn et al., 2016).

Sixty-one percent of maple producers offer at least one type of service, the most common being tours of their maple production facility and/or sugar bush, an "open house" during Maple Weekend (state-sponsored events used to promote maple production businesses in both states), and programs for school groups. Twenty-four percent of respondents offer one type of service, 11% offer two different services, 15% offer three to four services, and 11% offer five or more services. The mean number of services offered by respondents was 1.6, with a median of 1.0 (n=254; Kuehn et al., 2016).

About one-quarter of businesses do not use any form of marketing or promotion; the

remaining 74% of respondents use diverse promotional approaches, including word-of-mouth, a sign outside their business, business cards, listings on maple producers association websites, their own business website, and Facebook. Of those respondents who promote their business, 39% use only one form of promotion, 20% use two forms, 14% use three forms, and the remaining 27% use four or more forms. The mean number of promotional approaches implemented by respondents was 2.1, with a median of 1.0 (n=256; Kuehn et al., 2016).

Factors Related to Perceptions of Climate Change

Knowledge of climate change and forests

Respondents were asked to rate their knowledge of climate change and of forests in the northeast on a scale of –2 (strongly disagree) to 0 (neutral) to 2 (strongly agree). For "knowledge of climate change," the average respondent had a mean of 0.3, indicating weak agreement with statements related to perceived knowledge of climate change (Appendix A). The mean for "knowledge of forests" was slightly higher (M=0.43; Kuehn et al., 2016).

Beliefs concerning potential impacts from climate change

Three beliefs concerning the potential impacts of climate change on maple production, business operations, and maple tree health were examined. The first, "beliefs concerning impacts on production," had a negative and moderately strong mean (M=–0.62; Appendix A), indicating that the average respondent believes that climate change may cause a reduction in sap production in the future. The second belief factor concerning impacts on business operations had a moderately strong and negative mean of –0.7, indicating that respondents (on average) believe that maple producers may need to change how they operate in the future because of climate change. The third belief concerning impacts on maple health also had a strong, negative mean (M=–0.9), suggesting that respondents (on average) believe that climate change will harm maple health in the future (Kuehn et al., 2016).

Dependence of maple producers on their business

Three different factors were calculated concerning the dependence of maple producers on their business. The first, dependence on the income from maple production (i.e., "income dependence"), had a moderately weak mean of –0.46 (Appendix B). This result suggests that the average respondent likely has sources of income other than maple production. The second factor, "recreational dependence," had a moderately high mean of 1.0; the average respondent may rely on maple production for getting them outdoors and for physical exercise. The third factor, "social dependence," had a moderate mean of 0.46; the average respondent does appear to rely on maple production to a small extent for social reasons such as interacting with friends and family, attending social events, and carrying on cultural traditions. The mean for one variable included in this social dependence factor was high (i.e., "Maple production is important because it is part of my heritage and/or family traditions;" M=0.87), indicating a strong heritage-based connection between the average respondent and their production business (Kuehn et al., 2016).

Connections of maple production businesses with family, community, and business associations

Three factors were calculated concerning the connections of maple production businesses (Appendix C). The first, "connections between business and family," had a mean of 0.4, suggesting that the average respondent perceives a moderate connection between their business and family. The second factor, "connections of business with community," had a moderate and negative mean of –0.6; the average respondent does not appear to rely on their community for organizing events, networking opportunities, and promotions. The third factor, "connections between business and associations," focused on relationships between respondents and industry-based organizations such as maple producer associations. This factor had a moderate and positive mean (M=0.4), indicating that the average maple producer has a moderate connection with his or her association for promotions and networking overall. However, the variable "I greatly depend on a maple producers association

for up-to-date information about maple production" had a strong mean (0.85); this information-providing aspect of associations appears to be important to the average producer (Kuehn et al., 2016).

Business adaptability

Four factors were related to business adaptability (Appendix D). "Adaptability of management" concerned the perceived willingness and ability of respondents and their employees to plan ahead and quickly make decisions. The mean for this factor was 0.81, indicating that the average respondent had a strong and positive perception of their management adaptability. The second factor, "adaptability of technology," had a relatively weak mean of 0.23; the average respondent may not always have the finances and ability to keep up-to-date with new maple production technologies. The third factor, "adaptability of customer base," had a moderate mean of 0.40. Although the clientele base of the average respondent is perceived as only moderately diverse with regard to selling to retail, individuals, and families (M=0.47), respondents perceived the diversity of locations where customers reside (i.e., in-state and out-of-state) as high (M=0.84; Kuehn et al., 2016). The fourth factor, "adaptability of the resource base," had a negative and moderate mean (–0.56), suggesting that the average maple producer does not have back-up options in place for periods of low production or catastrophic events affecting their sugar bush (Kuehn et al., 2016).

Potential adaptability to climate change

This factor focused on producers' perceptions of their business to potentially adapt to climate change in the future with regard to labor, technology, customer base, and resource base (i.e., sugar bush; Appendix D). The slightly negative mean (M=–0.22) suggests that the average respondent does not perceive (at this time) that their business will be able to easily adapt to climate change. Adaptability of the resource base may be of particular concern to respondents since the average respondent most strongly disagreed (M=–0.49) with the variable "If any severe damage to my sugar bush occurred due to climate change, my business could quickly change how it collects and/or obtains sap."

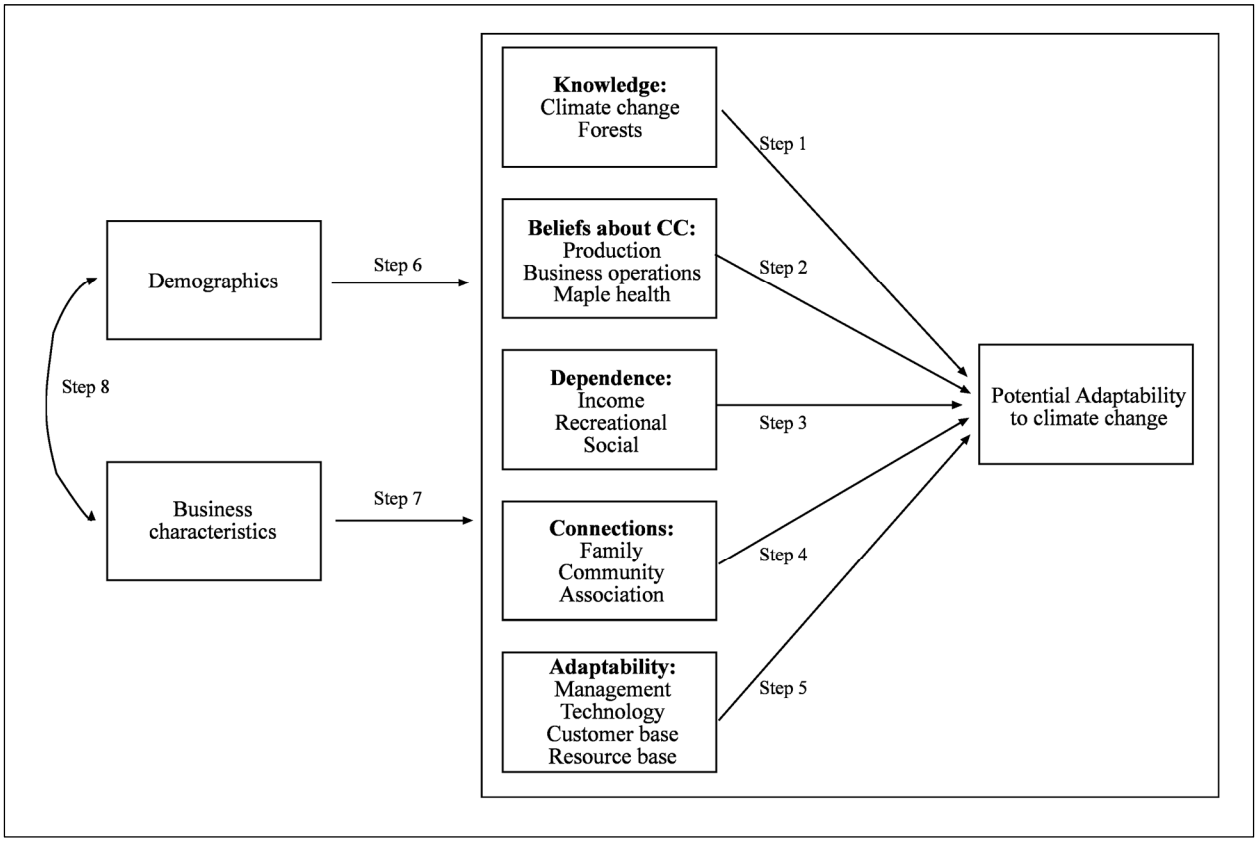
Path Model

A path analysis using robust techniques was conducted to identify the significant ($p \leq 0.05$) relationships among the factors shown in the tables in Appendices A through D, as well as demographic and business characteristics (Figure 3). Prior to the path analysis, respondents missing data for any of the independent or dependent variables were removed from the database, leaving a sample of n=170. Thirty-seven separate models were run during the analysis; during each step in the process, factors and variables that were not significant were removed from the model.

In the first step of analysis (Figure 3), one factor (knowledge of forests) was identified as significantly related to perceptions of adaptability of business to climate change (i.e., dependent variable; $S\text{-}Bx^2$ (1)=60.043, p<.001, CFI=.337, RMSEA=.591). In step two, relationships between belief-related factors and the dependent variable were added; only one belief factor was significant (i.e., beliefs concerning the impacts of climate change on production; $S\text{-}Bx^2$ (6)=142.167, p<.001, CFI=.162, RMSEA=.366). In step three, factors related to the "dependence" of the producer on maple production for income, recreation, and social purposes were added. Both the income dependence and social dependence factors were identified as significant, and model fit improved ($S\text{-}Bx^2$ (10)=18.627, p=0.045, CFI=.764, RMSEA=.071). In step 4, the factors related to "connections" of the business to family, community, and association were included; only connections with the community were found to be significant ($S\text{-}Bx^2$ (21)=117.982, p<0.001, CFI=.249, RMSEA=.165). In step 5, the "adaptability" factors were added (Figure 4). Although the factors of adaptability of management, technology, and resource base were found to be significant, several factors (income dependence, social dependence, and connections to community) were identified as no longer significant and were removed from the model ($S\text{-}Bx^2$ (28)=148.621, p<0.001, CFI=.519, RMSEA=.160).

Demographic and experiential characteristics were tested for both direct relationships with the

Figure 3. Step-by-Step Process Used to Conduct the Path Analysis

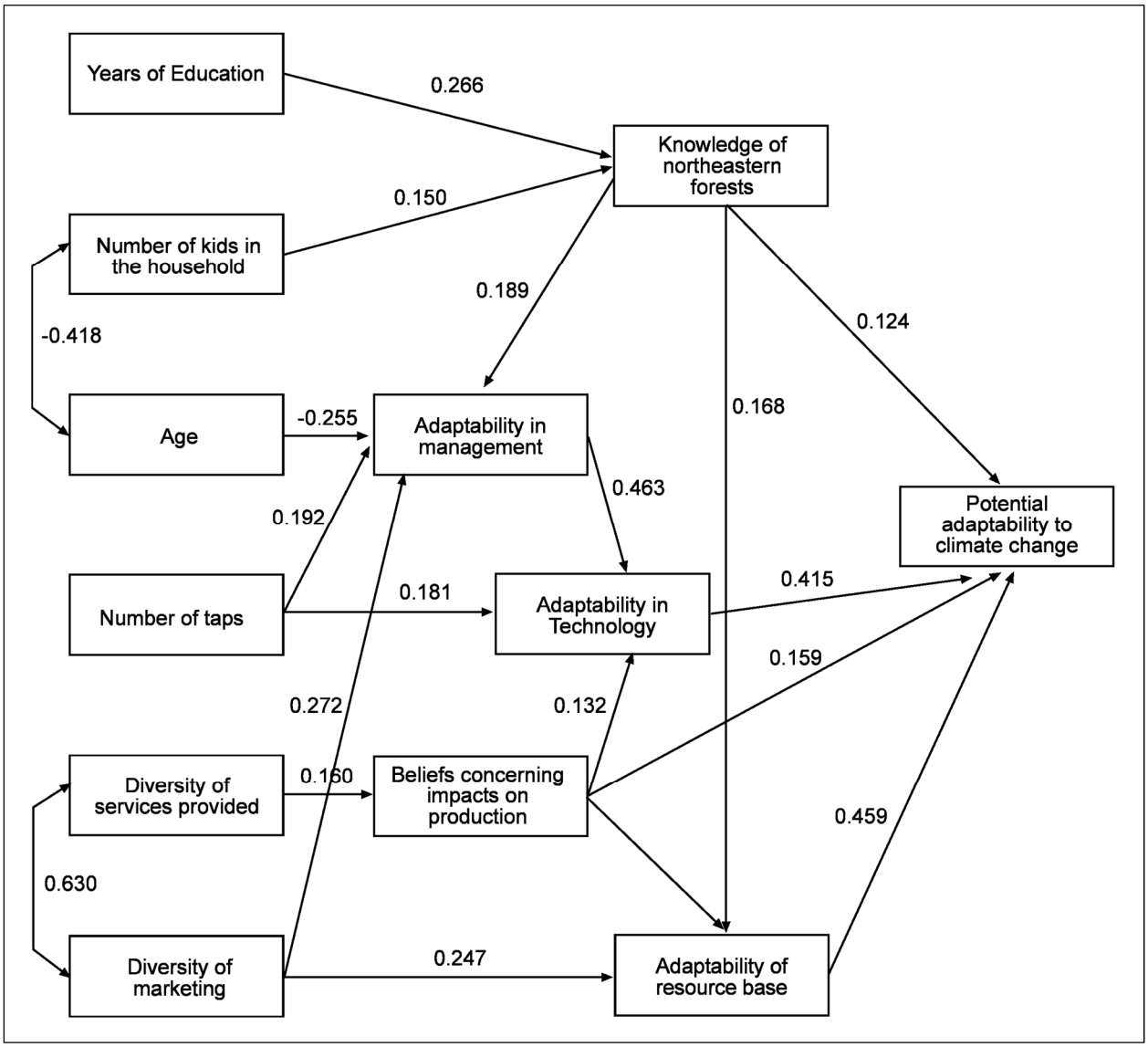


dependent variable and indirect relationships mediated by the significant factors identified in steps 1 through 5; none had significant direct relationships with perceived ability to adapt to climate change, but seven did have significant indirect relationships (i.e., education, number of children in household, diversity of services, age, income, number of taps, and diversity of marketing; $S\text{-}Bx^2$ (61)=249.449, p<0.001, CFI=.555, RMSEA=.135). Results of a LaGrange Multiplier test revealed potential relationships among the mediating factors; these relationships were added to the model ($S\text{-}Bx^2$ (58)=196.380, p<0.001, CFI=.673, RMSEA=.119). Relationships between exogenous variables were added in step 8; model fit improved significantly ($S\text{-}Bx^2$ (54)=73.369, p=0.041, CFI=.954, RMSEA=.0.046). Because the Satorra-Bentler chi square results were not yet showing adequate fit, additional analyses were run to test for improvement in model fit upon removal of each exogenous variable. Model fit was shown to improve when "income" was removed (S-Bx^2 (47)=58.676, p=.118, CFI=.970, RMSEA=.038). Although Wald test results indicated that no parameters needed to be dropped from the model, LaGrange multiplier test results indicated the existence of a significant relationship between beliefs concerning production and adaptability in technology. The addition of this relationship resulted in the final model (Figure 4; $S\text{-}Bx^2$ (46)=54.832, p=.174, CFI=.977, RMSEA=.034).

Discussion

This study employed a mixed-methods approach comprising interviews with maple producers and a mail/online survey to study the relationships affecting respondents' perceived adaptability to climate change in the maple production industry. The interviews revealed themes not previously identified in the literature, thus enabling a comprehensive examination of business adaptability for this specific industry, with general implications for

Figure 4. Path Analysis Model
Standardized parameter estimates are given above one-way arrows; correlations are given near two-way arrows.



small business adaptability. Through path analysis, we were able to confirm that significant relationships in this new adaptability model do exist. Furthermore, the results provide some important concepts for maple producers and other small resource-based businesses to consider with regard to the potential impacts of climate change on their business and industry, and to other external factors that could affect productivity.

The four factors found to be directly associated with the dependent variable of "potential adaptability to climate change" are adaptability of the resource base (i.e., resiliency of the sugar bush), adaptability in technology, knowledge of northeastern forests, and beliefs concerning the impacts of climate change on production. Of these four factors, adaptability of the resource base and adaptability in technology had the strongest relationships (standardized parameter estimates=0.459 and 0.415, respectively). Based on these results, it appears that the perceptions of respondents regarding the environmental and/or economic

setting of their business can be particularly important in their perceptions of the future viability of their business. Furthermore, for some responding business owners, perceptions regarding the ability of their business to adapt to change may be greatly influenced by their ability to obtain new technologies. Although adaptability in technology has been identified as an important element influencing business success by previous researchers (Peltier, Zhao, & Schibrowsky, 2012; Tuominen et al., 2004), adaptability of the resource base may be unique to resource-based businesses such as those involved in agriculture (Perks & Medway, 2012), natural resources management, and the maple production industry. Similarly, knowledge of the northeastern forest and beliefs concerning maple production are specific to the maple industry; however, it is possible that knowledge and beliefs specific to the business environment of other types of businesses may affect business owner perceptions as well.

Several of these factors found to directly influence "potential adaptability to climate change" also served as mediating variables. Adaptability in technology appears to be one of the most important mediating variables in our model, as adaptability in management, beliefs concerning production, and number of taps are all directly related to it. Furthermore, number of taps also directly influences adaptability in management. These results suggest that larger businesses (i.e., those with a greater number of taps) may be able to more easily handle management problems and afford new technologies than smaller businesses, possibly because of greater profit margins.

Other significant variables in the path model include demographic characteristics, years of education, number of children in the household, and age. The relationship between years of education and knowledge of northeastern forests suggests that increased education levels could help maple producers better understand the environment in which their business operates. Knowledge of northeastern forests is also influenced by the number of children in the household, indicating that maple producers with children may be more involved in learning about forests in general, perhaps as a way of engaging their children in their maple production business. Age seems to influence adaptability in management; the older a respondent was, the less likely they were to perceive themselves as flexible in responding to management problems.

Diversity in services was found to influence production beliefs, while diversity in marketing and promotion influenced both adaptability in management and adaptability of the resource base. Respondents who offer diverse services and implement diverse marketing and promotion strategies are more likely to perceive their sugar bush as resilient. These types of services may help maple producers maintain some level of income, even when production is low. Similarly, diverse marketing strategies may help maintain customer interest in a business, helping the maple producer weather periods of low production. It is important to note that "diversity of products" was not identified as a significant factor in the model, likely because 81% of respondents offer only maple products. It is possible that producers who do sell a diversity of maple and non-maple products are able to maintain a higher income during times of low maple production. Having a diverse product line may be particularly important in low production years since value-added maple products can be made using smaller amounts of syrup.

Several factors were not significant in the model; even though they were scored highly by respondents, these factors do not appear to influence respondents' perceptions of potential adaptability to climate change. First, "connections of business with family" was not significant, even though 92% of respondents receive assistance from family and friends during the tapping season. Furthermore, 18% of producers plan to pass their business on to their children, indicating that these family connections are important to respondents and could influence the future of the industry. The heritage and traditions involved in this industry appear to be especially important to respondents, with high averages for the variables "maple production is in my blood" and "maple production is important because it is part of my heritage and/or family traditions."

Next, "connection of business with associations" was not identified as a significant influence

on potential adaptability to climate change, even though associations were identified by respondents as an important source of information. Associations are likely to remain important to maple producers in the future should impacts from climate change occur, primarily because they provide producers with up-to-date information on production technologies. In addition to associations, education programs such as the Cooperative Extension were another important source of up-to-date information for respondents.

Finally, "dependence on maple production for recreational purposes" was not identified as significant in the model, but had the highest average (M=1.00) of all factors, indicating that the recreational aspects of maple production are important to the average respondent. Similarly, the variable "maple production is important to me because of the enjoyment it provides" had the highest average (M=1.41) of all variables included on the survey. Thus, although the recreational aspect of maple production is not likely to affect a business's potential adaptability to climate change, it is likely to affect whether a business owner decides to continue with maple production.

This study has important implications for research regarding the adaptability of food systems to climate change and other stressors. Although the model shown in Figure 4 was developed specifically for maple producers in the Northern Forest Region of New York and Vermont, the constructs identified through a mixed-methods process can be adapted for research on other types of businesses. For example, the concepts of "knowledge of climate change" and "knowledge of northeastern forests" should be considered for future research in a broader light as "knowledge of business-related stressors" and "knowledge of business setting." Similarly, "adaptability of the resource base," though focused in this study on sugar-bush resiliency, could very well be relevant to other businesses, especially those related to agriculture and natural resources. The constructs of "beliefs" related to business production and operations, though operationalized according to their relevance to climate change in this study, could be refocused on different issues important to business owners. Other constructs such as "dependence," "connections," and "adaptability" are all important to other businesses and should be considered for inclusion in future business adaptability models as well.

It is important to note the limitations of this study. First, the survey questions are designed to obtain the perceptions of respondents. As with any social science study, the perceptions of respondents may not always exactly reflect the situation as experienced by the respondent or as perceived by those not in the sample of respondents. Second, although efforts were made to obtain the most comprehensive list of maple producers in both New York and Vermont, producers who do not advertise on the Internet or who do not advertise online through an association may have not been included in the sample. Third, response bias is possible, as with any survey. Although the non-respondent follow-up survey did not reveal differences between respondents and nonrespondents, both surveys used the term "climate change" and it is possible that some maple producers chose not to answer the survey for that reason. Fourth, only maple producers in the Northern Forest Region of New York and Vermont were included in this study; maple producers in more southerly regions, which are more likely to be affected sooner by climate change, were not included. Finally, the survey instrument did not specify a time horizon for impacts of climate change, leaving the interpretation open to respondents. Future research is needed to better understand maple producers' perceptions of adaptability to climate change over different time horizons.

Conclusion

This study sought to identify the elements facilitating and limiting the ability of maple production businesses to adapt to climate change. Specifically, the alternative hypothesis tested was that significant relationships exist among business characteristics, demographics, perceptions concerning climate change, and producers' perceptions of their ability to adapt to climate change. We found many significant relationships among the factors and variables studied, supporting the hypothesis. The two factors that seem most important to respondents when assessing adaptability to climate

change are resilience of the resource base (the sugar bush in this case) and ability to adopt new technologies. Other factors such as beliefs concerning impacts on production, adaptability in management, knowledge of northeastern forests, and size of the business (as based on the number of taps) also appear to be important influences on respondents' perceptions of their potential ability to adapt to climate change in the future. Although this study is specific to maple producers, the basic concepts included in the model can be adapted to other business types and considered for inclusion in future research on food system adaptability to climate change. These constructs include knowledge, beliefs, connectedness, and adaptability; demographic and business characteristics should be taken into account as well.

In New York and Vermont, the findings of this study are currently being used to help maple producers identify strategies for adapting to climate change. Specific strategies, such as tapping earlier in the maple season, updating sap collection technologies by installing vacuum systems, and expanding the number of taps, are being implemented or considered for future implementation by the majority of respondents. Despite the uncertainty of the future, the results of the survey suggest that maple producers are committed to their operations, with only 10% planning to retire, sell, or close their business over the next five years. The vast majority of maple producers are optimistic about the future of maple production, with 48% wanting to increase their number of taps over the next five years, 42% wishing to keep their business "as is," and 18% wanting to expand the services and products they offer. These committed maple producers are managing to adapt to changing conditions, and they are attempting to create the foundation for a resilient maple industry into the future. This study highlights how one sector of the food system is adapting to climate change, with broad implications for adaptability of other sectors of the food system also affected by climate change.

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Appendices

Appendix A. Variable and Factor Means for Items Related to Maple Producers' Beliefs and Knowledge of Climate, Forests, and Maple Production[a]

Factor	Statement on questionnaire	Statement average	Factor Mean (Alpha)
Knowledge of climate change	I know a great deal about the potential impacts of climate change on forests in the northeast.	0.32	0.30 (.927)
	I know a great deal about the potential impacts of climate change on the health and vigor of sugar maple trees.	0.28	
	I know a great deal about the potential impacts of climate change on maple production.	0.32	
	I know a great deal about climate change in general.[b]	0.29	--
Knowledge of forests in the northeast	I know a great deal about forests in the northeastern United States in general.	0.34	0.43 (.930)
	I know a great deal specifically about maple forests in the northeast.	0.45	
	I know a great deal about the factors that influence maple forest health in the northeast.	0.49	
	I know a great deal about the ecology of maple forests in the northeast. [b]	0.27	--
Beliefs concerning impacts on production	I believe climate change will generally **increase** the amount of maple sap produced in the future.	–0.76	–0.62 (.746)
	I believe climate change will generally decrease the amount of maple sap produced in the future.	0.58[c]	
	I believe climate change will **not affect** the amount of maple sap produced in the future.	–0.52	
Beliefs concerning impacts on business operations	**I believe that maple production businesses will need to change their operations in the future to adapt to climate change.**	0.75[c]	–0.70 (.849)
	I believe that maple producers will **not** need to make any changes to adapt to climate change in the future.	–0.75	
	I believe that maple production businesses will need to adopt new technologies to adapt to climate change in the future.	0.61[c]	
Beliefs concerning impacts on maple health	**I believe climate change will influence where maple trees are able to thrive in the northeast in the future.**	0.76[c]	–0.90 (.826)
	I believe climate change will make it easier for insect pests and diseases to spread through forests.	0.81[c]	
	I believe that climate change will have **no** impact on the health and vigor of maple trees in the future.	–0.85	
	I believe that climate change will affect when tapping begins and/or ends each year in the future.	1.17[c]	

Source: Kuehn, Chase, Sharkey, & Powers, 2016.

[a] The scale used for these variable statements was: –2=strongly disagree, –1=disagree, 0=neither agree nor disagree, 1=agree, 2=strongly agree.

[b] This variable was removed from the factor due to the results of the confirmatory factor analysis. Although the variable was not used to calculate the factor mean, the mean of the variable is provided.

[c] The item (in bold) was "reverse coded" prior to calculating the factor mean; the actual variable mean is shown (i.e., rather than the reverse-coded variable mean). The factor mean includes the item after it was reverse-coded.

Appendix B. Variable and Factor Means for Items Related to the Dependence of Maple Producers on their Business[a]

Factor	Item	Variable Mean	Mean (Alpha)
Income dependence	Maple production is a primary source of income for my household.	–0.37	–0.46 (0.701)
	Maple production provides only a small proportion of my household's income.	0.36[c]	
	My household has other sources of income besides maple production.	1.40[c]	
	I greatly rely on maple production as a supplemental source of income.	0.29	
	I greatly rely on maple production to provide maple products for myself, my family, and my friends.[b]	1.03	--
Recreational dependence	Maple production is important to me for the physical exercise it provides.	0.93	1.00 (.872)
	Maple production is important to me because it gets me outdoors.	1.08	
	Maple production is important to me more as a hobby than as work.[b]	0.21	--
	Maple production is important to me because of the enjoyment it provides.[b]	1.41	--
Social dependence	Maple production is important to me because of the social events and activities it gets me involved in.	0.14	0.46 (.728)
	Maple production is important because it is part of my heritage and/or family traditions.	0.87	
	Maple production is important to me because it makes it possible for me to spend more time with family and/or friends.	0.52	
	Maple production is important to me because it makes it possible for me to meet new people (e.g., customers).	0.33	
	Maple production is "in my blood." [b]	1.26	--

Source: Kuehn, Chase, Sharkey, & Powers, 2016.

[a] The scale used for these variable statements was: –2=strongly disagree, –1=disagree, 0=neither agree nor disagree, 1=agree, 2=strongly agree.

[b] This variable was removed from the factor due to the results of the confirmatory factor analysis. Although the variable was not used to calculate the factor mean, the mean of the variable is provided.

[c] The item (in bold) was "reverse coded" prior to calculating the factor mean; the actual variable mean is shown (i.e., rather than the reverse-coded variable mean). The factor mean includes the item after it was reverse-coded.

Appendix C. Variable and Factor Means for Items Related to the Connections of Maple Production Businesses with Family, Community, and Business Associations[a]

Factor	Item	Variable Mean	Mean (Alpha)
Connections of business with family	My family is extensively involved in the day-to-day operations of maple production.	0.36	0.40 (.929)
	I depend a great deal on family members to help run my maple production operation.	0.50	
	The profitability of my maple production operation is greatly due to the help I get from family members.	0.35	
	My family's traditions and/or heritage are greatly dependent upon maple production.[b]	0.12	--
Connections of business with community	My community greatly supports my business by organizing events that include and/or showcase maple producers.	–0.36	–0.60 (.880)
	I greatly depend on my community to create promotional materials (e.g., brochures, websites) that promote my maple production business.	–0.75	
	I greatly depend on my community to provide me with opportunities to network with other business owners (e.g., Facebook, meetings).	–0.69	
	I am frequently involved in events hosted by my community (e.g., farmers' markets, festivals) at which maple products are sold.	–0.54	
Connections of business with associations	I frequently attend events and/or workshops organized by a maple producers' association in my state, region, or county.	0.45	0.41 (.759)
	I greatly depend on a maple producers' association to promote my business.	–0.09	
	I greatly depend on a maple producers' association for up-to-date information about maple production.	0.85	
	I network a great deal with other maple producers, whether through an association or on my own.	0.44	

Source: Kuehn, Chase, Sharkey, & Powers, 2016.

[a] The scale used for these variable statements was: –2=strongly disagree, –1=disagree, 0=neither agree nor disagree, 1=agree, 2=strongly agree.

[b] This variable was removed from the factor due to the results of the confirmatory factor analysis. Although the variable was not used to calculate the factor mean, the mean of the variable is provided.

Appendix D. Variable and Factor Means for Items Related to the Adaptability of Maple Production Businesses[a]

Factor	Item	Variable Mean	Mean (Alpha)
Adaptability of management	I **plan ahead** for any major issues or concerns identified for the maple production industry.	0.57	0.81 (.756)
	My employees (if any) and I always **work quickly** to resolve maple production problems.	0.89	
	I am always **willing** to make changes to my business to resolve any maple production problems.	0.98	
Adaptability of technology	My business has the financial resources necessary to quickly adopt new maple production technologies.	0.19	0.23 (.864)
	I am always able to keep my business up-to-date with new maple production technologies.	0.11	
	I always invest in new technologies when I know I will get a return on the investment.	0.39	
Adaptability of customer base	My maple production business caters to a diverse clientele such as retailers, individuals, and families.	0.47	0.40 (.711)
	My customers reside in diverse locations both within and outside my state.	0.84	
	My customers are attracted to the diversity of products and services (e.g., tours, demonstrations) my business offers.	–0.11	
Adaptability of the resource base (i.e., sugar bush resiliency)	I have several back-up options for obtaining sap/syrup when maple production is low.	–0.49	–0.56 (.802)
	I have several back-up strategies to keep my business running if my sugar bush is damaged by storms, disease, insects, or other catastrophes.	–0.55	
	I can quickly adapt how and/or where I collect sap if my sugar bush is damaged by storms, disease, insects, or other catastrophes.	–0.64	
Potential adaptability of business to climate change	If any changes in **labor** (number of workers, and/or hours worked) are needed due to climate change, my business could quickly get the help it needs to operate.	–0.06	–0.22 (.797)
	If any changes in maple production **technologies** are needed due to climate change, my business could afford to quickly adopt the new technologies.	–0.08	
	If any changes in **customer base** are needed due to climate change, my business could quickly find and attract new customers.	–0.24	
	If any **severe damage to my sugar bush** occurred due to climate change, my business could quickly change how it collects and/or obtains sap.	–0.49	

Source: Kuehn, Chase, Sharkey, & Powers, 2016.
[a] The scale used for these variable statements was: –2=strongly disagree, –1=disagree, 0=neither agree nor disagree, 1=agree, 2=strongly agree.

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Preserving large farming landscapes: The case of Lancaster County, Pennsylvania

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Abstract

Preserving large farming landscapes is one of the main goals of farmland preservation programs. Other goals include protecting highly productive soils, maintaining and enhancing the local farming economy, and promoting locally produced fresh food. Farmland preservation programs take time, however, because of the hefty funding requirements and the detailed process of preserving farmland through the acquisition of conservation easements by purchase or donation. The standard measures of dollars spent and farmland acres preserved do not give an accurate picture of the spatial outcomes of preservation and preservation effectiveness. Three other measures better reflect the spatial effectiveness of farmland preservation: acreage and percentage of preserved farm parcels located in agricultural zones, number and acreage of preserved farm parcels in large contiguous blocks, and number and acreage of preserved farm parcels along growth boundaries. Scattered preserved farms and preserved farms not located in agricultural zones are likely to face more nonfarm development nearby as well as problems with nonfarm neighbors. The farmland preservation effort in Lancaster County, Pennsylvania, provides an important case study of the pattern of farmland preservation over time. Other counties and land trusts can employ geographic information systems (GIS) methods in this study to monitor and evaluate the progress of their farmland preservation efforts.

Keywords

Farmland Preservation; Geographic Information Systems (GIS); Agricultural Zoning; Urban Growth Boundaries

Disclosure

Tom Daniels was the director of the Lancaster County Agricultural Preserve Board from 1989 to 1998.

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Introduction

Federal, state, and local government programs for farmland preservation, as well as preservation efforts from private, nonprofit land trusts, are well-established (Daniels & Bowers, 1997; Liu & Lynch, 2011; Sokolow, 2006a, 2006b; Sokolow & Zurbrugg, 2003; Sorenson, Greene, & Russ, 1997; Stoms, Jantz, Davis, & DeAngelo, 2009). Nevertheless, between 1982 and 2012 more than 42 million acres[1] of land—including at least 24 million acres of agricultural land—were converted to development (U.S. Department of Agriculture [USDA], 2015). Although the conversion of farmland has not threatened the nation's food supply, it has posed challenges to farming industries in several metropolitan areas, such as declining farm-support businesses as fewer farms remain, increasing conflicts between farmers and nonfarm neighbors, and rising land prices, which make entry into farming and the expansion of farms difficult (Heimlich & Anderson, 2001; Sorenson et al., 1997).

Since 1996, the federal government has provided more than US$1 billion in matching grants to state and local governments and land trusts for the purchase of conservation easements to farmland through the Farm and Ranchland Protection Program and its successor, the Agricultural Conservation Easement Program managed by the Natural Resources Conservation Service (NRCS) (American Farmland Trust, 2013; NRCS, 2017). A conservation easement is a legally binding document that restricts the use of a property to farming and open space, usually in perpetuity. A landowner may voluntarily sell or donate a conservation easement to a government agency or private land trust and a deed of easement is recorded at the county courthouse. The land remains in private ownership, and may be sold or passed on to heirs, but the restrictions apply to all future landowners (Daniels, 1991). As of 2015, 28 states had passed legislation creating programs to purchase conservation easements and had spent nearly US$4 billion to preserve more than 2.5 million acres (American Farmland Trust, 2015). As of 2012, nearly 100 counties and other local governments had created and funded farmland preservation programs (American Farmland Trust, 2012); more than 500 land trusts listed farmland preservation as one of their top priorities in a 2011 national survey, and these land trusts reported that they had preserved more than 3 million acres of agricultural land (Land Trust Alliance, 2011; American Farmland Trust, 2013).

Since the first agricultural conservation easement was purchased in 1974 in Suffolk County, New York, government agencies and private land trusts across America have spent more than US$5 billion purchasing conservation easements to farmland and have preserved more than 5 million acres (American Farmland Trust 2016a, 2016b; Daniels & Wright, 2015; Liu & Lynch, 2011; NRCS, 2016). While this preserved land is a small portion of the nation's 900 million acres of farm and ranchland, at least half of the roughly 3 million acres of preserved farm land—not including ranch land—has been preserved in about 50 metropolitan counties (Daniels & Wright, 2015; Sokolow & Zurbrugg, 2003). Metropolitan areas are generally under significant development pressure, yet they often contain high-quality agricultural land and have the potential to provide fresh produce to nearby cities and suburbs.

The preservation of farmland has four main goals: (1) protecting highly productive agricultural soils on a long-term basis; (2) maintaining and enhancing local and regional agriculture; (3) providing opportunities to produce fresh local food for local consumers; and (4) preserving large farming landscapes (Stoms et al., 2009). These goals often overlap with goals to slow the rate of farmland loss, limit the fragmentation of farmland, keep farmland affordable for new and expanding farm operators, and provide nearby open space for urban dwellers (Liu & Lynch, 2011; Lynch & Liu, 2007; Stoms et al., 2009).

The potential benefits of preserving large farming landscapes include (1) maintaining a critical mass of farms and farmland to enable farm-support businesses to continue; (2) keeping development at a distance from farms, so that development pressures and conflicts with nonfarm neighbors are kept to a minimum; (3) channeling growth to areas with adequate infrastructure; and (4) creating a local farm-business climate that promotes

[1] Note: 1 acre = 0.4 hectare

succession to the next generation (Schilling, Esseks, Duke, Gottlieb, & Lynch, 2015).

Acquiring conservation easements on large farming landscapes requires planning, funding, and willing landowners (Daniels & Bowers, 1997; Gerber & Rissman, 2012; Sokolow, 2006a). Some of the nation's leading counties in farmland preservation, such as Baltimore County, Maryland, and Sonoma County, California, use three interrelated techniques: (1) restrictive agricultural zoning; (2) urban growth boundaries; and (3) the purchase of conservation easements on farmland (Daniels, 2010; Sokolow, 2006b). First, a local government can recognize the importance of agriculture in its comprehensive plan and adopt goals to protect and preserve farmland. To help implement the comprehensive plan, agricultural zoning can limit the number of nonfarm dwellings allowed, such as only one house per 40 acres. Urban growth boundaries are typically agreed upon between cities and a neighboring county to restrict the extension of sewer and water lines and thus urban development from the countryside. .

By reducing the potential for nonfarm development, urban growth boundaries and agricultural zoning tend to make land more affordable for farming, so the farmland preservation option is more attractive. Both urban growth boundaries and agricultural zoning are important tools for protecting farmland over the short- to medium-term. Neither of these tools actually preserves farmland, however, and both can be changed by elected governing bodies (Bengston, Fletcher, & Nelson, 2004).

Farmland preservation over the long term usually involves the sale of a conservation easement, also known as development rights, to a government agency or land trust. Farmland preservation is a legal process in which a landowner voluntarily signs a deed of easement to restrict the development of the land to agricultural and open space uses, usually in perpetuity (Daniels, 1991). Once the deed of easement is recorded in the land records at the county courthouse, the restrictions in the deed of easement "run with the land," thus applying to all future landowners. The landowner receives a payment for the conservation easement from the land trust or government agency, based on an appraisal of the value of the conservation easement. A landowner may donate a portion of the easement value in a "bargain sale" involving part cash and part donation (Daniels & Bowers, 1997). The landowner can use the value of the donation as a tax deduction. Clearly, the higher the landowner's income, the more valuable the deduction in tax savings. Land trusts often have relatively little cash on hand to purchase conservation easements, and so they often preserve land through a bargain sale of a conservation easement, involving part cash paid to the landowner and part donation by the landowner. A landowner may even donate the full easement value.

Success of farmland preservation programs is generally judged according to dollars spent and acres preserved (Lynch & Musser, 2001). But if a major goal is to preserve large agricultural landscapes, a farmland preservation program must prioritize land for conservation easement acquisition (Sokolow & Zurbrugg, 2003; Tulloch, Myers, Hasse, Parks, & Lathrop, 2003). To assess the effectiveness of a prioritization strategy, it is important to determine whether farmland is being preserved in contiguous blocks rather than in scattered parcels, and in locations consistent with public policies, such as comprehensive plans and agricultural zoning, and to manage the location and pattern of growth by limiting or directing urban expansions, such as preservation consistent with an urban growth boundary (Lynch & Liu, 2007; Machado, Stoms, Davis, & Kreitler, 2006; Sokolow, 2006b; Stoms et al., 2009).

Most state and local governments that are active in purchasing conservation easements do not have agricultural zones, and very few have growth boundaries or urban service boundaries. In these states and municipalities, it is still important to determine whether government programs and land trusts are preserving farmland in contiguous blocks or in a scattered pattern. Without restrictive agricultural zoning, a scattered pattern of land preservation can act like magnets for nonfarm residential development. Data have shown that the value of nonpreserved land rises when it is next to preserved land (Daniels & Bowers, 1997). But nonfarm residents often complain about the noise, dust, and odors of neighboring farming operations.

In addition, without limits on sewer and water extensions, these services can penetrate farther into the countryside, inducing the conversion of farmland to intense development. But a farmland preservation program may not actually be able to preserve farmland along urban growth boundaries to make the boundaries more difficult to expand into farming areas. Stoms et al. (2009) pointed out this shortcoming in their study of acquisition of agricultural conservation easements in the San Francisco Bay Area.

The focus of this paper is whether and to what extent geographic information systems (GIS) can help to evaluate the implementation of a strategy to preserve large farming landscapes, as well as help to guide the strategy. To test these roles for GIS, we used GIS to analyze the location of preserved farms in Lancaster County, Pennsylvania, according to four criteria: (1) whether the farm is located in an agricultural zoning district, consistent with public policy (Stoms et al., 2009); (2) the number and size of contiguous blocks of preserved farmland (Brabec & Smith, 2002); (3) the number of acres of preserved farmland adjacent to an urban growth boundary (Machado et al., 2006); and (4) the location of easement sale applications relative to existing preserved farms (Daniels & Bowers, 1997).

Farmland Preservation in Lancaster County, Pennsylvania

Lancaster County, Pennsylvania, has one of the nation's leading farmland preservation programs. Since 1983, the county Agricultural Preserve Board, with the Lancaster Farmland Trust and the Brandywine Conservancy (based in neighboring Chester County), have preserved more than 100,000 acres, placing Lancaster County first among counties nationwide in the amount of preserved farmland (Daniels & Wright, 2015). The mission statement of the Agricultural Preserve Board is "to forever preserve the beautiful farmland and productive soils of Lancaster County and its rich agricultural heritage; and to create a healthy environment for the long-term sustainability of the agricultural economy and farming as a way of life" (Lancaster County Government Center, n.d.-a, para. 1). But the Preserve Board's conservation easement program guidelines do not mention preserving a farm based on its appearance, but rather on its soil quality, farm viability, development pressure, and proximity to already preserved farms (Lancaster County Agricultural Preserve Board, 2010). This last factor represents the goal of preserving farmland in large blocks.

Lancaster County also has long had robust geographic information systems (GIS) data that provides an opportunity to measure progress over time toward landscape-scale farmland preservation. Thus far, GIS has been used largely to identify parcels for preservation and to keep track of preserved properties (Hoobler, Vance, Hamerlinck, Munn, & Hayward, 2003; Tulloch et al., 2003). Yet GIS offers a compelling method to analyze the spatial performance of a farmland preservation program and to provide insights about both accomplishments and adjustments that would enable a farmland preservation program to better achieve its landscape-scale preservation goal (Stoms et al., 2009).

Lancaster County covers 603,000 acres in southeastern Pennsylvania, approximately 60 miles (97 kilometers) west of Philadelphia. The county contains some of the most productive farmland in the nation; about two-thirds of the county is in farm use (USDA, 2014). The average farm size is only 85 acres, in part because of the presence of Plain Sect farmers (Amish and Mennonite), who farm with animals rather than machinery (Daniels, 2000). Agriculture is a US$1.5 billion a year industry in Lancaster County, with large dairy, egg, and poultry production (USDA, 2014). Yet the county population in 2012 was 519,445 people, which defines the county as a metropolitan area. Moreover, in the 1990s and 2000s, Lancaster County's population grew by 11 percent, well above the statewide rate of only 3.4 percent (U. S. Bureau of the Census, 2011), so the county has faced significant development pressures that show little sign of abating.

In the late 1970s Lancaster County began to experience development pressure from the sprawling Philadelphia metropolitan area, as well as from internal growth. In 1980 the Lancaster County commissioners appointed a nine-member Agricultural Preserve Board to develop strategies to pro-

tect farmland. The board called for the creation of a purchase of agricultural conservation easements program to preserve farmland. The county program began in 1983. In 1976, townships[2] in Lancaster County began to adopt agricultural zoning ordinances, which limited nonfarm development in the countryside. More than half of Lancaster County, about 325,000 acres, is now zoned for agriculture (Lancaster County Planning Commission, 2010, p. 7), and effective agricultural zoning is found in 38 of the county's 41 townships. Effective agricultural zoning means that only one new house is allowed per 20 acres, and the house must be on a lot of no more than 2 acres (Lancaster County Planning Commission, 2010, p. 3). While effective agricultural zoning is a strong land use policy, the zoning can be changed by the elected township officials at any time, if they so desire. The fact that zoning can be changed can hinder farmland preservation efforts by adding uncertainty for farmers deciding whether to preserve their farms and for public officials and private donors deciding whether to fund farmland preservation programs.

By the late 1980s, the county planning commission was pushing the townships, villages, and urban core to create urban and village growth boundaries to promote more compact growth by limiting the extension of sewer and water lines. The first urban growth boundary in Lancaster County was formed in 1993. Since then 13 urban growth boundaries and village growth boundaries have been put in place around cities and villages through voluntary agreements (Lancaster County Planning Commission, 2006). Today, nearly 112,000 acres, more than one-sixth of the total acreage of the county, lies within an urban or village growth boundary. Within these boundaries, enough "buildable" land exists to accommodate development over a 20-year period, based on population growth projections and expected land use needs.

Every three to five years, the county may review and recommend changes to the boundaries. But if land adjacent to an urban or village growth boundary is protected from development through the sale or donation of a conservation easement, the boundary cannot be extended at that location. Thus, preserved farmland along a boundary "locks in" that part of the boundary, and forces future boundary expansions to occur somewhere else.

Since 1983 the Agricultural Preserve Board has administered the county purchase of agricultural conservation easements program, and has received funding from the county government, the state of Pennsylvania, the federal Farm and Ranchland Protection Program, and the new Agricultural Conservation Easement Program, created through the 2014 farm bill. Landowners may apply to sell a conservation easement to the Preserve Board, which then "ranks the applications for priority, hires appraisers to estimate the value of development rights, and makes a formal offer to the landowner" (Lancaster County Government Center, n.d., "History of the Board," para. 1).

In 1988, the nonprofit Lancaster Farmland Trust was created to add a private farmland preservation effort especially for preserving farmland owned by the Amish, who generally do not want to receive government funds. In addition, in 1998 the private nonprofit Brandywine Conservancy, based in neighboring Chester County, acquired donated conservation easements on farms in southeastern Lancaster County.

Since 1989, the Agricultural Preserve Board has enjoyed an average budget of more than US$5 million a year to acquire conservation easements, or about US$175 million in total. The Farmland Trust has had a policy of stretching its dollars by offering less than US$1,500 an acre for conservation easements; many of its acquisitions are either donations of conservation easements or bargain sales involving part cash and part donation of easement value. The Preserve Board and the Farmland Trust have had a cooperative agreement since 1989 and have combined efforts to preserve a dozen farms.

Assessing the Progress of Lancaster County's Farmland Preservation Effort

The purpose of this study is to assess the progress of Lancaster County toward its goal of preserving a

[2] A township covers about 20,000 to 30,000 acres, and a township government has control over planning and zoning within its boundaries.

large-scale farming landscape according to three criteria:

(1) Consistency of farmland preservation with agricultural zoning; that is, farmland zoned for agriculture should be preserved, not land that iszoned for rural residential development or commercial or industrial development (Stoms et al., 2009). The greater the number of farm parcels and acreage within effective agricultural zoning districts, the less likelihood of conflicts with nonfarm neighbors and the greater the likelihood of being able to create large blocks of preserved farmland at a landscape scale.
(2) Changes in the patterns of land preservation between 2007 and 2016; specifically, the number and size of contiguous blocks of preserved farm parcels, which show the degree to which farmland is being preserved in large blocks or in a scattered pattern. The size of the contiguous blocks should grow over time if the acquisition of conservation easements is strategic; otherwise, if the blocks do not expand, this suggests a more opportunistic and scattered approach to easement acquisition, which will not provide as much protection for preserved farms (Stoms et al., 2009).
(3) Preservation of farmland along growth boundaries to limit or direct future expansions of the boundaries. The more farmland is preserved along growth boundaries, it is less likely the boundaries will move outward over time and the more likely that there will be a separation between urban and rural land (Machado et al., 2006).

The results point out strengths and weaknesses of the county farmland preservation efforts and suggest potential worthwhile changes in preservation strategy.

Methodology

The analysis consists of four parts. First, we identified the total number of preserved farm parcels and preserved farmland acres in Lancaster County (Table 1). Next, we determined the number of preserved farm parcels and acreage in effective agricultural zones for 2007 and 2016 (Table 1). Then, we computed the number and acreage of the contiguous preserved farm parcels in the county for both 2007 and 2016 (Tables 2 and 3). Last, for 2007 and 2016 we determined the number of miles of urban and village growth boundaries and the number of miles of preserved farmland along the growth boundaries.

The Lancaster County GIS Department provided data on preserved farms, agricultural zoning, and growth boundaries. The data contained information on the location of land zoned for effective agriculture, urban growth boundaries, and the individual preserved farm parcels. It is important to note that the number of preserved farm parcels (2,259 in 2016) does not reflect the actual number of preserved farms in the county, which is slightly more than 1,300. The term "farm parcel" refers to the fact that a farm, although under one owner, is displayed in the GIS dataset as having more than one parcel of land if the farm is divided by roads, waterways, or power lines.

We used ESRI ArcMap geographic information systems software and tools available in the Arc Toolbox to analyze data for each parcel

Table 1. Total Preserved Farm Parcels and Acreage, 2007 and 2016, and Preserved Farm Parcels in Agricultural Zones, 2007 and 2016

Years	Total Preserved Farm Parcels	Preserved Acreage
2007	1,543	71,910
2016	2,259	102,678
	Preserved Farm Parcels in Agricultural Zones	**Preserved Acreage**
2007	1,479	69,287
2016	2,194	100,094

Note: 1 acre = 0.40 hectare

and for the county as a whole. We first identified the total number of preserved farm parcels and preserved acres for 2007 and 2016. Then, we used "select by location" by centroid of the GIS polygons in the GIS software. This method enabled us to select both the preserved farms GIS layer and the agricultural zoning layer to determine how many farm parcels fell within effective agricultural zoning districts.

We next measured the contiguity of the preserved farm parcels by reconfiguring the farm parcels into contiguous blocks. A contiguous block was defined as any number of groups of farm parcels that share a common property line or are separated only by a roadway. To accomplish this reconfiguration, the boundaries between farms that were touching were dissolved to create polygons that included multiple farms. Then a buffer was placed around the farms at one half the width of the road right-of-way, to account for farms that were separated by a road. The contiguous farm parcels were joined together and then clipped back to their original shapes based on the outline of the original shapefile.

Last, we measured the length of the urban and village growth boundaries. We obtained the total outside perimeter of the growth boundaries by dissolving the growth boundary polygons based on type and then removing interior lines. We then calculated the perimeter of the resulting polygons, and determined how many miles of preserved farmland and how many farm parcels shared an edge with a growth boundary. To perform this task we employed a "select by location" with a small buffer to account for roads. Farm parcels that were adjacent to a growth boundary but fell just outside the buffer were selected by hand.

Table 2. Contiguous and Stand Alone Farms by Acreage, 2007

Farm Blocks in Acres	Number of Blocks	Acreage in Block
TOTAL	339	71,910
Contiguous Blocks	231	65,743
1000 or more	9	20,927
500–999	18	12,112
250–499	37	13,039
250 or Less	167	25,832
Stand-alone Parcels	108	6,167
Within ½ Mile of a Contiguous Block	76	4,382
Beyond ½ Mile of a Contiguous Block	32	1,785

Note: 1 acre = 0.4 hectare

Table 3. Contiguous and Stand Alone Farms by Acreage, 2016

Farm Blocks in Acres	Number of Blocks	Acreage in Block
TOTAL	358	102,678
Contiguous Blocks	244	96,325
1000 or more	17	47,809
500–999	22	14,594
250–499	41	14,810
Less than 250	164	19,508
Stand-alone Parcels	114	6,353
Within ½ Mile of a Contiguous Block	80	4,880
Beyond ½ Mile of a Contiguous Block	34	1,473

Note: 1 acre = 0.4 hectare

Results and Discussion

Total Farmland Acres Preserved

For 2007, we identified a total of 1,543 preserved farm parcels and 71,910 preserved acres. For 2016, there were 2,259 preserved farm parcels and 102,678 preserved acres, an increase of 30,768 acres and 43 percent more preserved acres in nine years (Table 1). This is a strongly positive trend for a county-level farmland preservation program.

Farmland Acres Preserved in Agricultural Zones

For 2007, we found 1,479 preserved farm parcels in

effective agricultural zones. These parcels composed 95 percent of the preserved farm parcels and accounted for almost 70,000 acres or 96 percent of the preserved farmland (Table 1 and Figure 1). For 2016, there were 2,194 preserved farm parcels located in effective agricultural zones, making up over 97 percent of all preserved farm parcels (Table 1 and Figure 2). The number of preserved farmland acres in effective agricultural zones also grew to 100,094, an increase of 30,807 acres or 44 percent from 2007.

In 2007, there were 64 preserved farm parcels (4.1 percent of all preserved parcels) located outside of an effective agricultural zone and covering 2,623 acres (3.6 percent of all preserved farmland). In 2016, 65 preserved farm parcels (2.9 percent of all preserved parcels) covering 2,584 acres (2.5 percent of all preserved farmland) were located outside of an effective agricultural zone.

The Agricultural Preserve Board has long favored the preservation of farmland in agricultural zones, and in 2000 the board adopted a policy to preserve farms *only* in agricultural zones. The Lancaster Farmland Trust does not have such a policy, and has continued to preserve some farms that are not in agricultural zones.

In sum, the overwhelming majority of farms that are preserved in Lancaster County are in effective agricultural zones, which is consistent with public policy and planning. The proportion of preserved farm parcels and acres in agricultural zones has increased between 2007 and 2016. This is a positive trend, because effective agricultural zoning reduces the likelihood of intensive nonfarm development on neighboring properties that could result in complaints and conflicts over farming operations.

Contiguity of Preserved Farmland

In 2007, preserved farm parcels in blocks of two or more totaled to 231 contiguous blocks of farmland, 1,435 parcels (93 percent of all preserved parcels), and 65,743 acres (91 percent of all preserved farmland). There were 108 stand-alone farm parcels in 2007 (Table 2 and Figure 1). The average size of a block of preserved farmland was 285 acres. The largest contiguous block contained 201 farm parcels and covered 8,676 acres. In addition, there were nine contiguous blocks totaling 1,000 or more acres and 18 contiguous blocks totaling between 500 and 999 acres. Of concern, however, was the fact that the predominant contiguous block

Figure 1. Preserved Farm Parcels, Urban Growth Areas, and Effective Agricultural Zoning, Lancaster County, Pennsylvania, 2007

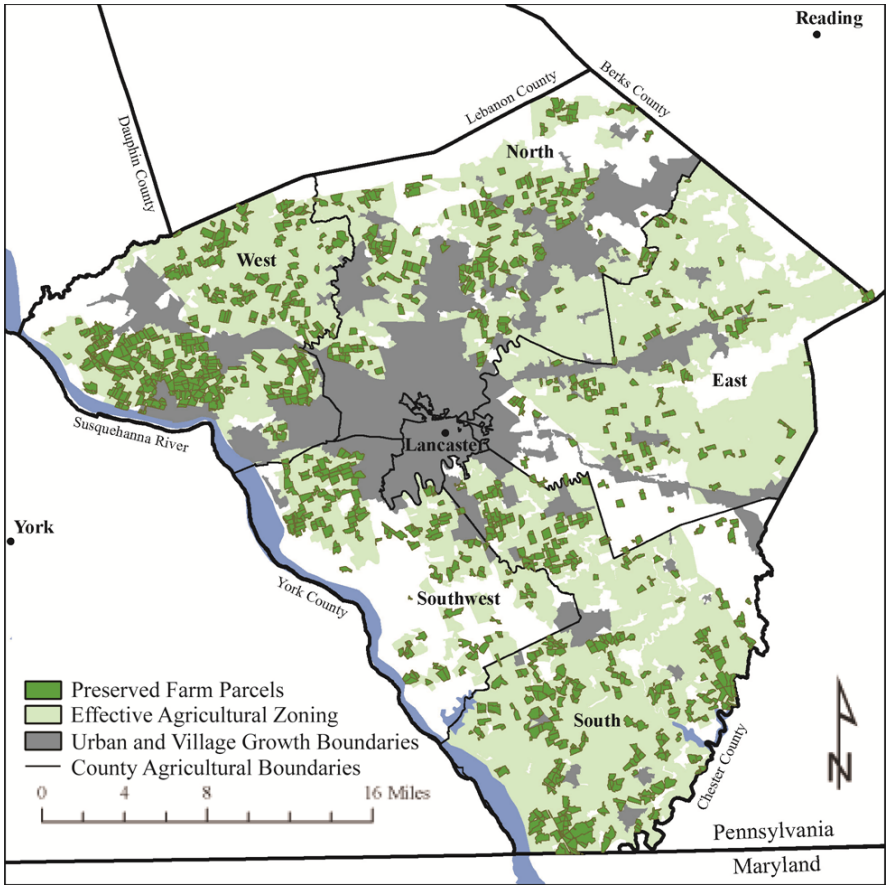


Figure courtesy of Christina Arlt; used by permission.

size was less than 250 acres, with 167 contiguous blocks accounting for more than 25,000 acres, or greater than one-third of the preserved farmland in the county. The average size of a block of less than 250 acres was 155 acres. These relatively small blocks of preserved farmland could be somewhat vulnerable to adjacent nonfarm developments and complaints over farming practices. This result suggests that the county farmland preservation efforts need to produce larger contiguous blocks of preserved farmland. Large blocks of preserved farmland of 500 or 1,000 or more acres have more "interior" preserved farmland, and thus are generally less vulnerable to potential conflicts with nearby nonfarm development than blocks of less than 250 acres.

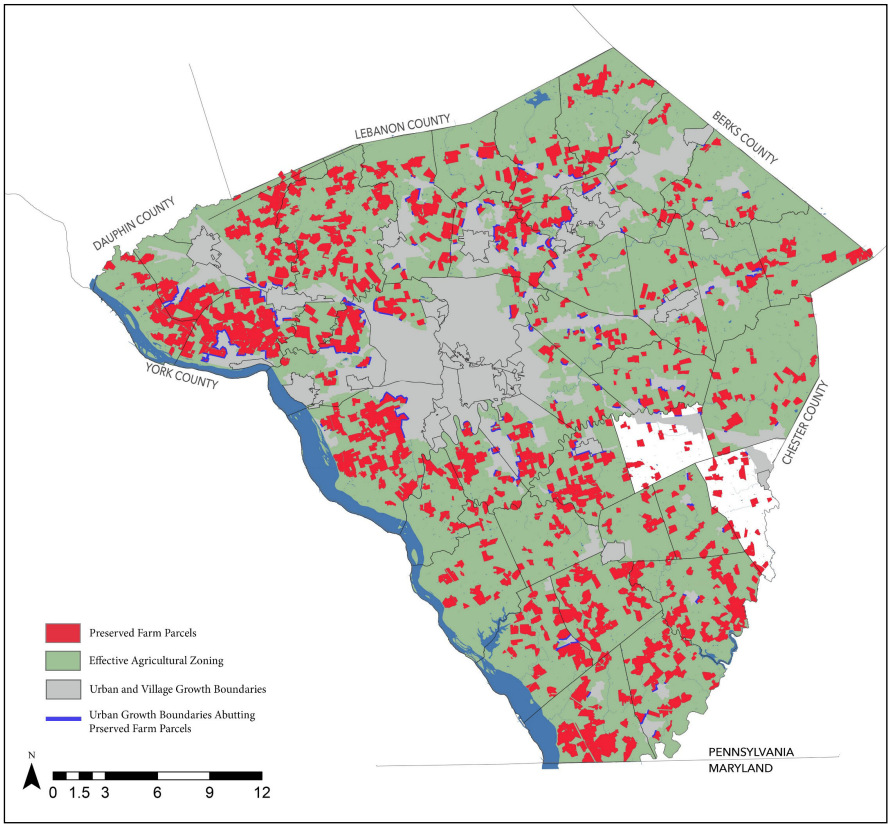
In 2016, there were 244 preserved farm parcels (93.2% of preserved parcels) in blocks of two or more parcels, and 96,325 acres (93.8% of preserved farmland) in those blocks. The amount of preserved farmland in contiguous blocks grew by 30,582 acres between 2007 and 2016. There were 108 stand-alone preserved farm parcels in 2007, covering 6,167 acres. By 2016, the number of stand-alone farm parcels had increased slightly to 114 and their acreage edged up to 6,353 acres (Table 3 and Figures 1 and 2). The average size of a block of preserved farmland increased from 285 acres in 2007 to 395 acres in 2016. These overall results strongly suggest that the pattern of preserved farms has grown less dispersed over time, in keeping with the contiguity strategy.

Another indication of this greater contiguity is that the largest contiguous block in 2007 contained 201 preserved farm parcels and covered 8,676 acres, and in 2016 that block grew to 261 parcels and covered 10,733 acres.

The most notable change among the contiguous blocks between 2007 and 2016 was the increase in the number and acreage of blocks of more than 1,000 acres. The number of blocks nearly doubled to 17 and the preserved acreage in those blocks more than doubled from 20,927 acres to 47,809 acres, or from 29 percent of the county total preserved farmland to 47 percent.

There were 22 blocks between 500 and 999 acres, covering 14,594 acres. The number of blocks between 250 and 499 acres grew to 41 and covered 14,810 acres. The number of blocks of less than 250 acres held rather steady at 164 blocks, but the acreage in these blocks declined by more than 6,700 acres, or 22 percent, to 19,113 acres. This suggests that at least some of the blocks of less than 250 acres were added to larger nearby blocks or simply grew into larger blocks of preserved

Figure 2. Preserved Farm Parcels, Urban Growth Areas, Effective Agricultural Zoning, and Preserved Farm Boundaries Touching Growth Boundaries, Lancaster County, Pennsylvania, 2016



farmland. Even so, these results imply that the Preserve Board and the Lancaster Farmland Trust need to continue efforts to preserve farmland adjacent to existing blocks of less than 250 acres to expand those blocks with a goal of at least 500 acres per block. A 500-acre block would be much more difficult to surround with nonfarm development and would create more interior preserved farmland. The small blocks of preserved farmland, even if they are in areas zoned for agriculture, may be vulnerable to nonfarm development next door because they provide a "preserved view."

Of the 108 stand-alone farms in 2007, 76 were located within one half-mile of an existing contiguous block, while 32 were beyond one half-mile. The stand-alone farms accounted for 6,167 acres or just under nine percent of the total preserved farmland in the county. The 114 stand-alone farms in 2016 consisted of 6,353 acres, or about 6 percent of the county preserved farmland. Eighty of the stand-alone parcels were within one half-mile of another preserved farm, and 34 were beyond one half-mile. Again, the results point to a trend toward greater overall contiguity of preserved farms.

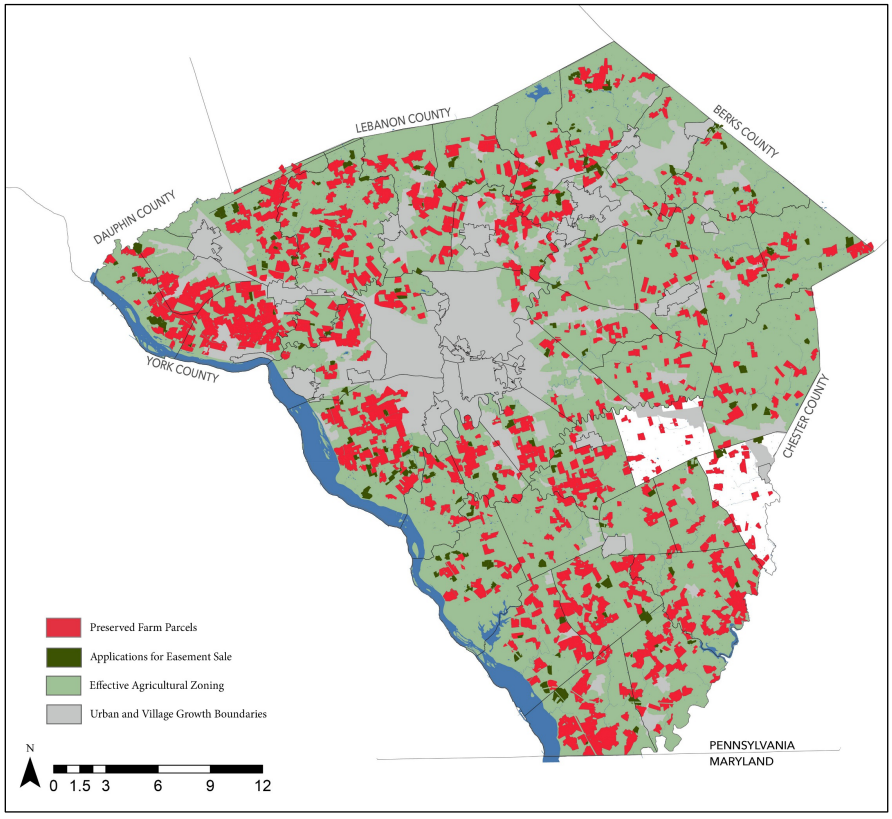
The Agricultural Preserve Board gives higher weighting in its application ranking system for farms adjacent to a preserved farm or within one half-mile of a preserved farm. This strategy appears to be working. The Lancaster Farmland Trust has traditionally pursued a more opportunistic approach to preservation, with less emphasis on contiguity or proximity to another preserved farm. However, the Trust has recently begun to emphasize the creation and expansion of blocks of preserved farmland (Lancaster Farmland Trust, 2016).

Preserved Farmland and Urban Growth Boundaries

We found that in 2007 Lancaster County had a total of 583 miles of urban growth boundaries. We determined that 65 miles of preserved farmland shared a common edge with an urban growth boundary. In other words, there are preserved farm parcels along 11.1 percent of the growth boundaries.

In 2007, 209 preserved farm parcels shared a common edge with a growth boundary. The Agricultural Preserve Board had, until 2000, pursued a strategy of preserving farms along growth boundaries because these farms were under the most development pressure and, if preserved, could obstruct development from penetrating into high-quality farming areas. The Preserve Board

Figure 3. Preserved Farms, Agricultural Easement Sale Applications, Effective Agricultural Zoning, and Urban Growth Areas in Lancaster County, Pennsylvania, 2016



average cost per acre to purchase development rights (slightly more than US$3,000) reflects an attempt to preserve those farms under moderate to significant development pressure close to built-up areas. In 2000, the county adopted a policy of paying no more than US$4,000 an acre for a conservation easement in order to reduce the likelihood of preserving farmland along growth boundaries, where some farms had been preserved at a cost of more than US$5,000 an acre. The Farmland Trust does not have the financial resources to purchase conservation easements along growth boundaries, and generally targets farms away from them.

The urban growth boundaries in 2016 were virtually unchanged from 2007, at 583 miles. A total of 335 preserved farm parcels shared 88.5 miles with the urban growth boundaries, so that 15.2 percent of the growth boundaries touched on a preserved farm parcel. These results suggest that preserving farmland along growth boundaries is a difficult strategy to implement, in part because the sale of a conservation easement is voluntary and the cost of preserving farmland near development is high. Moreover, landowners may perceive that the growth boundaries will move outward over time and that the sale of the farmland for development will occur eventually.

GIS can be used to compile the factors and the scores for the factors for farms under application for the sale of conservation easements. The scores include points for the proximity of an applicant farm to a farm that is already preserved. The scores are used to rank the order in which the applicant farms are appraised to determine the easement value, and generally the order in which applicant farms will be preserved. But GIS can also show the location of the applications that involve existing blocks of preserved farmland (Figure 3). If a main goal of the farmland preservation program is to create large blocks of preserved farmland, then applications for farms that would add to blocks of less than 250 acres or less than 500 acres may be preferred to farms that add to existing blocks of 500 or more acres.

Study Limitations and Future Research

This study concentrates on evaluating Lancaster County's acquisition of agricultural conservation easements to create large blocks of preserved farmland. The study does not incorporate (1) data on the amount of highly productive farmland that has been preserved; (2) direct sales of farm products from preserved farms to consumers; or (3) the change in the value of agricultural production in the county since the start of its farmland preservation program or, more specifically, the change in the value of production from preserved farms.

While preserving the farm from development is a first step, the second step is responsible management of the land to maintain and even enhance productivity over time. Soils are a priority in the Agricultural Preserve Board application ranking system. Soils data exist for each farm parcel in the county. This data could be keyed into a GIS database of preserved farms to measure the amount of prime farmland (NRCS Class I and II), soils of statewide importance (NRCS Class III), and any unique farmland (certain NRCS Class IV soils) that have been placed under conservation easements.[3] About 54 percent of Lancaster County contains prime soils, and 18 percent contains soils of statewide importance (Daniels, 2000). Monitoring farms for compliance with soil and water conservation is essential for maintaining and increasing soil productivity and reducing agricultural runoff that pollutes waterways. Conservation district personnel who have the necessary soil conservation expertise have assisted the Preserve Board in monitoring farms and drafting conservation plans.

Lancaster County is one of the leading counties in the nation in direct sales to consumers, ranking seventh in 2005 (Lancaster County Board of Commissioners, 2005). A survey could be conducted to estimate the direct sales from preserved farms to consumers. Similarly, a survey could be conducted to estimate the increase in the value of production on preserved farms since they came under a conservation easement. From 1992 to 2012, the county's agricultural output more than doubled, from US$681 million to US$1.475 billion (in constant dollars) (USDA, 1992, 2014). Related

[3] Farms preserved by the Lancaster County Agricultural Preserve Board must have a Soil and Water Conservation Plan. The local Conservation District has also helped to monitor farms to ensure compliance.

to the production of food is the access of new farmers and expanding farmers to land. One measure of this is the average age of farmers in a county. For the U.S., the average age was 58 years in 2012, and was 49 years in Lancaster County (USDA, National Agricultural Statistics Service [NASS], 2014). The younger the average age of farmers, the more likely it is that younger farmers have gained access to farmland.

Large agricultural landscapes exist at more than just the county level. Lancaster County is one of 10 counties in southeastern Pennsylvania and northern Maryland that have together preserved more than 600,000 acres (Daniels & Wright, 2015). Further study of the growth management efforts in these counties that includes the use of GIS to analyze farmland preservation, how their agricultural economies are linked together, and changes in farm output and direct sales could provide further insights into the effectiveness or shortcomings of agricultural conservation easement programs. Such a study would build upon this paper and the study of agricultural conservation easements in the San Francisco Bay Area (Stoms et al., 2009).

Lancaster County has a mature farmland preservation program. A focus on growth management and preserving farmland in large blocks therefore is warranted, given that the county's population is projected to increase from 519,445 in 2012 to 652,000 in 2040 (Lancaster County Planning Commission, 2012). Farmland preservation cannot guarantee that a farm will be a successful business enterprise or even that the land will be actively farmed. But farmland preservation can keep the land from being converted to nonfarm uses and can maintain the potential for the land to be farmed in the future. An update of the GIS study in this paper should be undertaken every five to 10 years to track Lancaster County's progress in farmland preservation.

A Final Note on Farmland Preservation Strengths and Weaknesses

The fact that farmland preservation is voluntary on the part of the landowners is both a strength and weakness. The strength is that landowners willingly sell or donate a conservation easement on their property to restrict its use. Thus, there is no struggle over Fifth Amendment "takings" because landowners have voluntarily placed a conservation easement on their property for which they receive compensation in the form of cash and/or a tax deduction and even estate tax benefits. The voluntary aspect of farmland preservation is also a weakness, as it is not possible to compel the owner of a farm to sell or donate a conservation easement. For that reason, as Stoms et al. note, "planners can never be completely strategic" (2009, p. 1160). If the farmers next to a preserved farm do not want to sell or donate a conservation easement, then that preserved farm will continue to stand alone. Similarly, if farmers next to a block of preserved farmland do not want to preserve their farms, then the block will not increase. And finally, farmland owners along a growth boundary may prefer to wait for the boundary to expand around them, and then sell their farms for development. Nevertheless, farmland preservation programs succeed when large numbers of farmland owners within a local area voluntarily sell or donate a conservation easement.

Conclusions

Preserving large agricultural landscapes is fundamental for long-term success in maintaining a critical mass of farms and farmland. This involves the preservation not only of large farms but also of smaller, intensively cultivated farms, as has occurred in Lancaster County. Gauging progress over time is essential for identifying whether farmland preservation efforts are creating large contiguous blocks or scattered pockets of preserved farmland. Such analysis can help farmland preservationists to focus strategically on preserving farmland next to or close to existing preserved farm parcels.

A comparison of two time periods indicates good progress in Lancaster County toward creating preserved blocks of 1,000 or more acres. The number of preserved parcels and acres in this category doubled between 2007 and 2016. However, the number of acres in blocks of less than 250 acres, although lower in 2016, remains a concern.

Stoms et al. (2009) note the need for new tools that planners and land preservation programs can use to identify where to acquire conservation easements as strategically as possible. GIS analysis can

provide new ways to determine the effectiveness of farmland preservation efforts. With adequate digitized data for agricultural zoning, growth boundaries, and preserved farm parcels, the analysis can inform local governments and land trusts about where their efforts are succeeding and where to focus future efforts. Two measures computed in this study—consistency between farmland preservation and agricultural zoning, and the degree of contiguity of preserved farmland—can easily be transferred to evaluate the performance of other public (township, county, or state) and private land trust farmland preservation programs.

The experience of Lancaster County shows that it is possible to preserve a significant amount of farmland along growth boundaries and in effect make parts of the boundaries permanent. Preserving farmland along growth boundaries will compel future growth boundary expansions to occur away from some high-quality agricultural areas. But this strategy has enjoyed somewhat less success than the preservation of farmland in agricultural zones and in large contiguous blocks.

The Lancaster County experience demonstrates that three techniques—effective agricultural zoning, growth boundaries, and the acquisition of conservation easements—can work together in a farmland preservation package of approaches. Agricultural zoning discourages most nonfarm development and holds down the cost of purchasing conservation easements; growth boundaries limit the extension of sewer and water lines and urban development into the countryside; and the purchase of conservation easements on tens of thousands of acres gives greater certainty for continued farming over time.

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Using contribution analysis to assess the influence of farm link programs in the U.S.

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Abstract

This paper examines 12 U.S. farm link programs (FLPs) using a type of program evaluation called contribution analysis (CA) to determine if FLPs are effective in facilitating farmland transfers between retirement-aged farmers without family successors and new farmers beginning their career. CA guided the data collection, which included web audits, interviews, questionnaires, and scholarly and grey literature review. We developed an analytical framework in the form of a theory of change, followed by analysis of the FLPs and their contribution to farm transfers. The analysis focused on four themes that emerged from the theory of change: (1) the effectiveness of FLP design and program activities; (2) the usefulness of FLP databases to meet the needs of farmers; (3) farmer motivation toward development or land preservation; and (4) trends and systemic influences on farm transfers. Although some FLPs experienced relative success, the lack of professional support systems, a heavy reliance on a self-serve Internet database, and the presence of various external conditions prevent most FLPs from facilitating substantial numbers of farm transfers. To conceptualize how FLPs may be more successful, a revised theory of change was developed, offering new perspectives on the systemic conditions in which FLPs operate.

Keywords

Contribution Analysis; Family Farm; Farm Link Programs; Farm Transfers; Retiring Farmers; Succession Planning

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Introduction

In the U.S., farm link programs (FLPs) endeavor to preserve productive agricultural land by facilitating farm transfers from retiring farmers or landowners

to those starting a farming career (Hubbard, 2006). FLPs also look to other types of arrangements to support this transition, such as short- or long-term leases. Nonprofit organizations, universities, and outreach arms of government departments typically run FLPs, also known as 'land link' programs (Hubbard, 2006). Their overall intent is to keep farmland "in agricultural production while helping preserve rural communities and family farms in the face of ever-growing corporate interests" (Slack, 2013, p. 505). FLPs hope to enable farmers to retire comfortably, make affordable land accessible to beginning farmers, and limit the loss of farmland to development.

The literature describes mostly what FLPs do and how they function (Goeller, 2012; Hubbard, 2006; Slack, 2013; Strange, Thompson, Prosch, & Johnson, 2003). Ingram and Kirwan (2011), however, explore the difficulties FLPs face through the lens of the challenges and ultimate dissolution of the Fresh Start FLP in Cornwall, U.K. They suggest that it is nearly impossible for FLPs to account for, and thereby mitigate, the 'social factors' that influence farm transfers, such as lack of trust between retiring and new farmers (Ingram & Kirwan, 2011). Their critique highlights the fact that research on the ultimate effectiveness of FLP efforts is lacking.

The intent of our research was to evaluate the capacity of FLPs to facilitate various types of farm transfers while identifying barriers and challenges that may interfere with this goal. The research was undertaken using the program evaluation framework contribution analysis (CA). With CA as a guide, we analyzed literature and interview data from FLP staff in order to position FLPs in the broader scheme of farm transfers in the U.S. We also analyzed the environments in which FLPs operate to identify some general program design flaws as well as the ability of the programs to facilitate farm transfers effectively.

Literature Review

Farmland occupies roughly 40 percent (914 million acres) of privately owned U.S. land (Daniels & Bowers, 1997; Nickerson, Morehart, Kuethe, Beckman, Ifft, & Williams, 2012). Total acreage, however, has decreased since the shift to industrial agricultural production began in 1935 (U.S. Environmental Protection Agency [U.S. EPA], 2013). Large farms dominate agricultural production, and smaller family-run farms have been going out of business (Hamilton, 2005; Lyson, 2007). Each year up to 500,000 acres (202,343 hectares) of farmland is lost and developed. Between 1982 and 2010, about 24,125,400 acres (9,763,203 hectares) were lost (Farmland Information Center, 2013). As urban areas expand, the economic value of farmland increases (Kuethe, Ifft, & Morehart, 2011). In the 2000s, farmland values increased significantly (Gloy, Boehlje, Dobbins, Hurt, & Baker, 2011; Weber & Key, 2015), influencing the ability of new farmers to afford farmland. Moreover, three-quarters of new farmers do not come from a farming family who could help them access land and capital (Ahearn & Newton, 2009; Inwood, 2013; Inwood, Clark, & Bean, 2013; Mailfert, 2007).

Urban sprawl—the expansion of urban and suburban areas onto rural land—can cause farmers to perceive development as inevitable, thus affecting their desire to update their agricultural model (Lindstrom & Bartling, 2003). "Farmers often feel discouraged from taking creative action to continue farming and are put in a financial situation where they need to sell quickly" (Lindstrom & Bartling, 2003, p. 2), so farmers often sell their farm for less than market value, a cycle that leaves farmers without adequate retirement income while encouraging continued suburbanization.

Many aging farmers have no familial successors (Scott, Cameron, & Benjamin, 2010). Traditionally, farms are passed on to children as farmers approach retirement age, but the difficulties of farming encourage farmers' children to pursue other careers (Ball & Wiley, 2005). The average age of farmers in the U.S. is 58, up from 55 in 2002, and the number of farmers over 75 has increased 20 percent since 2002 (U.S. Department of Agriculture [USDA], 2007a, 2012). Without successors, farmers work well beyond traditional retirement age (Amshoff & Reed, 2005; Ball & Wiley, 2005), and without adequate succession plans, the future of their farms may be at risk.

By 2019, about 10 percent (91.5 million acres or 37 million hectares) of farmland will change

hands (USDA, 2014). Many farmers will need to sell their farms, but to whom and for how much? Those wanting to enter farming often struggle with high start-up costs and obtaining land, despite their willingness to enter the profession (Ingram & Kirwan, 2011) and often cannot purchase land at a price that enables financial security for retiring farmers (Pitts, Fowler, Kaplan, Nussbaum, & Becker, 2009), thereby making farm transfers impracticable. When developers offer good prices for farmland, it is understandable that a farmer without a successor would sell land to finance retirement. Research that can help unpack the nuances of supporting more successful farm transfers is important to disrupt this trend.

Methods and Analytical Approach

We based the methodological framework for this research on a Program Evaluation (PE) method called contribution analysis (CA), first developed by John Mayne in 2001 (Mayne, 2012). CA accounts for the fact that external factors may have more of an impact on a program's observable outcome than the structured activities of the program itself (Shadish, Cook, & Leviton, 1991), and thus is based on the understanding that programs do not operate in a vacuum. In using CA, we conducted an initial round of data collection followed by preliminary analysis, which provided the foundation for the development of the key tool in CA, the theory of change (ToC) (Anderson, 2005). We then created the analytical framework, collected more data, and conducted another round of analysis, which informed a revised ToC. Use of the CA framework required information about the program and its outcomes, and also required incorporation of program-specific data. Table 1 outlines the standard stages of CA and how we applied each of them in this study, including deviations from standard CA procedures that were necessary for this study.

Initial data collection consisted of Internet

Table 1. Stages of Contribution Analysis (CA) and Applications in This Study of Farm Link Programs

Stages of CA	Description	Function	Application and Deviations from CA in this Study
1. Establish attribution problem	Establish the research question; determine what program elements will be assessed	Description	No major deviation
		(Research)	Included preliminary data collection to improve initial understanding of farm link programs' (FLPs') operations
2. Develop theory of change (ToC)	Create a flow diagram of how the program is theoretically supposed to affect change	Description	Extrapolated from preliminary findings to develop a general, cross-program ToC
		(Research)	Included preliminary analysis to extrapolate themes dominating the ToC
3. Gather information on ToC	Data collection related to the program	Research	In this instance, content analysis and further literature review relevant to themes dominating the ToC
4. Assemble the contribution story	Assess the validity of the ToC	Analysis	Reported the findings supporting the identified themes in the ToC
5. Gather more evidence	Identify research gaps and gather data accordingly	Research	Did not explicitly have a separate stage
6. Revise contribution story	Incorporate new data and reassess its relationship to the ToC. Make final conclusions in the form of a statement of contribution.	Analysis	Did not revise the contribution story. Instead proposed a revised ToC with stronger theoretical foundations based on research findings.

Note: Adapted from Mayne, 2008.

searches for U.S. farm link programs. The researchers searched Google, using the search terms 'farm link programs,' 'land link programs,' and 'farm matching programs' to identify as many programs as possible. We reviewed each program website for information about process, intention, operational history, success metrics, contact information, and other relevant documentation. We then entered the information into a spreadsheet and developed a questionnaire to address information gaps such as budgets, staffing levels, and any governmental relationships. The questionnaire also included open-ended questions.

To supplement publicly available information, we emailed participation requests to staff at 19 FLPs; 12 agreed to participate. Over a three-month period we collected data. Eight participants completed the questions in writing and submitted them by email; four chose a phone interview format. The researcher conducting the interview took notes throughout the phone interview and returned these to the participant for verification. We entered participant responses into tables and reviewed the data for significant trends and themes. We then conducted more research based on those trends and themes and used all data to produce the theory of change (ToC) (Table 2).

We developed the ToC based on what we learned about FLPs as a category during the preliminary data gathering and initial analysis described above. Table 2 reflects the resulting ToC for FLPs. Each section of the table represents a specific stage in an ideal FLP farm transfer process, with the progress of each stage depending on the success of the previous stage. This ToC outlines the ideal process flow that should occur in an FLP.

Four themes emerged from the ToC: (1) the effectiveness of FLP design and program activities; (2) the usefulness of FLP databases to meet the needs of farmers; (3) farmer motivation toward development or land preservation; and (4) trends and systemic influences on farm transfers. These themes guide the second round of data collection, providing context for the findings and structure for the contribution story (CS) (Delahais & Toulemonde, 2012; Lemire, Nielsen, & Dybdal, 2012), which is based on evidence collected about the themes emerging from the ToC. The CS can be described as a narrative explaining why the ToC is or is not accurate, and hence why the program is effective or ineffective. The ToC is tested by examining each theme in the context of how it affects FLPs and the land transfer process. The assumptions associated with each theme (Table 2) are challenged using literature and empirical data (interviews and/or questionnaires). This approach incorporates common practices found in other types of theory-driven evaluations, where the strength of a program is tested according to how well the components of the theory function (Mayne, 2001). Once the influence of each theme is understood, each theme can be discussed in relation to the others; how these influencing factors impact FLPs and farm transfers then can be better appreciated.

At the CS development stage, program credibility and its contribution, if any, to observed outcomes are assessed (Mayne, 2008). The CS serves to validate, question, and explain the theory of change, and includes the primary empirical data and a review of relevant academic and grey literature. Specific to this research, the creation of the CS allows flaws within FLP functioning that prevent (or limit) success to be identified. The final result of the CS is a Statement of Contribution (SoC) (Mayne, 2008), which, in this case, clearly states if and how FLPs are contributing to land transfers. Several recommendations emerged that may help FLPs mitigate some of their operational challenges.

Evaluating Program 'Success'

Determining what success means for FLPs warranted further inspection of each FLP's stated objectives. Each FLP included in this research has stated goals, which are described in Table 3.

Results and Analysis: How FLPs Affect Farm Transfers (the Contribution Story)

The following section is the CS stage in CA. Discussing the major components of the ToC in more depth, we assess the validity of the ToC as based on evidence. To put it another way, we are answering the question, "How do the main components of the ToC contribute to the effectiveness of FLPs?" Below, we discuss the four themes drawn from the ToC in greater detail.

Table 2. Theory of Change for a Farm Link Program

Description	Assumptions	Risks
Stage 1: External Conditions		
1. There is no familial successor	• A nonfamily member could succeed instead.	• The typical transfer process does not favor nonfamily succession.
2. Farmland is at risk of being sold for development	• Farmers prioritize keeping their land in production.	• Selling farmland for development is a preferable or acceptable choice.
3. Farmers need help finding a successor	• FLPs can be a natural go-to place for farmers seeking help with a farm transfer.	• Farmers can engage in farm transfers independently. • Farmers seek assistance elsewhere. • Farmers do not trust nonfamily members. • Farmers do not know that FLPs exist and may be able to help with a farm transfer.
4. Beginning farmers cannot find affordable, desirable farmland	• FLPs can help bring new entrants into farming.	• Farms remain too expensive to purchase despite FLP efforts, or farms do not meet the criteria desired by the new entrants.
Stage 2: Program Outputs		
1. Database	• All interested parties (seller and buyer) use the database effectively.	• The database is an inappropriate tool and/or is underutilized.
2. Basic staff support and/or facilitation	• Enough support is given to supplement the use of the database.	• Participants need more help than is provided.
3. Print resources	• Print resources can provide relevant and appropriate guidance for farmers.	• Print resources are not an acceptable and/or appropriate medium for farmers.
4. Educational opportunities	• Workshops, etc. are useful learning tools that augment FLP work.	• Workshops do not result in knowledge uptake or have limited effectiveness.
5. Program marketing	• Marketing schemes are effective in recruiting new and retiring farmers to the FLP.	• Marketing schemes do not draw in farmers to the FLP.
Stage 3: Immediate Outcomes		
1. Awareness of potential farm buyers and sellers	• Farmers have used FLP information and/or resources. • The database has been used successfully.	• Farmers do not use FLP information and/or resources. • The database is ineffective at initiating matches.
2. Opportunities arise for mentorship or lease-to-own arrangements (nonsale partnership)	• A potential match has been identified. • Farmers are prepared to teach and begin relinquishing control.	• Personal differences prevent a farm transfer. • Farmers do not have the specialized knowledge or support required to arrange a nonsale partnership.
3. Opportunities arise to negotiate a farm transfer	• A potential match has been identified. • Farmers are prepared to discuss a farm transfer. • Farmers have access to appropriate professional assistance to help negotiate a transfer.	• Personal differences prevent a farm transfer. • Farmers do not have the specialized knowledge or support required to arrange a farm transfer.
4. Better understanding of farm transfer process	• Farmers have used resources or participated in workshops.	• Farmers are not prepared to implement new knowledge.
Stage 4: Intermediate Outcomes		
1. Farm mentorships and/or lease-to-own arrangements occur	• The FLP was helpful. • Arrangements would have been made anyway.	• Personal or other issues prevented arrangements from occurring.

continued

Description	Assumptions	Risks
2. Farm transfers occur	• The FLP was helpful. • Farm transfers would occur anyway.	• Personal or other issues prevented transfers from occurring.
3. Retiring farmers are financially secure	• Farm transfers adequately provide farmers with enough money to fund retirement.	• Farmers are not able to sell the farm for enough money to live comfortably in retirement.
4. Agricultural production is sustained in region	• New farmers will maintain existing level of production.	• New farmers engage in smaller-scale farming, possibly part-time.
Stage 5: Final Outcomes		
1. Farm preservation	• Farms are transferred to a new farming generation.	• Farms are sold for development or left fallow.
2. Rural employment	• The farming venture is successful and able to employ staff. • Spin-off industries maintain viability.	• Farms are too small to require extra staffing. • Farms are unsuccessful businesses. • Farms have difficulty finding qualified, willing laborers.
3. Farmland transferred to a new generation	• Farms are sold to people for farming purposes. • Farmers retire financially secure.	• Farms are not transferred. • Farms are sold to people who choose to significantly downsize farming operations.

Table 3. Stated Objectives of Farm Link Programs (FLPs) in This Study

Program	Farm transfer as a stated goal or service offered	Farming opportunities and other nontransfer arrangements as a stated goal or service offered	Land protection as a stated goal or function
Virginia Farm Link Program	X	X	Not explicitly, but the FLP is part of the Office of Farmland Preservation
Pennsylvania Farm Link Program	X	X	X
Central New Mexico LandLink	X	X	
Iowa State University Beginning Farmer Center: Ag Link		X	
New York Farm Link	X	X	
Center for Rural Affairs: Land Link Services (Nebraska)	X	X	
iFarm Oregon		X	
Colorado Land Link	X	X	
New Entry Sustainable Farming Project Farmland Matching Service (Massachusetts)		X	
New Jersey Farm Link Program	X	X	
Land Link Montana	X	X	
Ohio		X	

Effectiveness of FLP Design and Program Activities

Each FLP has unique characteristics, which are identified and examined to understand their impact on program outcomes. Impact is specified as the number of successful matches, transfers, and/or leases resulting from program efforts. Three FLPs stand above the rest. Since the FLP came into existence, New York Farm Link reported 75 transfers and 500 farmers receiving services related to long-term transfers; the Iowa Ag Link program reported 68 farm transfers; and iFarm Oregon reported 35 transfers, including long-term lease agreements. The other programs that reported a specific number of transfers reported fewer than 10, while some could not provide a specific number because they did not keep such data. There were no consistent trends apparent in the data that could easily explain the differences in the number of farm transfers between programs, which indicates a need to further analyze and understand the programs at a more fundamental level.

Notably, some FLP staff stated that programs should be evaluated on their ability to help establish any type of connection with potential farmers, not just on the number of successful transfers. However, program websites still specifically identify farm transfers as an important outcome (Table 3), in addition to helping establish other farming opportunities. Given that programs were created to support land transfers, in addition to these other types of connections,[1] the term 'transfer' will hereafter include sales, leases, and other forms of longer-term partnerships.

Budgets and funding. FLPs rarely operate as the sole activity or focus of an organization. When asked about the yearly budgets of FLPs, most participants could provide only an approximate dollar amount. The budgets of the surveyed FLPs range from none[2] to over US$120,000 per year. Most budgets were between US$15,000 and US$50,000 (eight out of 12); much of this money went to paying staff.

An important finding was that neither levels nor sources of funding corresponded with the number of transfers. For example, a program that reported a budget of US$120,000 had zero matches associated with the program, while a program reporting a high number of matches had a budget of approximately US$45,000 per year. A young program also reported a high number of matches while operating with a budget of only US$30,000. Sources of funding—mainly from the government, university funding, and private donations—did not correspond with program success. Some programs charged a user fee to new farmers, but this was not typical. Retiring farmers were not charged a fee in any of the study programs.

Staffing. Staff levels at all programs are minimal: three programs have only one full-time staff member, and nine have only a part-time staff member. Aiming to learn from existing FLPs to design a well-functioning FLP in Montana, Hubbard (2006) considered the day-to-day role and function of staff in FLPs: "It is no surprise that these understaffed programs facilitate matches as efficiently as possible by publicizing the information and resources, hoping their participants will utilize them well" (p. 20). The energy needed to actively initiate matches is not always available to staff. However, even understaffed programs have been relatively successful, suggesting that success and funding are not necessarily related. This finding suggests that further investigation is needed to better understand the specific nature of program features that are most commonly linked to success.

Program focus. FLPs all operate on similar principles. Therefore, variations in the number of transfers may result from differences in the organizations that run FLPs, or from the influence of the other services the organization offers.[3] Additional services that FLPs provide can be divided into three categories. The first is farmer education and includes business planning, educating on farming

[1] Some FLP staff included any type of connection made between farmers (e.g. long-term leases, partnerships, or land-share arrangements) within their definition of 'transfer.'

[2] One program reported that it was operating at a loss—its organizational budget did not allocate any funds for FLP work, but the work was being done by staff anyway.

[3] FLPs generally operate as one segment of an organization that offers numerous services and programs. All FLPs that participated in this research were run simultaneously alongside other programs and services offered by their respective umbrella organizations.

issues, and/or providing additional educational resources to farmers. The second category of services encourages social and political engagement and includes the operation of farmers markets and development of consumer information and resources, policy formation or government lobbying, and/or rural development work. The third category relates to land issues such as preservation, conservation, and zoning.

Of the three programs that declare the most number of matches to date, two strongly focus on farmer education. The third program has some focus on education for farmers, and some on broader social and political engagement activities. None of the three are concerned explicitly with land conservation. That these three FLPs focus on education and broader social and political activities is not necessarily the cause of their relative success; other FLPs also participate in these types of programming activities, yet do not have success rates comparable to these three. Therefore, it is difficult to attribute those successes to one replicable program characteristic.

Given the small number of farm transfers made through the 12 FLPs surveyed, even including those reporting higher transfer rates, it appears that FLP transfers are responsible for only a minority of farm transfers or start-ups. According to the USDA, 291,329 new farms started between 2002 and 2007, making up about 13 percent of all farms in production during those years (USDA, 2007b). It is unclear whether these farms were transferred to family or nonfamily members, or were entirely new farming operations starting up on previously unfarmed land. The relatively small influence that FLPs have on the overall number of farm transfers raises the question of what wider issues may also be influencing low transfer rates among FLPs. This part of the CS suggests that present program designs may be inadequate to influence land transfers. As the CS is developed, a clear portrayal of what FLPs do with limited staff and financial resources will underpin the overall understanding of the potential impact of FLPs. The limited influence on farm transfers is clear, but is this the whole story? The following three sections endeavor to uncover some specific challenges that may be linked to poor outcomes for FLPs, what additional factors may need to be considered, and what modifications could be made to improve FLP success.

Usefulness of FLP Databases to Meet the Needs of Farmers

Questionnaire and interview results indicate that FLPs place a heavy emphasis on database use. Participants indicated that these databases automated much of the FLP matching process. The database set-up differs in each case, but many participants indicated that they allow automated emails or contact information to be sent to a farm seller or seeker under certain conditions. Some programs screen participants and facilitate initial contacts between parties. That FLP staff rely so heavily on databases to facilitate matches is, therefore, worth examining, as their usefulness and the level of uptake on the part of users are likely significant factors in the success of FLPs.

Participants (staff who completed the interview or questionnaire) reported significantly more farm seekers than sellers using these databases. Several participants observed that the farm seekers drive the program, as they are the more eager of the parties. Two FLPs directly encouraged retiring farmers to be the main drivers of the process by initiating contact with potential buyers. Goeller (2012) also noted a disproportionate number of farm owners (fewer) and farm seekers (more) listed in FLP databases, although it is usually free for landowners to register, while seekers often have to pay a fee. The limited use of these programs by retiring farmers signifies a potential problem. It is possible that retiring farmers are less interested in engaging with an FLP that requires submission of an online form to begin the matching process. Therefore, it may be problematic that FLPs rely so heavily on databases to facilitate matches between farmers. These issues are discussed further below.

Farmers and Internet use. The body of literature that explores how farmers use the Internet is fairly homogeneous in its observations and conclusions (Briggeman & Whitacre, 2010; Charatsari & Lioutas, 2013; Chiu, Cheyney, Ramirez, & Gerr, 2015; Howell & Habron, 2004; Stenberg & Morehart, 2007). While most farmers do have a personal computer (Briggeman &

Whitacre, 2010), the scope and scale of Internet usage depend predominantly on things like farm size (Briggeman & Whitacre, 2010; Mishra & Park, 2005; Stenberg & Morehart, 2007), income level, education, and age (Stenberg & Morehart, 2007).

Computers are used fairly often for farm business-related tasks (Mishra & Park, 2005). In the early days of the Internet, however, the rate of its regular use for daily farm business tasks was much lower than that of other businesses of similar size (Warren, 2004). Since then, the literature suggests that activities such as sourcing information, email, online banking, and purchasing and/or selling goods are minimal and not universal among farmers (Charatsari & Lioutas, 2013; Chiu et al., 2015; Taragola & Van Lierde, 2010). This lack of use is not due to limited rural access: by 2011, about 60 percent of rural residents had access to high speed Internet, compared to 70 percent of urban residents (U.S. Department of Commerce, 2011). Although the rate of farmer Internet use is increasing (USDA, 2013), rural farmers still lag behind those in other sectors (Khanel & Mishra, 2013). Limited Internet use among farmers is not necessarily a problem, unless the Internet is used as a "default medium for knowledge transfer, commerce, etc." (Warren, 2004, p. 380), thus leaving some farmers at a disadvantage.

There are legitimate reasons why Internet adoption has been slower among aging farmers; FLPs need to understand these issues. "Older operators are less likely to adopt the internet" (Briggeman & Whitacre, 2010, p. 573). Studies consistently show a clear negative correlation between age and Internet use in farmer business (Howell & Habron, 2004; Stenberg & Morehart, 2007), and a 2015 study by Chiu et al. investigating where farmers got health and safety information shows the Internet to be a least trusted source of information among farmers of all ages. While farmers may have computers and Internet access, they may not use them as a business tool or a source for business-related information (Chiu et al., 2015; Stenberg & Morehart, 2007). Varble, Secchi, and Druschke (2016) suggest that those farmers who do use the Internet more extensively—such as for business communications and sourcing information—would be considered 'innovators,' suggesting that the use of the Internet for these purposes is not the norm for farmers. Such conditions provide plausible explanation for why the FLP databases are sparsely populated with farm owners.

Personal security on the Internet. Older farmers are concerned that personal information will not remain secure on the Internet (Briggeman & Whitacre, 2010; Warren, 2004), more so than other population groups (Stenberg & Morehart, 2007). FLP staff have noted this concern and emphasized the need to take extra care to protect contact information stored in FLP databases to alleviate farmers' concerns about security. FLPs need to improve farmer confidence that their personal information is secure.

Perceived usefulness of the Internet. Hubona and Geitz (1997) suggest that any type of technology adoption process requires the potential adopter first to perceive the technology as useful and easy to use. This positive (or negative) perception determines adopter attitude toward the technology, which in turn drives his or her intention to use it (or not). Research suggests that farmers often are not aware of how they can benefit from using the Internet (Taragola & Van Lierde, 2010), and their "lack of perceived need for the internet" (Briggeman & Whitacre, 2010, p. 581) will prevent its use. In addition, "farmers are more skeptical of the quality of the internet as compared with that of face-to-face information diffusion" (Charatsari & Lioutas, 2013, p. 122), and believe that the Internet is not actually a suitable replacement for traditional methods of conveying information to farmers (Ballantyne, 2009).

In the case of FLPs, the online database and automated functions such as email have replaced the human-to-human interaction and information exchange that are more comfortable and familiar to farmers. Interestingly, various interviewees were aware of this issue and suggested that farmers still make connections primarily via their own networks of friends, family, and acquaintances. Interviewees accepted that using a program like an FLP is not a typical way to sell a piece of property, and that despite the best efforts of FLPs, farmers wishing to sell their land will look to more traditional avenues (e.g., lawyers and real estate agents). To be more

successful, FLPs may need to invest in more traditional communication methods including, ideally, more face-to-face contact. One opportunity could be to arrange networking sessions in hub locations that involve both buyers and sellers and a form of facilitated interaction. Other industrial sectors seeking to development relationships between disparate actors have used this "speed-dating" approach with considerable success (Liu, Adams, Cote, Geng, & Li, 2016), thus demonstrating the potential for such events.

Farmer Motivations Concerning Development and Land Preservation

Data analyses suggest that FLPs assume that farmers prefer their farmland to be kept in production and that it is only the difficulty of transferring the farm that prevents it from being used for continued agricultural production. These assumptions are simplistic, as complex economic, personal, and geographic factors influence farmers' decisions about the future use of their farmland. Farmland is a financial asset and can be a source of income during retirement; it is a potential home during retirement; it is a place filled with sentimental value for many farmers (Mishra, El-Osta, & Johnson, 2004); and in many cases, it is a legacy (Duffy, 2011). The services FLPS offer may not address the reasons a farmer might decide to sell farmland.

Financial considerations. Farmers considering selling land take into account things like their health, age, children's interest in farming, opportunity for nonfarm occupation, and desire to relocate (White, 1998). Financial needs strongly motivate farmers' decisions about their land; in many cases, farmer financial needs are better served by selling the land at development prices (Zollinger & Krannich, 2002) than by passing it on to subsequent generations (Pitts et al., 2009). A farmer facing unfavorable farming conditions, such as sprawl, may consider transferring to a family member who has expressed interest in taking over the family farm, but not to a nonfamily member (Zollinger & Krannich, 2002) because "farmers may feel that the child who has been planning to take over the farming operation should have the right to attempt farming operations in the current area or sell the operation for non-agricultural land use" (Zollinger & Krannich, 2002, p. 459). If there is no family member to take over the farm, however, the farmer may simply sell the land for non-agricultural uses (Zollinger & Krannich, 2002) or hold onto the land as long as possible (Duffy, 2011). For FLPs, this means that some decisions regarding farm sales have little to do with the farmer's ability to find a buyer. These common tendencies of retiring farmers may prevent farmland from becoming available to new farmers, thus limiting the rate of possible transfers.

If the farm owner is interested in selling to a new farmer, pricing can make selling difficult. Retiring farmers seek to profit enough to make retirement comfortable, but to keep the land undeveloped and in production, the asking price must be affordable for the new farmer (Pitts et al., 2009). Without a family successor, farmers may feel it is not worth the effort to find a successor if they believe market, community, or geographical conditions are poor. Alternatively, a farmer may simply not be willing to put the farm on the market for a nonfamily member to purchase (Duffy, 2011). This presents a question of convenience: when faced with various options, will a farmer opt for the simplest type of sale?

Sentimental attachment to family farmland. Money may not be the only important factor in the decision to sell farmland. Farmers can have a sentimental attachment to their land and feel that it is part of their identity (Gasson & Errington, 1993). For some, the possibility that their children will not take over the farm may produce a deep sense of loss (Dessein & Nevens, 2007). Their attachment to the land and their history on it can affect how likely they are to try to keep the land in production (Kuehne, 2013). Because the link between how farmers define their identity and the decisions they make about their land is poorly understood (McGuire, Morton & Cast, 2013) it raises the possibility that some farmers would avoid succession planning as a self-identity preservation tactic; that is, being unable to accept that their farm will, or should, be transferred, a farmer may delay developing a succession plan and thus keep their farming identity intact. What is known, however, is that farmers who choose to develop succession plans do have a desire to see their land continue to

be used for agriculture (Darnhofer, 2010; Higby, Ruhf, & Woloschuk, 2004). The absence of succession planning will likely limit the likelihood that farmers will be able to transfer their farms, thus undermining the possibility of its continued use as farmland (Pitts et al., 2009).

Urbanization considerations. Urban and suburban encroachment results in decreased output and productivity for remaining farms and, over time, a higher amount of idle farmland (Daniels & Bowers, 1997; Thompson & Prokopy, 2009). In a phenomenon known as 'impermanence syndrome,' when farmers assume that their land will be developed eventually, they reduce their investments in soil health and their production capacity wanes (Daniels & Bowers, 1997; Olson, 1999). Farmers adapt to urban encroachment with 'negative adaptation'; they attempt to maintain business as usual, but eventually they close the farm business (Johnston & Bryant, 1987; Sharp & Smith, 2003). External pressures, then, further affect the circumstances under which farmers operate and make decisions about farmland preservation or development. If an FLP works under the expectation that farmers want to keep their land in production at all costs, that FLP may be on the path to failure.

Trends and Systemic Influences on Farm Transfers

Succession process. Arranging transfers with nonfamily members is a difficult, emotionally wrought endeavor; a farmer may not be willing or able to bring an unknown person into their operation as easily as they might bring in a family member. This is not to suggest that transitions with family members are simple; they too can be difficult. A farmer's attachment toward his or her farmland makes it difficult to break ties to the land upon retirement (Mishra, Johnson, & Morehart, 2003). Relinquishing control may also be financially worrisome for farmers who need to generate retirement income from farm assets (Keating & Munro, 1989). Any of these issues can hinder the transition process (O'Neill, Komar, Brumfield, & Mickel, 2010).

Much of the motivation to modify a farm business is linked to preparations undertaken to pass on the farm within a family (Inwood et al., 2013). Keating and Munro (1989) describe how younger farmers prepare to take over a farm by engaging in activities of increasing responsibility in the following order: general farm work; livestock care; production management; marketing management; financial management; land holdings; and equipment holdings. Any good succession process typically begins long before a farmer sells the farm to a successor because the mere expectation of a successor (or none) can affect the succession process (Pitts et al., 2009). Farmers who intend to pass on their business are more likely to make decisions aimed for longer-term growth (Gasson et al., 1988; Stiglbauer & Weiss, 1999). Potter and Lobley (1992) describe this phenomenon as 'the successor effect.'

Larger farms are more likely to have a family successor than smaller farms (Glauben, Tietje, & Weiss, 2002). Smaller family farms may be at a greater risk of experiencing the impermanence syndrome. Furthermore, relatively few farmers have concrete retirement plans, intending instead to use their farms for income once they retire (Duffy, 2011). This finding is congruent with other studies that indicate that as farmers become semiretired, they expect to be able to continue drawing income from the farm (Gasson, Errington, & Tranter, 1998; Keating & Munro, 1989; Kirkpatrick, 2013). Such farmers tend to adopt static management practices or disinvest in the farm, selling off some land and assets with the intention of continuing to use the remaining land to finance their retirement (Inwood & Sharp, 2012).

Leasing as a potential farm transfer option. Leasing can be a more affordable and gradual way for new farmers to begin their farm business or gain valuable experience (Hubbard, 2006). Also, some farmers wanting to sell land have more to sell than is typical for new farmers to purchase. Leasing may allow new farmers to take partial control of the land, which can offer alternative retirement financing options for the landowning farmer.

However, leasing or renting land may impinge on the long-term productivity of the land. Various tax structures in the U.S. incentivize farmers to rent their land to fund their retirement rather than sell it, which may mean that the farm is not as well managed and productive as it would be if it were owned (Slack, 2013), possibly because tenant

farmers are likely to take few big risks in their farming operations (Fukunaga & Huffman, 2009). Leasing arrangements offer no guarantee that production would continue after the death of the landowner (Slack, 2013). Furthermore, farmland available to rent may not be suitable for new farmers; if the land available is excess land without a house or other buildings, it is more likely that an established neighboring farmer will lease it. The more farmland that is rented in such scenarios limits the land available for young farmers to purchase (Ilbery, Ingram, Kirwan, Maye & Prince, 2012).

Given the limitations on the viability of leasing land on a long-term basis, FLPs should nurture farmers wanting to enter such arrangements, while being mindful that many new farmers choose to own land (Shute et al., 2011). As a short-term option, leasing may be acceptable, but as a long-term strategy, ownership may be a more successful option.

New farmers. Understanding the behavior, motivations, situations, and needs of aspiring farmers is important when trying to create a more favorable farm transfer environment. New farmers are not all young; in the U.S., their average age in 2007 was 48 (USDA, 2007b), with approximately one-third over 55 (Ahearn & Newton, 2009; Inwood et al., 2013). New farmers are unevenly distributed across the U.S.; concentrations range from 10 percent or less in a county to as much as 50 (Ahearn & Newton, 2009). New farmers tend to start out with smaller farming operations; "entry rates decline as farm size grows" (Ahearn & Newton, 2009, p. 20). The average size of new farms in 2007 was 201 acres (81 hectares), less than half the average farm size of 418 acres or 169 hectares (USDA, 2007b). New farmers may want to start with smaller farms due to the challenges of accessing financing, resources, and information (Clark, Inwood, & Sharp, 2016). Furthermore, as beginning farmers are likely to have off-farm employment (as 80% do) (Inwood et al., 2013; USDA, 2007c), there is less need to make money solely from farming, lessening the need to purchase a large land parcel. The connection between age and off-farm employment is notable: new farmers may enter farming later in life after working in other careers and saving for a farm purchase. They may also continue working in other jobs; new farmers are often drawn to the farming lifestyle as opposed to a farming career (Ahearn & Newton, 2009). In fact, in the 2007 U.S. census, 32 percent of new farmers[4] did not report any production on their land at all (Ahearn & Newton, 2009). Understanding that new farmers are not always young, are likely to seek out smaller farms, and may choose to be employed off the farm can provide insight that may support program innovations within FLPs to alleviate the potential difficulties in transferring land caused by these realities.

Incongruent needs: retiring vs. new farmers. Beginning farmers have needs that are not aligned with those of established farmers. One problem is that established farmers have much more land and a larger farm business than a beginning farmer can often afford or manage (Inwood et al., 2013). New farmers face high start-up costs (Ahearn & Newton, 2009), and as land values increase, it becomes even more difficult to buy large parcels of farmland (Lobley & Baker, 2012), which may not even suit the needs of new farmers (Ahern & Newton, 2009).

Importance of social networks. Existing social networks create both opportunities and barriers. Strong social networks are important for beginning farmers, yet many—when they are from outside a given agricultural community—experience social isolation in communities where they attempt to begin their farming career (Mailfert, 2007). Such networks facilitate farm acquisition, since it is more likely for farms to be exchanged between friends, family members, and neighbors (Robison, Myers, & Siles, 2002, p. 45). Furthermore, farmland typically sells at a lower price when the seller knows the buyer, demonstrating that "relationships do matter in farmland exchange" (Robison et al., 2002, p. 57). New farmers who want to rent farmland may find themselves competing against established area farmers who want to

[4] The USDA defines 'beginning farmer' as someone operating a farm for 10 years or less regardless of how much income they derive from their farm. These farmers may not have a goal of producing agricultural commodities and may simply be living on the farmland (Ahearn & Newton, 2009).

expand their business (Ingram & Kirwan, 2011). Accordingly, new farmers wanting to make short-term arrangements with an established farmer to gain experience may find it difficult to do so.

Study participants emphasized that they are as interested in helping farmers find opportunities as they are in facilitating farm sales. Recalling what was discussed earlier about incorrect assumptions about how farmers value their farmland, the understanding that farmers have strong social bonds can be an advantage to FLPs. We suggest that time and energy spent building social networks between retiring and new farmers could result in more favorable outcomes later in terms of farm transfers.

Recap of FLP Challenges

Table 4 summarizes the challenges FLPs identified during this research (Column 1), and possible solutions that we have proposed (Column 2). Acknowledging and addressing challenges, problems, and common mistakes of FLPs are foundational in developing a more effective FLP. The

Table 4. FLPs: Existing Problems and Potential Solutions

	Problem	Solution
Program Challenges	Heavy reliance on internet to recruit farmers with land	• Face-to-face recruitment • Hard copy/mail-in registrations for program • Staff to facilitate matches more actively • Educate farmers on Internet use and online security
	Unclear long-term goals	• Clarify long-term goals and develop viable strategy
	Short-term goals do not match long-term strategy	• Determine whether other initiatives should be undertaken alongside FLP (lobby for better policies and/or legislation, find secure funding, build and strengthen farming networks, etc.)
	Understaffed programs	• Better align staffing with the program tasks and actions known to have the greatest influence to optimize staff impact • Where possible, hire more staff
	Unstable funding leads to lack of long-term planning	• Secure long-term funding[a]
	Not connected to ready and affordable specialists on farm transitions (e.g., lawyers, real estate agents, etc.)	• Establish connections with professionals willing to support and/or facilitate major parts of the farm transition, possibly including counselors to help with personal stresses experienced by farmers
External Challenges	Mismatched farm size to sell, rent, or buy	• Enhance cooperative farming opportunities to create more flexible options
	Farmers with land renting to established farmers rather than to beginning farmers	• Create and foster strong mentorship programs and farmer networks
	Farms are too expensive for beginning farmers	• Work with alternative or innovative financing mechanisms to create better financing options for beginning farmers
	Weak networks for beginning farmers	• Create more mentorship opportunities, farm community integration programs, and networking opportunities for new and established farmers
	Farmers often unprepared for farm transfers, or succession plans made too late to maintain viable farm business	• Provide education on succession planning for farmers at all ages and stages of their farming career
	Lack of trust between farmers selling and new farmers buying land	• Create more opportunities for incorporating new farmers into the farming world • Provide networking opportunities
	Family farms may be sold after each generation	• Create a culture of farm succession planning for non-family members

[a] The difficulty of this task is fully recognized, but it must be stated here because adequate funding is imperative to the long-term planning and implementation of a well-functioning FLP.

table has been divided into two sections: the challenges specific to how the programs operate (Program Challenges), and external challenges (External Challenges) that are more systemic and institutionalized within the agriculture sector. By understanding the problems with current FLPs, one can integrate mechanisms and strategies into newly developed programs to address such issues.

The revised ToC (Table 5) draws from the evaluation work completed here. From the development of the CS, it became clear that the original ToC is flawed; that is, program activities seem to be based on flawed assumptions. Therefore, the ToC was revised to better reflect conditions that may ensure the success of an FLP. The hope is that this new, more robust ToC can be used to create a new FLP or to update an existing FLP's programming. Stage 1 of Table 5 focuses on an FLP's day-to-day activities, the reasoning behind them, and possible risks that may prevent success. If the actions taken by the FLP as outlined in Stage 1 are successful, certain short-term outcomes would be expected. Stage 2 outlines immediate (short-term) expected outcomes. Stage 3 focuses on indirect (long-term) outcomes that may result from the program outputs (Stage 1) and the short-term outcomes (Stage 2). This revised ToC can serve as either a starting point for a new FLP or a point of evaluation for existing FLPs.

Discussion: Contribution of FLPs

Stages four through six of CA focus on building the contribution story of FLPs. The information needed to build the CS is presented in the previous sections. The final task in the CS is to make a statement of contribution (SoC), a short summary of how well the programs meet—or do not meet—intended outcomes (Mayne, 2001). In the context of this research, the following statement is offered: FLPs are well-intentioned programs aimed at addressing real concerns in the farming community, but in their current form are not able to effectively facilitate large numbers of farm transfers.

FLPs have not demonstrated their ability to successfully, reliably, and routinely facilitate farm transfers on a large scale. Although this is a reasonable metric of success, FLP staff have often been reticent to define success in this way. This would suggest a recognition of their limited influence. While their efforts have not been entirely in vain, one must consider the steady rate of farmland loss each year, the number of farm sales that occur outside an FLP program, and the limited influence FLPs have had facilitating these transfers. It remains unclear if FLPs actually did facilitate successful matches, thereby preventing the sale of farmland for development, or if FLPs simply capitalized on a farmer's commitment to succession and provided an additional avenue to do so.

The crucial challenges FLPs have yet to face include reliance on the Internet for initiating farmer connections, despite evidence of its lack of effectiveness; a small staff complement, who are unable to provide legal, financial, and professional assistance required by farmers; limited resources and mechanisms for bridging the gap between new farmer financial capacity and the price of farmland; weak networks for new farmers and FLPs' limited ability to improve them; and a mismatch in the requirements of new and retiring farmers. If they are to be relevant in the longer term, FLPs need to carefully assess each of these challenges and determine their capacity to overcome them. Importantly, challenges must be addressed simultaneously—as they are essential components of a farm transfer—and work synergistically. FLPs should consider several improvements to their structure, programming, and skill set. While these recommendations are not necessarily a component of CA, our research has resulted in several recommendations that may help mitigate problems experiences by FLPs.

Strengthening Networks

FLPs should not operate in isolation; many FLPs do function within an organization that can provide education for farmers and consumers, networking opportunities, professional development, and so forth. Networks are vital for farmers, and new farmers especially. FLPs should consider expanding networks by partnering with other organizations—connecting with local, state, or even the federal government, education centers and universities, financial institutions, or real estate and legal professionals. Having strong support from these types of institutions can strengthen the

Table 5. Revised Theory of Change for a Farm Link Program (FLP)

Description/Activity	Assumption	Risk
Stage 1: Program Outputs: Specific activities done by FLP and day-to-day program activities		
Heavy focus on succession planning education for all farmers: hold workshops, provide literature, etc.	Succession planning is essential to foster farm transfers and is the foundation of successful farm transfers.	Succession planning has not occurred yet; farmers do not prepare for the emotional and/or social challenges that accompany farm transfers.
Personal outreach by staff to all farmers approaching retirement age without a successor.	Personal connections are the most effective way of bringing retiring farmers into the program.	Farmers are not interested or are skeptical of the service.
Offer Internet database as a supplementary tool, targeted to young farmers.	Young farmers are more likely to use the Internet to find information and connect to farming opportunities and communities.	Relying on the database to attract new farmers may not be the most effective form of engagement.
Partner with and utilize farm transition specialists (e.g., lawyers, real estate agents) to facilitate farm transfers.	This will help the FLP meet specific needs of farmers who will use the program.	Could be difficult to bring in these partners on a reliable basis.
Connect young farmers with loan and financing opportunities.	The FLP should help with all aspects of farm transfers, including helping young farmers secure funding.	There are funding bodies in place, and it may not be possible for the FLP to offer more funding.
Host localized networking opportunities, e.g., farm tours or work parties.	This can help broaden a farmer's network, provide opportunities for older and young or new farmers to mingle, and establish trust.	Farmers may not want to participate in these types of events and will still choose to develop their own networks.
Stage 2: Immediate Outcomes		
Farmers are better prepared for retirement and succession.	The information given is appropriate and applicable.	Improper planning and lack of education is not what prevents farmers from selling their land to a new farmer.
Stronger networks in the farming community.	Strong networks build trust between farming generations.	Trust and confidence in the abilities of new farmers may not actually improve chances for succession.
Begin matching retiring and new farmers.	Farmers are interested in using the FLP services.	Farmers are not served by the FLP and choose not to participate.
Stage 3: Indirect (Long-term) Outcomes		
Farm transfers are arranged and completed.	FLP was able to meet the needs of farmers to facilitate a farm transfer.	Farmers still have difficulty transferring their farm to a nonfamily member.
Farms continue to be productive.	New owners continue to use the land for food production.	Farms turn into hobby farms and are not especially productive.
Farm transfers become a regular part of farm businesses.	Family succession decreases and farmers need to sell the farm upon retirement.	Farm transfers to nonfamily members remain difficult and rare.
Farmland is protected from urban development.	Farmers will choose to keep their land in farming if they can.	Farmers are able to financially benefit from selling their land for development and prefer this option to fund their retirement.

resources that FLPs can offer.

By affiliating with other farming organizations, FLPs can gain credibility with potential land sellers. Relying on landowning farmers to register online to list their land has not proven successful; FLPs need to find other ways to foster participation. More direct interaction may help farmers recognize the benefits and opportunities of participating in FLP

programming and the transfer process. In addition, implementing integrated networking strategies that have been utilized in other sectors is important; farmers are a heterogeneous, disparate group, and looking to other sectors that have integrated such network development successfully could be tremendously helpful. Of particular interest could be industrial-sector network development strategies that seek to bring together small and medium-sized enterprises and industrial players who have potential resources to exchange but no other obvious grounds for interaction.

Normalize Succession Planning

As the number of farmers seeking to retire increases and land values continue to rise, FLPs will need to strengthen their programming if they are to play a relevant role in supporting sustainable succession of farm land in the U.S. As noted, FLPs need to improve opportunities for face-to-face networking and facilitating more meaningful interaction. This will either require more staff and funding (a challenge), or more innovative approaches to facilitating interaction between land sellers and seekers. Family transfers are declining, so it is essential for FLPs and related initiatives to find ways to meaningfully connect with farmers and actively encourage them to think and plan for succession early on.

Improve Financial Support

Funding a new farming venture is onerous; FLPs can expand financial support services and secure avenues that would allow them to offer financial assistance to new farmers. Although California FarmLink did not participate in this research,[5] publicly available information suggests that its program structure allows it to facilitate financial support for new farmers. It has more staff than any of the FLPs that participated in this study, and its staff becomes very involved in the transfer process. California FarmLink also can offer new farmers loans of up to US$25,000 and has connected with alternative financing sources to provide further assistance (California FarmLink, 2013). It has reportedly assisted over 3,000 farm businesses and has successfully arranged 125 farm leases and related partnerships (California FarmLink, n.d.). Its hands-on, practical approach appears to demonstrate an understanding of the main challenges linked to farm transfers. Ideally, FLPs serve as a distribution broker for resources such as start-up grants or funding that supports new farmers, thus helping new farmers to find both land and funding.

Evaluation Processes

Regular and systematic evaluation of FLP activities is essential. Part of the evaluation should be to ensure that the FLP's goals are articulated clearly and specifically. Understanding the links between initiatives and the FLP's goals, internal capacity to deliver on initiatives, and ultimate success of the transfer program should help inform any changes or improvements the FLP may need. Those working in FLPs must also recognize outside contributing factors that influence farm transfers, and those factors must be accounted for in FLP programming as much as possible. CA could serve as a useful framework for individual, ongoing FLP evaluations.

Innovative Stakeholder Engagement

FLPs are not the only operations that face challenges engaging with their stakeholder groups. During their program evaluations, it is imperative that FLPs seek out innovative mechanisms used to connect disparate groups, not only those within other farming related organizations, but also those in different sectors.

Conclusions

While FLPs have the potential to help farmers find reasonable and appropriate farmland arrangements suitable to their own personal circumstances, several FLPs involved in this study have yet to experience much success, in terms of transfer numbers or in facilitating other types of land arrangements. More successful programs have some of the essential criteria for success in place, although each program is strong in different areas. Common strengths include having established networks within farm communities, spending time recruiting landowners, and offering legal and financial support. This research has helped to position the work

[5] They were, however, invited to do so.

of FLPs within a broader context, leading to a better understanding of the contribution FLPs can make toward preserving farmland, helping farmers retire with financial security, and assisting new farmers with start-up costs and access to land. FLPs need to clearly understand and articulate their own internal goals and limitations in order to be a useful resource, and they should monitor and evaluate their program offerings. Providing an Internet database and a website is not enough to encourage farm transfers. More work needs to focus on the actual development and strengthening of networks, particularly between other organizations supporting successful farm transfers, and between potential land sellers and seekers.

This research contributes to the body of knowledge associated with FLP effectiveness, which currently suffers from a dearth of material. In addition, we have found CA to be a useful framework for future FLP research because it requires analysis that incorporates many outside factors, from tax structures to attitudes and beliefs about farmland. Each factor is worthy of specific study in the context of farm transfers and FLPs. A fuller understanding of the changing trends in farm ownership and the opportunities and challenges presented is also an important research area.

It was beyond the scope of this research to engage directly with farmers who have used FLP services, but further research could focus on whether FLPs met their needs and expectations, and thus identify more specific criteria for success for FLPs. Additionally, it would be useful to research the experiences of farmers who have sold their farmland for development; their stories could inform ways to mitigate the loss of farmland to urban development.

Understanding the role of FLPs can be an important component in the discussion about farmland preservation and how to better support transitioning farmers. To date, FLP programs have met with limited success, but with specific changes, FLPs could play an important role in keeping farmland in production. This study has used an evaluation framework for the first time to assess FLPs' effectiveness in facilitating farm transfers. This research has made a strong case for FLPs to include formal evaluations regularly as a means to find practical ways to improve on program offerings. As external conditions change and more farmers find they have difficulty transferring their farms, FLPs will need to change and adapt as well. Knowing where change is necessary in their program operations can be found through rigorous evaluation, thus improving prospects for FLP success.

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It's not just about the destination, but also the journey: Reflections on research with Indigenous women food growers

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Abstract

Research with Indigenous Peoples has a history associated with colonialism, oppression, and power and control dynamics. In order to work with Indigenous communities within a research context, unique methodologies encompassing Indigenous values, participatory approaches, and horizontal collaboration and/or knowledge exchange is required. The reflective essay explores how I (author Stein) utilized a blend of participatory and Indigenous research methodologies, including *kaupapa Māori,* which is unique to Māori of Aotearoa (New Zealand) and encompasses Māori cultural values, aspirations, and *tikanga* (protocols). While the research explored how Māori women are reclaiming the food system and promoting agroecology, food self-reliance, and alternative visions based on Māori cultural values and traditions, this article is a reflective work based on my experiential learning through the process of utilizing a participatory methodology and kaupapa Māori. Nonetheless, I touch upon key research findings. The vastly opposing worldviews between Indigenous women promoting agroecological farming and the industrial model of food production are representative of the conflicting values of an Indigenous versus an academic worldview. In this paper, I set out a series of reflections on working with Indigenous Māori women within a research context; the challenges and tribulations that were overcome; as well as how kaupapa Māori, an Indigenous methodology, expands on participatory research.

Keywords

Agroecology; Food Sovereignty; Indigenous Knowledge; Indigenous Methodologies; Indigenous Peoples; Kaupapa Māori; Knowledge Exchange; Participatory Approaches; Traditional Food Systems; Women; Gender

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Introduction: Research, Colonization, and Indigenous Peoples

This article is as much about the methodologies that I used along the way as it is about the research that I've been conducting over the last three years. As the old saying goes, it's not just about the destination, but also the journey. This encapsulates a perspective that is helpful for researchers to take when working with Indigenous Peoples (IP) and communities. My research focused on food self-reliance among Indigenous women and sought to understand how local gardening initiatives by and for Māori are reconnecting people with their food, culture, and the environment. In this article, I explore the obstacles, solutions, and lessons learned through a research process using a blend of participatory and Indigenous research methodologies.

Like other IP globally, Māori, the *tangata whenua* (people of the land) of *Aotearoa* (New Zealand) are overrepresented in statistics related to inequality, food poverty, and diet-related diseases such as diabetes and obesity. Māori have poverty rates double that of *pākehā* people (New Zealanders of European ancestry) (Perry, 2016). A higher rate of Māori youth (22.4% compared with 9.1% of non-Māori youth) are not currently in the educational system or employed (Te Puni Kōkiri, 2012). Perry's (2016) report on household incomes in New Zealand from 1982 to 2015 defined poverty as living at less than 60% of the national median wage, which equates to about NZ$28,000 per year, or approximately NZ$500 per week. Māori are in the lowest group in terms of household income (Perry, 2016).

According to the New Zealand 2008/09 Adult Nutritional Survey, 59.1% of households were fully or almost fully food secure, 33.8% were moderately secure, and 7.1% had low food security status (University of Otago & Ministry of Health, 2011). Pacific Islanders and Māori were the least food secure. Among Māori, only 34.8% were food secure, 48.7% were moderately secure, and 16.5% were food insecure (University of Otago &, 2011). Overall, females were less food secure than males, with 56.5% of females being food secure as compared to 61.8% of males (University of Otago & Ministry of Health, 2011).

Māori have difficulty accessing healthy food and are more likely to live in areas with limited access to quality supermarkets and an overabundance of fast food outlets (Te Hotu Manawa Māori, 2007). In addition, food insecurity is positively associated with obesity (Drewnowski & Specter, 2004; Townsend, Peerson, Love, Achterberg, & Murphy, 2001). Close to half (48%) of Māori adults are considered obese, and 19% of Māori children are obese (Ministry of Health, 2013). In a 2008 study by Lanumata, Heta, Signal, Haretuku, and Corrigan, Māori unanimously attested to the need for better access to nutritious foods, with most Māori, Pacific, and low-income research participants not always having access to the food they needed for a healthy life. The barriers they identified for living a healthy life included lack of money and the cost of healthy food (Lanumata et al., 2008). Similarly, research by Moeke-Pickering, Heitia, Heitia, Karapu and Cote-Meek (2015) identifies barriers to healthy living that include access to healthy food and the depletion of food stocks due to pollution, resulting in a high dependence on purchasing food that is inexpensive, but not necessarily healthy. Participants in the study were concerned with how processed foods were affecting their health and "confidence in us to take back our land and to take back the sovereignty" (Moeke-Pickering et al., 2015, p. 37). Similarly, the women involved in my study identified the issues affecting Māori communities as having to do with environmental degradation, resource depletion, and economic inequalities, all of which are impacting access to healthy, sustainable, and culturally appropriate food.

My research began with a general interest in how food sovereignty is defined by Māori women and actualized on the ground in the form of community food initiatives led in particular by Māori women. This research was also inspired by the lack of Māori women's voices in scientific literature, underlying the need to highlight examples of Māori women taking the lead in devising innovative, empowering solutions to health, nutrition, food, and environmental issues impacting their *whānau* (families) and communities. Research on food security and community gardens within New Zealand is also limited, including a significant lack

of Māori perspectives and the importance of Indigenous knowledge and values. Thus the aim of my research was to explore Māori women promoting food self-reliance, the meaning behind their actions, and the challenges they have faced along the way. As L. T. Smith (1999) states, our role as kaupapa Māori researchers is to listen and document Māori experiences and meanings.

A unique blend of kaupapa Māori and participatory research approaches informed this study. Kaupapa Māori is an Indigenous methodology that is context-specific and based on Māori cultural principles. It is specific to Māori, including Māori *tikanga* (protocol) and cultural values within the research process. Kaupapa Māori "speak[s] to pressing daily issues for [Māori]—food production, unemployment, access to resources and so on… Lately, a focus on food security, poverty, and health has come to surpass a focus on language and culture and even the environment" (G. H. Smith, Hoskins, & Jones, 2012, p. 14).

The study took place over the course of three years and involved four Māori women as "case studies," who were leading local food initiatives. Three were located in the North Island of New Zealand and one in the South Island (Table 1). The four case studies were selected using purposeful sampling. All of the women were selected due to their knowledge of running a community initiative, growing food, and Māori culture. Because of the small sample size, the results of the study are not intended to be generalizable to the whole population, but rather offer insights into how a particular group of people perceive a problem, along with their opinions and ideas for solutions.

Research with IP has been criticized for being "disempowering" and "biased" (Davey & Day, 2008; Kidman, 2007); however, the democratic, collaborative, and emancipatory nature of participatory research (Todhunter, 2001) is more historically and socially appropriate for IP. Its strong emphasis on social justice empowers those who have traditionally been the "objects" of research as "equal collaborators" instead (Brown & Strega, 2005, p. 7). Relationships are based on mutual respect, equality, collaboration, and inclusivity (Reilly, 2010). This involves gaining an insider view of a particular issue, including personal perceptions and insights (Reilly, 2010). Most importantly, researchers need to be respectful and honor relationships (Kovach, 2005).

It is important to remember that just because research is focused on Māori, it does not mean it is within a kaupapa Māori framework (G. H. Smith, 2003). Within the scope of this project, Smith's kaupapa Māori principles underlay the development of the research and guided the study, including (1) the principle of *ata,* "spending quality time and effort to establish respectful and reciprocal relationships that include a transformative element"; (2) *kia piki ake I nga rarurarau o te kainga,* "ensuring the research is of positive benefit to Māori communities and addresses socio-economic issues"; (3) *tino rangatiratanga,* "recognizing the principle of self-determination and the goal of control over one's own life and cultural well-being"; (4) *taonga tuku iho,* "assuring the centrality and legitimacy of *te reo Māori* (Māori language), *tikanga* (Māori protocol), and *māturanga* Māori (the Māori worldview), "that Māori ways of knowing, doing, and understanding are valid in their own right"; (5) *kaupapa,* "that the overall research topic contributes to a collective vision and purpose"; (6) *whānau,* "that the researcher recognizes their responsibility and obligation to the *whānau* (family) and respects the relationship between the researcher, researched, and research"; and (7) *ako Māori,* "ensuring the research methods, such as

Table 1. Participating Farm/Garden List

Case Study Participant	Farm/Garden	Location
Charissa Waerea	Parihaka Community Garden	Parihaka, New Plymouth
Lisa Isherwood	Awhi Farm	Turangi
Ellen Baldwin	Motueka Community Garden	Motueka
Hanui Lawrence	Aunty's Garden	Waipatu Marae, Hastings

oral traditions and storytelling, respect the culture and preferences of Māori" (G. H. Smith, 2003, pp. 6–8).

Kaupapa Māori is change-oriented and focused on social action, where the knowledge bases of both researcher and participants are considered equal and roles are more egalitarian than traditional research relationships (Reilly, 2010). The goal of both participatory and kaupapa Māori research methodologies is to democratize knowledge making and to ground research in real community needs (Chevalier & Buckles, 2013). With Māori communities overrepresented in poverty and food security statistics, this research is highly relevant to community needs. However, it goes beyond a focus on "food security," is a term that was formed in neoliberal discourse, does not take into account how or where food is produced, and lacks an understanding of the cultural, social, and historical significance of food. Research results have implications for policy development given the lack of adequate research on Māori women's perspectives on issues of hunger, malnutrition, and health impacts (obesity and/or diabetes) on their own communities.

Indigenous and Participatory Research Methodologies: Community, Collaboration, and Learning

Participatory research approaches are gaining traction in the social and environmental sciences (Brydon-Miller, Maguire, & McIntyre, 2004; Jason, Keys, Suarez-Balcazar, Taylor, & Davis, 2004; Kindon, Pain, & Kesby, 2007a; Reason & Bradbery, 2006). They are being used in community-based conservation and sustainable development to learn more about co-management practices, natural resource management, and enhance sustainable forestry, agriculture, ecological restoration, and wildlife management (Fortmann, 2008; Wilmsen, Elmendorf, Fisher, Ross, Sarathy, & Wells, 2008). They are also gaining prominence in the community development and health fields (Cornwall & Jewkes, 1995), and are now widely promoted among international development agencies (Reilly, 2010). Participatory research is gaining in popularity among many Indigenous communities and projects, particularly in Canada, due to inherent critical, participatory, and collective principles (Kovach, 2005). Having worked in rural community development with Indigenous organizations in Guatemala and Belize for five years, I recognize that forming authentic relationships is the most important part of any collaborative process. Thus, throughout all stages of the research, the focus was on developing relationships with people involved in *marae* (a sacred Māori gathering place) or community gardens and farms, requiring substantial time and commitment. Data collection began in March 2015. As is typical with case studies, data collection occurred "over a sustained period of time" (Stake, 1995, quoted in Creswell, 2003, p. 15).

In Tobias, Richmond, and Luginaah's (2013) research with Indigenous communities, two researchers relocated and lived in close proximity to the communities during the data collection phase as a means to balance power. Similarly, I chose to relocate with my family to the North Island during the initial phases of the project in order to be in closer proximity to the women and initiatives, which allowed for more flexibility in arranging visits and more frequent interaction than otherwise would have been possible. This facilitated consistent contact and the building of trusting relationships. Participants were contacted and visited multiple times in order to establish trusting relationships before data collection began. Repeated contact with participants strengthens the rapport between the researcher and the participants, enhancing the richness of the data obtained (Tong, Sainsbury, & Craig, 2007). In order to continue contact with the participants during the later stages of the research processes (data analysis and results dissemination), I decided to stay in the North Island through the end of the project. With participatory and Indigenous research approaches, the process is always dynamic and fluid.

Participatory research demands a significant investment in time and energy, as developing trustworthy relationships is particularly important (Davey & Day, 2008; Reilly, 2010). Relationship-building is the foundation of participatory research and, as mentioned above, began at the onset of the research project. My family and I met

the women's families, visited marae, went to community *hui* (gatherings), shared meals, worked in the gardens and on the farm, and attended church with one of the women. I volunteered time through grant-writing for one of the projects, which secured NZ$1,000 toward the costs of running the organization as a result. During the initial stages of development, the women contributed to the direction the research would take through a collaborative process. The women also voiced their interest in research addressing power and control dynamics in the food system, as well as examples of other initiatives that would take a holistic, integrated approach to food poverty. With an emphasis on whānau an integral part of kaupapa Māori, I met and formed connections with some of the women's families; the women also became close with my husband and daughter, who accompanied me on visits. The women also were vocal about being able to meet with one another when we discussed the other projects that were involved in the study. As a result, we made plans to obtain funding for exchanges among and between the women. Funding was difficult to obtain, but sufficient for one exchange. Face-to-face visits were conducted after official data collection in order to get feedback on initial codes and the emergence of potential themes. During the exchange in Parihaka, participants had the chance to provide their feedback on the findings in a collective analysis of themes. Transcripts were returned to all participants to review and for comment. This added validity to the findings by ensuring the participants' perspectives were accurately represented (Popay, Rogers, & Williams, 1998).

Realistically and in practice, participatory research is situation-specific, with collaboration and participation varying both among the research partners and throughout the stages of the research process (Israel, Schulz, Parker, Becker, Allen, & Guzman, 2003). Kindon et al. (2007b) argue that choices about participation are made not just by the researcher, but "negotiated" between researcher and participants (p. 16). The researcher must be cognizant of not pressuring participants when or how much to participate, as participants should ultimately make the decision about how much participation they are comfortable with (Kitchin, 2001). Within the context of this research, the total number of case studies was originally six, but cognizant of the apprehension of two case studies to participate, I did not pressure them, and they ended up not being involved with the study. Researchers must ensure that when they work with people, they understand that, depending on their circumstances and the situation, "various forms of participation may be valid at different times" (Kindon et al., 2007b, p. 16). Participation in this study fluctuated from initiative to initiative and throughout the research stages, a common issue when conducting participatory research. For example, the close proximity between my residence and Turangi, the location of Awhi Farm and within a 45-minute drive, facilitated continual collaboration with one participant, while the greater distance (4.5 hours) to Aunty's Garden meant fewer site visits. Ironically, the most site visits were made to Parihaka Community Garden, which was also 4.5 hours away, but Charissa Waerea was involved the longest, starting with the conceptual stages of the project. Hanui Lawrence, from Aunty's Garden in Hastings, began collaborating on the research during the later stages of data collection, and, coupled with greater distance to the project, her participation was more limited. However, I was able to connect with her at other times away from the garden. Regardless, attempts were made to balance the number of opportunities for in-depth discussion with each woman throughout the research process.

The project had three key areas of investigation: (1) How are Māori women promoting *tino rangatiritanga* of *maara kai* (self-determination with regard to food) within their *whānau* and community?; (2) What are some of the challenges and opportunities they face?; (3) How does community gardening fit within *te ao* Māori (worldview)? Within the sampling frame of the research, I strove to ensure that the initiatives included a diversity of forms (e.g., community gardens, marae gardens, and local farms) and that all included Māori women as coordinators playing a fundamental role in the establishment and ongoing running of the garden and/or farm. Additional criteria for selecting initiatives included being owned by and accessible to a variety of stakeholders.

The study design was inherently flexible, which allowed for a degree of emergent sampling to take place with regard to Hanui Lawrence, Aunty's Garden, and Waipatu Marae, which came on board during the data collection phase of the research after one of the initial cases decided to no longer participate.

In addition, characteristics of community/marae gardens and local farms in the study included:

- Locations on both the North Island (Awhi Farm, Parihaka Community Garden, and Aunty's Garden) and the South Island (Motueka Community);
- Vulnerable groups benefiting from the gardens, including elderly, people with low incomes, youth, etc.; and
- Diverse reasons for establishment (e.g., to promote sustainability, good health and/or nutrition, community food security and/or food self-reliance, for educational purposes, and to teach horticultural and/or permaculture skills).

It has been argued that "the key element of participatory research lies not in methods but in the attitudes of researchers, which in turn determine how, by and for whom research is conceptualized and conducted" (Cornwall & Jewkes, 1995, p. 1667). Consulting participants may also want to know about the methods one is going to use, how long it is going to take, and who will be involved. I visited each of the women at least once before beginning the data collection stage of the research to explain more about the research, my intentions, and what was expected of them. I then conducted in-depth discussions. Two multiple-day visits to Parihaka Community Garden preceded in-depth discussions with Charissa Waerea, while four to five single-day visits to Awhi Farm preceded interviews/discussions with Lisa Isherwood. With Ellen Baldwin (Motueka Community Garden) and Hanui Lawrence (Aunty's Garden, Waipatu Marae), one initial introduction preceded in-depth interviews/discussions. All of the women were also knowledgeable of my experience and background, which facilitated greater levels of comfort for when more in-depth discussions began.

A systematic approach to information gathering, analysis, and reflection was taken (Table 2). The research process was ongoing and cyclical, with steps continuously repeated (Hinchey, 2008). Data was collected through informal discussions and observation. Participant observation included working together with individual women/initiatives by assisting with grant-writing and helping in the gardens. Data was collected in an informal setting, typically at the gardens (Awhi Farm, Motueka Community Garden, and Aunty's Garden), with one (Parihaka Community Garden) at Charissa's office in Parihaka. Nobody else was present during the discussions, except for other gardeners who were out of earshot and involved in their own activities at the time. Questions were used to guide and prompt, but the interview/discussion structure remained very flexible and open. The interviews/discussions were audio recorded, and field notes were also taken during visits and data collection. Interviews/discussions lasted from 2 to 3.5 hours. The study design was flexible enough to enable steady reflection and preliminary analysis. NVivo, qualitative data analysis software, was used to manage data, including the process of coding and identifying themes.

Challenges Throughout the Research Process

Four primary challenges arose: (1) bridging two worlds with differing worldviews; (2) understanding what was necessary in terms of commitment of time and energy, but not having the resources to do it (e.g., getting funding for multiple visits and exchanges); (3) explaining the project repeatedly to those in academia who were unfamiliar with what the project required (e.g., time and commitment) to be able to form trusting relationships with participants; and (4) using methodologies that are often questioned or disapproved of in an academic setting, but staying steadfast and believing in what I was doing. Common criticisms of participatory approaches include that researchers are not trained properly; they do not spend enough time in the field; they develop weak relationships; and their research entails inadequate participation (Ozanne & Sattcioglu, 2008). While participatory research and kaupapa Māori are distinct from each other,

Table 2. Summary of Participatory/Kaupapa Research Process Specific to Project

Research Step	Objectives	Methods	Outputs
Initiating the project	Identify potential Māori focused and/or led *mara kai* (food garden) projects	Internet searches, outreach/establishing contact (emails/phone calls, following leads)	List of potential projects to include in research
Forming relationships	Establish contact with women leading mara kai projects	Face-to-face visits to gauge interest in the project. Initial site visits to introduce myself, meet face to face, and explain intentions and proposed project and research (Parihaka, Motueka, Awhi Farm, with Tahuri Whenua AGM as platform to meet with Hanui)	Agreement to collaborate in research project
Establishing trustworthy relationships	Strengthen relationships	Second or more site visits to discuss project and deepen relationships (Parihaka, Awhi Farm)	Research plan put in place; participant research interests defined
Documenting relevant information	Identify how Māori women define food sovereignty and associated cultural values	In-depth one-on-one interviews	Transcripts and in-depth data focused on research questions
Evaluating the data	Review collected data collected with the women and analyze potential results	One-on-one discussions to validate transcripts and analyze emerging themes	List of potential themes
Collaborate on dissemination of results	Collectively review research findings, identify missing information	Horizontal knowledge exchange for women to share projects, informational workshops by and for women	Summarizing research results
Practical steps forward: Informing policy, future research, and developing relevant projects	Identify potential areas for future research and how findings inform policy	Community hui to share research results and inform future actions	Future action: Informal exchanges to visit the other initiatives

"they both share some common language" (Kovach, 2005, p. 23). Participatory research was initially developed in resistance to traditional research practices, which were often perceived as colonizing (Kemmis & McTaggart, 2000). It represents a "counterhegemonic approach to knowledge production" (Kindon et al., 2007b, p. 9), and recognizes "the ongoing legacies of colonisation, modernistic development interventions, and positivistic research paradigms promoted by university-based researchers" (Kindon et al., 2007b, p. 10). Both participatory and Indigenous methodologies focus on research participants having more control of the research process.

The time-intensive nature of participatory methodologies also involved financial obligations that were a major challenge that had to be overcome. Financial constraints necessitated the decision to move from the South to the North Island in order to be closer to participants to facilitate field visits, maintain consistent contact, and build trusting relationships. Financial constraints also made it difficult to visit the initiatives as much as I would have liked to. Many of my visits were self-funded, while exchanges among the women were limited to one gathering in Parihaka rather than all of the women visiting each of the projects, which would have been preferred. I applied for funding multiple times to facilitate such exchanges, and while a small amount was secured, Charissa (Parihaka) and I had to work together to figure out how we could make it happen on an extremely limited funding.

Relationships make the difference to the

quality of data and transmission of information. When working with Indigenous organizations and communities, researchers may experience a general mistrust and apprehension to collaborate. Being non-Indigenous while working with Māori added another element of contention to the project. This was not a feeling I got from the participants, but rather from those in academia leery of work involving Indigenous communities given both a history of power differentials and a general lack of trust among IP toward research that may not serve their best interests. Though I see myself as an ally—working with, for, and among IP—I realize that others may not see me in that light and that my intentions were likely to be questioned, which underlies the importance of continually defining one's motivations and intentions both internally and externally.

Working with IP requires the researcher to reflect on power differences between him- or herself and the communities and/or people he or she is working with. Throughout the research, some of the women I was working with, as well as other researchers and academics, thought that I, being American, seemed to be more accepted among the women and communities than New Zealand *pākehā* (non-Indigenous people) might have been, as they are often seen as connected to colonization through their ancestry. There was some initial distrust given that the women and I were from different races and cultural backgrounds, but as women, we had some commonalities. However, I will never understand how it feels to be a minority and experience racism. It did seem that my experience working with Indigenous communities in Central America helped me to gain respect and earn the trust of some of the women, which contributed to my being viewed as an ally rather than a threat.

Being an ally to Indigenous communities entails working alongside IP to further their cause, protect their rights, and fight for environmental sustainability, *Papatūānuku* (Mother Earth), and future generations. This was especially the case in Parihaka, where I spent the most time (even though it was a 4.5 hour drive away). This was attributable to the fact that I began visiting Parihaka during the initial stages of the project. During these multiple day visits, I had the most community interaction, facilitated by monthly *hui* (gatherings) at which I was able to introduce myself and share some of my past experiences. The Parihaka *pā* (community) is highly organized and historically represents a seat of nonviolent resistance to colonization. From the first time I visited, I was welcomed with open arms and felt like whānau—an ally rather than an outsider through being genuine and honest.

The women I worked with directly perceived me as an ally in furthering their cause, focused on respect for Papatūānuku (Mother Earth), concern for future generations, and promoting sustainable food systems. Though there were imbalances between us related to my being in academia, these were overcome by relating to the women on their terms, person to person, and without talking down or in an overly academic and theoretical manner. Visiting the women with my husband and daughter —whom the women knew from infancy—also helped. With family highly valued and appreciated in Māori culture, this broke down many barriers that I may have otherwise experienced. Additionally, my husband and daughter are of Pacific Island descent; their also being a minority in New Zealand helped to strengthen relationships among the women and communities.

In addition, important ethical considerations and cultural concepts that guided the research process included seven Māori cultural values, as defined by Cram (2009) and L. T. Smith (1999):

(1) *Aroha ki te tangata:* Respect for those involved in the research process and allowing for the people involved to define where and when to meet;
(2) *He kanohi kitea:* Being a known and familiar face while facilitating trust and communication;
(3) *Titiro, whakarongo…korero:* Researchers should look, listen, and then speak, taking the time to establish relationships;
(4) *Manaaki ki te tangata:* Looking after people and ensuring genuine hospitality;
(5) *Kia tupato:* Researchers should be careful, cautious, culturally appropriate, and reflective;

(6) *Kaua e takahia te mana o te tangata:* Collaborate with people and ensure their *mana* (dignity) is respected, recognizing that they are the experts over their own lives; and
(7) *Kia mahaki:* Be humble when sharing knowledge and understanding.

This research was approved by the Ngāi Tahu Research Consultation Committee as well as the University of Otago Human Ethics Committee. Participants agreed to participate and be identified in publications.

Insights from Māori Women: Key Research Findings

The results of the research generated a rich understanding of what food sovereignty means to Māori women, exemplifying ideas and practices that ensure cultural sustainability and continuance with regard to knowledge surrounding the importance of food production and *māra kai* (food gardens). The seven themes that emerged are detailed in Table 3.

Results for Social Change Through Exchange: The End is Just the Beginning

Given the unequal power relations that have traditionally characterized research with IP, researchers should attempt to be as participatory and collaborative as possible. This is in direct contrast to the relative control that researchers normally have over the research process and places the researcher in a much more passive role. Sharing decision-making throughout the research process is key to undertaking participatory research with IP (Fröding, Elander, & Eriksson, 2013; Israel et al., 2003). For me in this study, this included decisions on what areas the research would explore, with some women expressing interest in power and control dynamics in the food system as well as in learning more about other projects that are taking a holistic approach to food security issues. This more participatory approach also entailed continual contact with the women throughout all stages of the research process, rather than only during the data collection stage, as is usually the case with traditional research methods. Feedback was sought regarding the transcripts, during the initial formulation of the themes, and collectively agreeing on final themes. These methods "are seen less as means to an end than as offering ends in themselves: the emphasis is not on outcomes, but on processes" (Cornwall & Jewkes, 1995, p. 1670).

While participatory research is useful for overcoming traditional power imbalances in research, incorporating culture-specific Indigenous research methodologies (in this case, kaupapa Māori) enhances the validity, reliability, and ethical soundness of the project. Indigenous methodologies integrate cultural values and protocols into the research process, and are "declared openly as part of the research design, to be discussed as part of the final results of the study, [and] to be disseminated back to the people in culturally appropriate ways and in a language that can be understood, as part of an ethical and respectful approach" (Smith, Hoskins, & Jones, 2012, p. 16).

Kaupapa Māori provides the "lens through which the analysis was conducted, within a Māori worldview, and Māori women need to be involved, defining and telling their stories while analyzing situations pertinent to them" (Hutchings, 2004, p. 20). As the women illustrated when speaking about their reasons for doing what they are doing, diverse local food-based practices are about more than just growing food. They are about cultural values, such as history, traditions, sustainability, family, and children. These women are asserting their values through the food system, including the importance of community and tribe; traditions and ancestors; family and future generations; health and wellness; care for the Earth through agroecological farming; and self-determination and food self-reliance. For some, such as Charissa from Parihaka Community Garden and Lisa from Awhi Farm, it is also a way to challenge the corporate food system.

As the women express their love for the land and their duty to look after it, this reinforces claims that the land is a fundamental part of Māori existence, identity, and worldview (Durie, 2001). Papatūānuku, the Earth Mother, is where the people are from and where they will return, and thus Māori are tangata whenua, "not people in the land or over the land but people of it" (Jackson, 1993, p. 71). Papatūānuku is the "primal parent—

Table 3. Key Research Findings and Themes

1. Community, *Iwi* (Tribe), and *Hapū* (Subtribe)	"It's all about people, community….It's open to anyone who wants to come. It's a community garden, It's not a commercial garden. It's for families." —Hanui
	"The most important resource we have is each other." —Charissa
	"We have to be strong and work together." —Lisa
2. Traditions and *Tīpuna* (Ancestors) • *Tikanga* (Cultural protocol) • *Rongoā* (Traditional Medicine)	"We grew up growing gardens…We grew crops for Watties canneries, Watties Heinz now. We grew peas and tomatoes, plus we grew all sorts of veggies for the gates sales. We had a little shop at the gate." —Hanui
	"Part of my vision, living in Parihaka with successive children that are going to inherit what we leave them, is actually reliving or trying to reintroduce the old way of gardening that they [ancestors/previous inhabitants of Parihaka] had here that sustained big numbers." —Charissa
	"Wild food and rongoā (traditional medicine) that we have—it's all interlinked, isn't it? Actually we just had a wild food harvest yesterday, going around, getting the plantain, the chickweed; there's actually plenty of food, people have just stepped away from it." —Lisa
	"I was very little, but I can still remember how they [Ellen's parents] stored potatoes. They had to have a dark space for potatoes and stuff. They used to cover them with fern. I don't know much about the pits. I can't ever remember my parents using pits. They had a store room, an out place, an outhouse sort of thing. It would be all closed up. There would be no windows, just a door to go in, a sort of a bin type thing and all the crops used to go in there when storing them. Mom used to cut the fern, probably just for aeration, and the darkness, of course, to keep them stored." —Ellen
3. *Whānau* (Family) and *Ngā Whakatūpuranga* (Future Generations)	"The pathways are for children. I love to see them running around the place." —Hanui
	"The children are the drive. We're supporting the drivers of change. It's all about the kids." —Lisa
	"My mom and dad were keen gardeners." —Ellen
4. Gardens, Wellness, and Connecting to the Land • Kaupapa Māori	"So for me, it's more about the total ecological system, not just gardening. But it's also, our connection to the earth by putting your hands in the soil you're reconnecting with our creators. Most activities we do these days there are often synthetic materials or business that prevents the contact we need to actually be having on a regular basis. So there's a lot of healing in that connection." —Charissa
	"Oh, it's so good for you. It's the action, the fresh air, the layers of soil. It's all about the observation and the interaction between where you are—being present where you are, you know?" —Lisa
	"If I didn't like gardening like I do, you wouldn't see me here for dust. It's because I like doing this. It's because I like doing what I do and I can see what comes out of what I do, and it makes me happy. It's good therapy for me to be down here working." —Ellen
5. Agroecological and Natural Farming Techniques • *Kakano* (Seed)	"It's all natural. I haven't given them [the plants] any [fertilizer] although we have a bit of a warm farm. And then some seaweed stuff that we put on occasionally, but this compost is very good." —Hanui
	"So we're just looking at redeveloping a quarter acre [.1 hectare] for root crops. We're going to plow it, and we're going to put a winter crop in, a nitrogen fixing crop over this winter, and then we're planting corn and pumpkin, which are low maintenance crops for the first year, this coming summer." —Charissa
	"There's a garden there [Ellen points to a plot near to where we're talking], and I'm seriously thinking about turning that into a seed garden and just put two plants from each thing that I think would be good to go to seed and have that as a garden just for seed." —Ellen
6. *Ngā tā ke* (Issues), *Ngā piki me ngā heke* (Ups and Downs/ Obstacles), *Putanga mahi o te maara* (Outcomes)	"I'm afraid that when I stop running this, there will be no one else to do it, to carry on with it, at this moment in time. I mean, I'm 70." —Hanui
	"There's a culture that still exists within us that we think its kind to feed the children sugar." —Charissa
	"I do know that dependency on industrial food is the main problem. Every town has fast food dominance, and it feels like it's cheaper, but it's actually everything but healthy." —Lisa
	"At the time when you're doing the garden they [community and family members] don't want to participate in growing the garden, but I just keep growing things, being a help, getting the guys to help me." —Ellen
7. *Tino Rangatiratanga of Māra Kai* (Food Sovereignty)	"I would define it as good food for the soul, that how I would say it, not like sovereignty." —Hanui
	"My children have now learned, and to me, that's *tino rangatiratanga* [self-determination], it's providing the knowledge that they need to understand what is tika [right] and what isn't, so they can make informed decisions, whether they take those decisions is another things, but you've provided that information, and that to me, is what's most important, the provision of knowledge around what it is you put in your mouth." —Charissa
	"Food sovereignty would be forest gardens, learning, and awareness of what's to come for generations ahead, which is climate change and a different way of sharing, of economics, because it's going to be more sacred than what it is now." —Lisa

the first human was formed from the soil that cloaked Papatūānuku—all life depends on her for its well-being" (Harmsworth & Roskruge, 2014, p. 123). As in research by Moeke-Pickering et al., participants thought it was important to protect knowledge for future generations, "grow their own *kai* [food] at their homes, on their Māori land trusts, at their marae, and to grow kai for their *mokopuna* [grandchildren] and *kaumātua* [elders]" (2015, p. 38; italic added). With regard to land tenure among these rural agricultural projects, three of the four are located on Māori tribal land (Auntie's Garden and Parihaka Community Garden are on or near to marae, and Awhi Farm is on Tuwharetoa tribal land). The other, Motueka Community Gardens, is located on town council land with a mutual agreement for a community garden. Three of the initiatives are considered semirural, located near or outside of small towns, and one, Parihaka, is rural.

It is important to note that while there are differences in circumstance regarding Indigenous Peoples throughout the world, there are also many similarities, including a common history of colonization resulting in loss of culture, land, and voice; health disparities, including socioeconomic positions and patterns of disease such as obesity, cancer, diabetes, and mental health issues; and, most importantly, worldviews, including a tradition of respect, identity, and connection with their environment (Durie, 2004). According to Rangitāne o Wairarapa Inc., people choose to "[care] for Papatūānuku to maintain their own health or [abandon] her to concentrate on their own short-term personal needs; ultimately an unhealthy Papatūānuku will lead to unhealthy people" (2006, p. 6). For IP, their culture, food, and environment are intricately related (Panelli & Tipa, 2009). Their traditional farming systems are not dependent on chemical inputs and not only yield more food energy per unit of energy used in production, but also rely on renewable energy sources (human labor, animals for hauling and plowing, and manure). This is in contrast to capital-intensive industrial agriculture, which depends heavily on climate-disrupting fossil fuels (Altieri, Funes-Monzote, & Petersen, 2012).

As food self-reliance or food sovereignty entails democratic control over food systems, participatory and Indigenous research methodologies entail active collaboration, which contributes to creating a "healthier and more sustainable environment" (Fröding et al., 2013, p. 32). Not only has there been a desire to improve practice through research, but also to "lead research through practice" (Haseman, 2006, p. 100), in this case by bringing into focus the incredible contributions that these women are making toward reforming our food system through the promotion of sustainable food production based on their personal and cultural values. Gardeners and farmers are more likely to listen and learn from their peers, especially if they are able to visit the farms and/or gardens and see them "with their own eyes," (Rosset, Sosa, Jaime, & Lozano, 2011, p. 169). Kaupapa Māori is a participatory methodology based on a person's own culture, environment, and history; it "[takes] advantage of the rich pool of family and agricultural knowledge which is linked to their specific historical conditions and identities" (Rosset et al., 2011, p. 169). As demonstrated by the Māori women involved in the study, it fits well with the idea of exchanges. The Campesino-a-Campesino (Farmer-to-Farmer) methodology of horizontal knowledge exchange and learning began in Central America (Rosset et al., 2011). The premise is that farmers and gardeners have solutions to problems they commonly face, often "rediscovered older traditional solutions" (Rosset et al., 2011, p. 169). The farmer-to-farmer method of exchange, while not as popular as in Central America, is also practiced in the Global North, including Europe (Schneider, Fry, Ledermann, & Rist, 2009) and the U.S. (Hassanein & Kloppenburg, 1995). We see a form of this exchange practiced in New Zealand with Tāhuri Whenua, a national Māori vegetable growers collective, representing Māori interests in the horticulture sector.

The Māori Women Food Growers Exchange occurred in Parihaka during a time the village usually gathers for their monthly hui (meeting) and was due all of the women's desire to connect with one another. Having traveled with my family to meet the women several times over the course of three years during this study, they all had heard of each other and wanted to connect in some way.

While funding was originally sought for four exchanges so the women would be able to visit each initiative, ultimately we could only secure funding for one exchange. Given that I had the longest-standing relationship with Charissa in Parihaka and that the village gathers on a monthly basis, we decided to hold the exchange there (Figures 1–3). Hanui, who is also a member of Tāhuri Whenu, brought 200 *tīpu* (kumara seedlings) that the collective had donated to the exchange. Together, we prepared the land and planted the tīpu, with the help of other members of the community, including the village leader. During our time in the māra kai, we were only allowed to speak the Māori language in order to strengthen cultural awareness and identity, and again stay true to the tenants of kaupapa Māori, which emphasize the use of the Māori language and cultural revitalization. Given that the exchange was during a monthly hui usually held to commemorate Te Whiti and Tohu, Māori peace activists who practiced food cultivation as a way to claim land back from European settlers, this planting was especially significant. We also shared seed from each other's gardens, presentations, and photos from each of the women's projects, common problems and solutions encountered in the gardens, stories, and experiences. The village hui was for three days, during which we stayed collectively at the marae. Visitors from all over the country were there, including a school group with whom the women were also able to share their stories and experiences. The women also expressed the desire to continue the exchanges informally, without funding, by driving themselves to visit the other initiatives involved with the study.

Figure 1. Hanui teaching about growing *kumara tīpu* (kumara seedlings) during the exchange in Parihaka.

Figure 2. The garden as a classroom: Kumara workshop conducted as part of the Parihaka exchange.

Policy Implications

Actions to combat food poverty need to occur at the grassroots level and also entail a certain level of top-down policy change. A two-pronged approach, with both bottom-up and top-down change, is needed. According to De Schutter, the former United Nations Special Rapporteur, participation

Figure 3. From left: Lisa Isherwood, Karyn Stein, Arohanui (Hanui) Lawrence, Ellen Baldwin, and Lisa's daughter Mary-Blossum in front of Te Whiti's statue in Parihaka.

by the people affected by food poverty, including women, IP, and other vulnerable groups, is "key to the success of such a strategy… This ensur[es] that real needs are identified and effectively responded to. Participation further increases the awareness around the right to food and thus empowers people…" (2010, p. 7).

Policy changes are needed both at the top and to be integrated into community-level solutions (Bidwell, 2009). According to Pimbert, policies that allow for more democratic participation in the context of local food systems, agriculture, and the economy are essential (2009). Funding needs to be increased for agricultural research and food sciences that encompass participatory approaches, to "broaden citizen and non-specialist involvement in framing policies, setting research agendas and validating knowledge, as part of a process to democratize science, technology and policy making for food, farming, environment and development" (Pimbert, 2009, p. 11). In addition, what is needed is support for local food policy councils, rural/urban linkages, local and/or regional procurement, and the elimination monopoly control of food and agricultural systems through anti-trust laws (International Assessment of Agricultural Knowledge, Science and Technology for Development [IAASTD], 2009).

Policies should support women in agriculture, particularly those practicing sustainable agroecological practices. Such agricultural policies should entail promoting access to productive resources, including land; support for exchanges and educational opportunities; infrastructure development for small farms and enterprises; and ensuring support for new farmers and those shifting to organic production. "Small-scale farmers—and women in particular—also need secure access to productive resources (e.g., land, water, and seeds), information, credit, and marketing infrastructure, as well as fair trade arrangements and supportive market conditions" (Ishii-Eiteman, 2009, p. 693). Public policies should facilitate farmer-to-consumer sales, for instance by providing infrastructure for farmers markets and also ensuring that third-party certification is affordable and more widely available (Ishii-Eiteman, 2009).

Conclusion

Cameron and Hicks emphasize the importance of researchers "being cognisant of the worlds that our research is helping to make more real" (2014, p. 68). Poverty and food insecurity are current issues being felt strongly in Māori communities, including malnutrition of essential nutrients due to the inadequate intake of fruits and vegetables, the increasing availability of cheap processed foods, and issues of obesity. Seyfang and Smith (2007) bring attention to grassroots projects, such as community gardening and farmers markets, that are often overlooked but offer "grassroots action for sustainability development" (p. 585). As academics, our roles are changing and being influenced by what is happening on the ground; as Gibson-Graham and Roelvink (2010) state, "we are being called to read the potentially positive futures barely visible in the present order of things, and to imagine how to strengthen and move them along" (p. 342).

The research results make the case for solutions to food poverty, especially when addressing food security in Indigenous communities, and take into account environmentally sustainable and socially just Māori cultural values. These solutions are also multifaceted, promoting agroecology and sustainable organic food production methods, especially in consideration of the environmental impacts of industrial agriculture. Given that conventional agriculture and the industrial food system are at the source of many problems Indigenous communities face, including obesity and readily available processed food, the women of this study all recognized the need for alternative solutions outside of the conventional food system and different from current top-down, compartmentalized approaches.

Within a context where Western values are embedded in and dictate the research process, traditional academic research methodologies remain rooted in power structures and colonialism (L. T. Smith, 1999). In line with participatory approaches, we need to "reinterpret what is meant by 'an original contribution to knowledge'" (Haseman, 2006, p. 100); in the context of this research, the focus was on improving practice through gaining an "insider's understandings of action in context…

rather than contribut[ing] to the intellectual or conceptual architecture of a discipline" (Haseman, 2006, p. 100). According to L. T. Smith, the process (consisting of both methodology and methods) is very important: it must be respectful, transformative, and contribute toward self-determination (1999). Climate change and resource depletion underpin the urgent need to question the dominant agri-industrial model and devise suitable alternatives to enhance resiliency and food security through crop diversification and local control of food systems. This study highlights the need to learn from the positive examples and experiences of Māori women leading local food initiatives. Research is about learning, reflecting, and challenging our worldviews. We need to make space for Indigenous values and world views in Western science, academic research, and society at large. As G. H. Smith, Hoskins, and Jones (2012) note, we need to "continue to make appropriate space for the validity of [Māori] ideas and ways of being" (p. 19).

In this case, the intention was to promote participation, critical thought, and creativity by utilizing a combination of methodologies to work with IP in a research context. Battiste, Bell, and Findlay's (2002) research with Aboriginal communities in Australia found that ownership over their own knowledge is essential and an important ethical principle. Bishop, Berryman, Powell, and Teddy (2005) also contend that Aboriginal communities have much concern over the control of research and who ultimately benefits. Kaupapa Māori reinforces the fact that the communities and people involved in the research should ultimately benefit from it. A key tenet of both participatory research and kaupapa Māori is that the research is useful and of positive benefit for communities (Israel et al., 2003). In both, researchers and participants collectively and critically examine an issue and build alliances throughout the research process, including the planning, implementation, and dissemination stages (McIntyre, 2008). In this study, this involved reclaiming, relearning, and revaluing the importance of traditional ways of growing "good" food, that is, growing in the natural way that the women's ancestors survived for thousands of years before the use of chemicals and pesticides.

The practical experience of working with the involved women and Indigenous communities has reinforced my theoretical knowledge surrounding participatory research, kaupapa Māori, and social learning exchanges. I can attest to the importance of integrating such methodologies into one's research through the deeply significant and trusting relationships I was able to form and the depth of knowledge and information the women were willing to share with both me and each other. There is no doubt that this was due to the time, energy, and commitment that participatory and kaupapa Māori theory and/or methodologies inherently entail. My deep level of trust of and commitment to such theories and methodologies have been repeatedly confirmed, previously while working with Indigenous communities in Central America and now in Aotearoa (New Zealand). Through the women's positive feedback regarding the Parihaka horizontal knowledge exchange, the importance of kaupapa Māori and participatory approaches was further solidified.

Finally, and most importantly, kaupapa Māori and participatory research methodologies share a common emphasis on transformation. According to G. H. Smith, Hoskins, and Jones (2012), this entails a certain level of action and personal transformative development. Transformation within a kaupapa Māori context is about making a difference in people's lives (G. H. Smith, Hoskins, & Jones, 2012). Since research should be of benefit to those who contributed to it (Reilly, 2010), horizontal information exchanges among the women and initiatives during the research dissemination phase was beneficial in empowering women through meeting community leaders like themselves while also contributing to their ownership of the research and results. In this case, the exchange was the element of transformation in practice. As stated by Schneider et al., social learning approaches have become prominent in the field of sustainable agriculture; their study of "farmer-to-farmer" exchanges in Switzerland indicated "that processes of social learning led to fundamental transformations in patterns…of interactions" (2009, p. 487). Through the exchange, participants were able to enhance their knowledge, skills, leadership potential, and ability to affect change at

an individual and collective level. Lisa expressed her deepfelt gratitude for the opportunity to be part of the exchange and to be inspired by like-minded individuals. Ellen went on to establish some plots in her community garden for her children and grandchildren, who are now taking a more active role in growing their own food. Hanui stated in a weekly newspaper editorial that the women spoke long into the night, relating ideas and experiences while invoking the true spirit of sharing through the kumara planting.

I presented the findings of the research in 2016 at the 11th International Conference of Organic and Sustainable Agriculture in Cuba. As Charissa stated, the sharing of the research results and their voices in Cuba were exciting for all of us, as it represented an international platform for the women's knowledge and Māori cultural values to be shared. Farmers, gardeners, and academics in attendance greatly appreciated the cultural insights and environmental contribution of these women. Cuban food growers have been able to boost their organic food production through the Campesino-a-Campesino (farmer-to-farmer) social process methodology, which they used to build a grassroots agroecology movement (Rosset et al., 2011).

The Māori women involved in this study attest to the positive benefits of community gardens for themselves, their families, and their local communities. By sharing experiences, the women were encouraged and motivated while their common struggles were recognized. The women were able to connect with like-minded individuals, consequently learning from each other, planting the seeds of future collaboration, and relieving felt isolation. The research attests to how Indigenous communities are going back to growing their own food, empowering themselves and others while also improving access to culturally appropriate, healthy food, as well as inspiring reconnection to the land and strengthening food sovereignty (Kamal, Linklater, Thompson, Dipple, & Ithinto Mechisowin Committee, 2015).

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Sustainable Intensification, community, and the Montpellier Panel: A meta-analysis of rhetoric in practice in sub-Saharan Africa

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Abstract

Agriculture-led economic development, an important policy driver in sub-Saharan Africa, requires both agricultural intensification and environmentally sustainable resource management. Sustainable Intensification (SI) provides a mechanism for achieving both. However, SI within an SSA context has yet to be widely examined in the scholarly literature; it has been confined instead to technical briefs and white papers. This meta-analysis, conducted in 2015, examines 58 articles that focus on SI in SSA published between 2001 and 2015 and listed in prominent research databases (EBSCOhost, Agricola, and Google Scholar). This analysis uses the 2013 Montpellier Framework for Sustainable Intensification (Agriculture for Impact, 2013) to examine, critique, and find avenues for improvement in research within this emerging body of literature. Generally, the literature adheres to major concepts within the Montpellier framework, with the exception of community. Despite the prominence of community within the Montepellier framework, incorporation of community processes was often accidental. This analysis also reveals that major components of SI, such as nutrition, food security, and income, are poorly operationalized and make an assessment of SI's impact on socio-economic conditions and nutrition problematic. Based on this meta-analysis, the need for interdisciplinary engagement (a blending of biophysical and social scientists) is clear. Additionally, there is a demonstrable need for the inclusion of measurable concepts of community within SI processes or outcomes.

Keywords

Sustainable Intensification; Sub-Saharan Africa; Agricultural Development; Community; Natural Resource Management

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Introduction

Broadly speaking, agricultural development has been a catchall for any effort to improve the well-being of agrarian people and places. Within a sub-Saharan Africa (SSA) context, agricultural development is focused largely on improving the efficiency of production systems, with a trend emerging to combine community and household well-being into agricultural productivity interventions. To this end, sustainable intensification (SI), a process that combines improvements to agricultural productivity with improved livelihoods and increased resilience to shocks among agrarian households, has been emerging as a popular approach (Food and Agriculture Organization [FAO] of the United Nations, 2014). SI is popular among policy makers and politicians, yet there is a lack of meaningful dialogue about what SI is exactly and, more importantly, its effectiveness as an agricultural development tool (Food Ethics Council, 2012).

This study is a meta-analysis of the relatively small body of literature (58 articles) on SI projects. In this the meta-analysis we look at the extent to which major SI tenets are actually incorporated into SI projects on the ground and thus evaluate the use of SI theory in actual SI practice. This study specifically establishes the level or extent of incorporation of social, ecological, and genetic agricultural processes (three major SI tenets) and inventories the types of outcomes experienced by farmers and communities in SI projects. Given the importance of community in discussing natural resource management and agricultural livelihoods, we also examine how community is included in the scholarly literature on SI.

Background

In her address at the 2015 Association of International Agriculture and Rural Development conference, Terri Raney, chief editor and senior economist of *The State of Food and Agriculture,* a flagship report of the FAO, noted that "family farmers are the largest managers of natural resources" (Raney, 2015). This is particularly true for smallholders in SSA. Yet smallholders face increased pressures from general population growth within SSA, which are exacerbated by the demand for land to grow grain for protein and dairy production for the growing global middle class (FAO, 2014). These pressures often jeopardize the sustainable management of smallholder-controlled natural resources (FAO, 2014).

Historically, agricultural development has been used to attempt to balance yield production with income generation, resource management at the farm level, and food security for smallholders. This approach has generally focused on the technical and ecological aspects of agricultural development (Napier, 2010; Palsson, 1991; Rogers, 1995). However, in the most recent reiteration of development, specifically the 2016 United Nations Sustainable Development Goals, sustainability has emerged not only as a key indicator of success, but also as a unifying principle in development activities. Sustainability has traditionally been couched in natural resource management terms, with an emphasis on ecology and biophysical processes (Hopwood, Mellor, & O'Brien, 2005). The 1987 Brundtland Report published by the World Commission on Environment and Development (WCED) ushered in a new era of sustainability defined in both ecological and social terms, which eventually gave way to the inclusion of socio-economic dimensions of sustainability (Hopwood et al., 2005; WCED, 1987). For the purposes of this analysis, sustainability incorporates elements of sustained economic and social well-being while reducing environmental impact (Agriculture for Impact, 2013).

Today, scholars, donors, and recipients acknowledge the critical importance of this more holistic concept of sustainability to agricultural development, and the role SI can potentially play in successful project implementation. SI is defined as being able to "produc[e] more outputs with more efficient use of all inputs—on a durable basis—while reducing environmental damage and building resilience, natural capital and the flow of environmental services" (Pretty, Toulmin, & Williams, 2011, quoted in Agriculture for Impact, 2013, p. 11). SI is used within development as a means of accomplishing increased agricultural production while respecting the socio-cultural context of rural livelihoods in SSA. In fact, SI has provided a mechanism for incorporating a plethora of development agendas, including building capital (the U.S. Agency for International Development

[USAID]'s 1992 community capitals perspective), improving resilience to climate change and ecological shocks, increasing stakeholder participation, building capacity, doing sustainable development, improving livelihoods, and increasing food security and nutrition (Agriculture for Impact, 2013; Carney, 1998; Luloff, Krannich, Theodori, Trentelman, & Williams, 2004; Marshall, Fenton, Marshall, & Sutton, 2007).

The Community in Sustainable Intensification

Community is often conceptualized as an interactional process among an ecologically bounded group of people where social interactions are necessarily shaped by the natural environment (Bridger & Luloff, 1999; Wilkinson, 1991). The tension between the need to exploit the natural resource base for livelihood gains and maintaining and managing the resource base for future use has been well documented (Bridger & Luloff, 1999). SI, though perhaps not originally designed to mitigate the conflicting goals of improved livelihoods and natural resource maintenance, could serve as a mechanism for accomplishing both while simultaneously empowering smallholders (Agriculture for Impact, 2013). In the SI framework (see Figure 1), the concept of community operates as a guiding mechanism, which differs from other sustainability frameworks in agriculture such as agroecology or conservation agriculture. Community and farmer are located at the center of the framework, around which sustainability measures, inputs, processes, and outcomes operate. Community ideally is incorporated into SI projects as a central guiding element. Priorities and the disciplinary backgrounds of SI practitioners, however, often limit the role of community in driving project design and implementation.

Methods

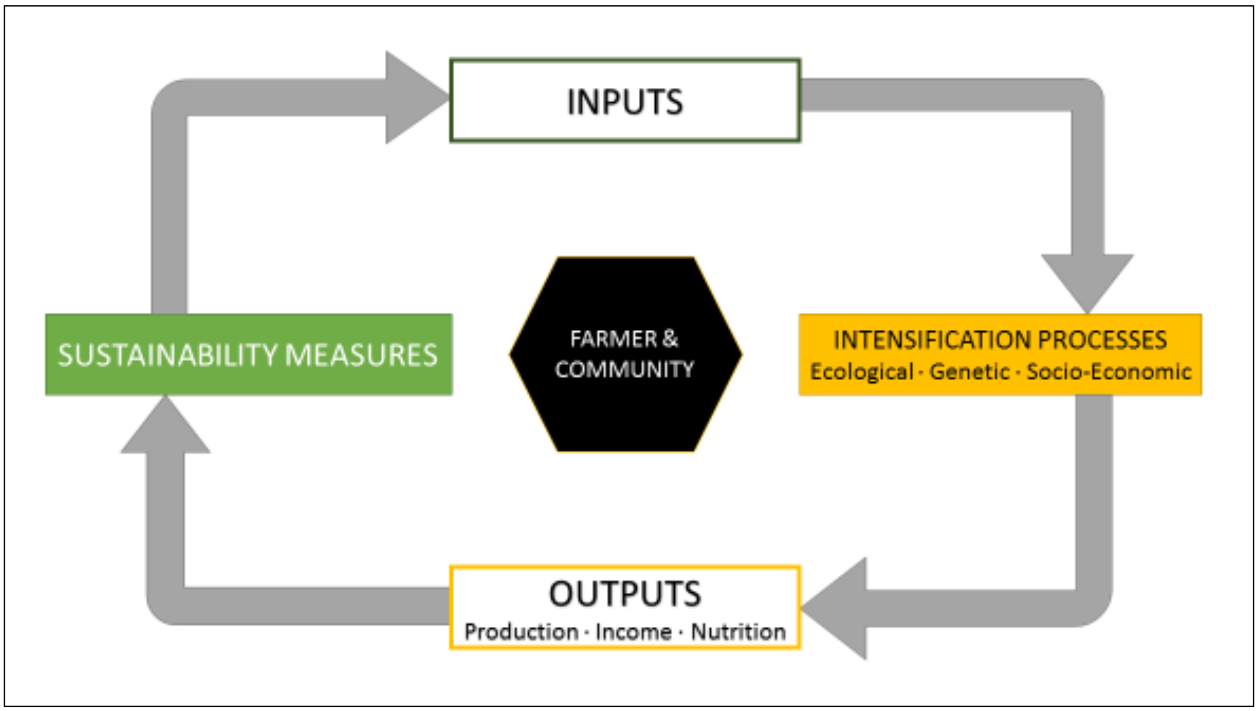
Systematic review and meta-analysis have been increasingly used to synthesize individual case studies in recent environmental and agricultural social science research (Qin & Grigsby, 2016). This study of SI literature employed a meta-analysis of case studies approach, similar to Pagdee, Kim, and Daugherty (2006) and Rudel (2008). This meta-analysis identified the type(s) of intensification processes within each case study, as well as measured outcomes, and compared them to the SI framework proposed in the 2013 Montpellier Panel Report authored by Agriculture for Impact, *Sustainable Intensification: A New Paradigm for African Agriculture* (see Figure 1).

In this SI framework, the Montpellier Panel outlines very concrete aspects of four major domains: sustainable measures, inputs, intensification processes, and outputs. The sustainability measures domain includes, as examples, reduced greenhouse gas emissions and increased natural capital, as well as the efficient and prudent use of inputs. The inputs domain includes both direct (e.g., labor, water, chemicals, biodiversity, land) and indirect (e.g. financial capital, knowledge, infrastructure) inputs. In this model, direct inputs are used to produce the outputs of agriculture, while indirect inputs are used to facilitate or modify the use of direct inputs (Agriculture for Impact, 2013). The intensification process domain, one of the two domains this paper focuses on, includes three process: ecological (e.g., improved soil fertility), genetic (e.g., improved varieties), and socio-economic (e.g., enabling environments; market access). The last domain, also an area of focus for this paper, is outputs and includes production (e.g., increased yield), income, and nutrition (including food security). This study additionally examined the presence of community, a component of the model located at the center with "farmer," within the SI literature (Figure 1).

Selection of Articles

SI is necessarily an interdisciplinary scholarly endeavor. Yet a significant amount of the literature remains in the biophysical disciplines or unpublished in grey literature and technical reports. Because scholarly literature often serves as a benchmark for how accepted a particular framework or paradigm is, this study focused only on scholarly literature. We conducted an initial search of the literature in 2015. Only articles published between 2000 and the current year in EBSCOhost, AGRICOLA, and Google Scholar were considered. Using key words "sustainable intensification" AND "sub-Saharan Africa" resulted in 682 articles.

Figure 1. Montpellier Panel Theoretical Model of Sustainable Intensification



Adapted from Agriculture for Impact, 2013, p. 12.

We narrowed the search results by excluding specific search terms (India, Asia, Reviews, Agricultural Policy, China, Agricultural Economics Policy). The exclusion of these search terms filtered out results from non-SSA geographic regions and those focused primarily on theoretical and policy debates, and resulted in 140 articles. We scanned each of these articles for the use of primary research (i.e., simulated models and theoretical pieces were excluded) as well as the inclusion of at least one of the outcomes outlined in the Montpellier Report: production, income, or nutrition. This final scan narrowed the 140 to 58 articles (see the Appendix for the full list of included studies).

Coding of Selected Cases

As the primary purpose of this meta-analysis was to attempt to determine if scholarly articles on SI projects possessed all the ideal components as published in the Montpellier Panel report, each of the process categories and potential outputs was coded as a binary variable. Articles that discussed aspects of each process (see Agriculture for Impact, 2013) —genetic, ecological, and/or socio-economic— were coded as "1" or, if they did not, they were coded as "0." This generated an initial SPSS file containing six binary variables. For each of the types of processes and outcomes, the Montpellier Panel report allows for several subtypes. In an effort to determine if projects generally fit the Montpellier Panel framework, we conducted a subtype inventory to determine the specific subtype used by researchers either within the design of the study (process of intensification) or within the discussion of outcomes. For example, the Montpellier report allows for several different subtypes of genetic processes, such as improved varieties, breeding, and drought resistance. For each article where genetic processes were used, we made a note to indicate the specific subtype of genetic intensification.

Community was also coded as a binary variable ("1" for presence of community engagement or "0" for no presence in the description of the study). We also included another variable indicating the employment of participatory methods ("1" = yes, "0" = no). It is important to note that a research team may very well have included aspects of community engagement in its study but did not

include it in the description of the research process. Additionally, the disciplinary toolkit available to the research team may have prohibited a systematic inclusion of community in the research design. Though this limits the types of conclusions that can be drawn about the implementation of SI, it may speak to a larger (non)narrative on community engagement in academic research.

We used IBM SPSS Statistics 21 to run chi-squared analysis on the intensification processes and outcomes as well as the presence of community engagement and the use of participatory methods within this set of articles. We ran cross-tabs on individual processes and outcomes together and then included the community and participatory approach variables. We conducted this analysis to explore the linkages between the types of processes used in the intervention and potential outcomes outlined by the Montpellier Panel as well as their connections with the incorporation of community engagement and participatory methods. Because the nature of this study is exploratory rather than explicative, we did not do additional analysis on these relationships.

Results

Descriptive Analysis

Of the 58 articles selected for analysis, 22 included some aspect of genetic intensification, 47 included ecological intensification subtypes, and 50 included elements of socio-economic intensification (Table 1). Only three articles did not discuss production outcomes, 42 discussed increases in income (or other economic issues), and only 22 discussed nutrition (or food security).

Descriptive analysis revealed some general trends, namely, that genetic and ecological intensification, though not mutually exclusive, often did not occur together. There were only 14 articles (24%) where both genetic and ecological intensification were utilized, and less than 40% of projects measured some aspect of nutrition. Additionally, we conducted subtype analysis using simple counts. Subtype inventory revealed that most articles discussed the same aspects of genetic, ecological, and socio-economic intensification and outcome categories used in the Montpellier framework. However, there were three notable exceptions. The first was the deliberate inclusion of community within the socio-economic intensification category. Five studies clearly indicated that a portion of the project was focused on community (community development; community infrastructure; community of practice; collective action; community resilience). Because community was not well defined in many of these studies, and, studies that incorporated the use of social capital development were also included in the community subtype for statistical analysis purposes (Gittell & Videl, 1998). The second exception is the inclusion of school fees as a potential outcome within the "income" category. The third exception was the inclusion of nutrient-specific measures of the nutrition outcome. Generally speaking, this particular outcome was often measured broadly as either improved consumption or improved access to food.

Perhaps just as important as what was included are the things missing from a large number of articles. Many of the articles mention or allude to "improved food security" or "improved nutrition," but fail to conduct a systematic investigation into the actual extent of improvement. In many cases, it is assumed that increases in income will translate to improved food security status or improved household nutrition.

Bivariate Analysis

Chi-squared analysis revealed a number of significant relationships between intensification

Table 1. Frequency of Intensification Processes and Outcomes in Sample

Intensification Processes				Intensification Outcomes				
Genetic	Ecological	Socio-Economic	Genetic + Ecological	Production	Income	Nutrition	Community	Participatory Methods
22 *(37.9%)*	47 *(81.0%)*	50 *(86.2%)*	14 *(24.1%)*	55 *(94.8%)*	42 *(72.4%)*	22 *(37.9%)*	19 *(32.8%)*	26 *(44.8%)*

processes and outcomes, as well as between processes and the use of participatory methods of engagement. Programs or projects that utilized genetic intensification processes were also more likely to utilize participatory methods. In many cases, the implementation of programs or projects focused on genetic intensification, which were often focused on breeding crops or livestock, and thus required researchers to conduct on-farm experiments with farmers. In these cases, researchers utilized local farmers' expertise to determine which varieties, characteristics, or breeding lines were most suitable to the agro-ecological context, which necessitated farmer participation. Perhaps not surprisingly, but nevertheless important, we found that ecological intensification processes were significantly likely to result in production outcomes, while socio-economic intensification processes were likely to result in income outcomes. Somewhat surprising, and perhaps indicative of the funding climate, genetic, ecological, and socioeconomic intensification processes were significantly likely to produce, or at least discuss, nutrition outcomes. Community was not significantly likely to be included in any of the types of intensification process (specific results not included in Table 2) or significantly associated with any of the various types of outcomes, but was significantly associated with projects or research where participatory methods were employed.

Discussion

This meta-analysis was conducted in an effort to determine if scholarly literature based on SI projects reflected the tenets of the SI framework, notably the framework published in the Montpellier Panel report (see Figure 1). This study specifically examined the presence of the three types of intensification (genetic, ecological, and socio-economic), as well as the desired outcomes of an "ideal" SI project: increased production and income, and better nutrition. Each of the proposed projects discussed at least one of the SI processes and at least one SI outcome according to the subtype inventory. In addition, this collection of 58 articles included all of the aspects of the Montpellier SI framework, including community, suggesting that the scholarly literature generally reflects the intent of SI. However, the extent of inclusion, the level of analysis, and the unintentional inclusion of community provides room for a brief critique.

Inclusion (or Not) of Community

The first critique is not a new one in the arena of development or natural resource management.

Table 2. Associations Between Major Variables (*N* = 58)[a]

Intensification Process	Number of Studies Combining "X" Intensification Process and "X" Outcome			Participatory Methods Used
	Production (χ^2 statistic)	Income (χ^2 statistic)	Nutrition (χ^2 statistic)	(χ^2 statistic)
Genetic Intensification	20 *(1.110)*	18 *(1.569)*	**12*** ***(4.156)***	**14*** **(5.070)**
Ecological Intensification	**47***** ***(13.517)***	35 *(0.524)*	**14**** ***(6.981)***	21 (*0.002*)
Socio-Economic Intensification	47 *(0.506)*	**40***** ***(10.443)***	**22*** ***(5.671)***	24 (*1.475*)
Both Genetic + Ecological Intensification	14 *(5.621)*	13 *(3.862)*	6 *(1.446)*	9 (*4.768*)
Community	18 *(0.983)*	15 *(0.604)*	7 *(0.014)*	**16***** **(17.720)**

[a] Given as the numbers of sample studies combing different study characteristics. For example, 20 studies included both "Genetic Intensification" process and "Production" outcome.
* $p<.05$, ** $p<.01$, *** $p<.001$

Concepts of community historically are missing from meaningful analyses of ecological management or development (Flint, Luloff, & Finley, 2008; Glasmeier & Farrigan, 2005). In this study, only five articles specifically included elements of community, either through community development in general or through facilitating collective action or improving community infrastructure (see a list of all 58 papers in this meta-analysis in the Appendix; also see Andersson & Gabrielsson, 2012; Asaah et al., 2011; Peacock & Hastings, 2011; Silici et al., 2011; Wambugu et al., 2011). The remainder of the articles either failed to mention community or else discussed community engagement at a superficial level, such as having farmers plant new varieties for on-farm trials (but not participating in the research process or providing feedback on community or farmers' perceptions of the new variety). Rarely is there a concerted effort to facilitate community change. Rather, many of these projects appear to act upon community as an afterthought. On a macro level, community serves as a theoretical driver for the conceptualization and justification of SI. In this critique, it becomes apparent that the relatively amorphous guiding principle of "community" fails to provide a mechanism for purposefully addressing community within SI projects. Rather than a guiding principle, community development should be an established, well-defined, measurable outcome. The Community Capitals Framework provides a useful starting point for determining the impact of projects on community well-being. This includes assessments of improved capacities in managing natural capital and cultural capital, as well as building or establishing human, social, political, financial, and built capital (Fey, Bregendahl, & Flora, 2006).

Because a community is not just a group of individuals but also their social interactions contextualized and bounded by the ecological environment, long-term change in resource management and sustainable agricultural practices requires a shift in how researchers view SI implementation and practice. Sustained use of SI by smallholders will, therefore, require researchers to push beyond the elementary implementation of projects in a community setting and systematically work toward purposeful midlevel integration and eventually to utilize community in the theoretical motivations for developing, implementing, and analyzing SI projects.

Nutrition or Food Security?

The second major critique of this subset of articles is their failure to systematically explore the outcomes of these projects in terms of nutrition. The Montpellier Panel provides maximum latitude in terms of assessing nutrition—from dietary diversity to an increase in consumption to an increase in production of staple food crops. Yet only 22 of the 58 articles attempted to assess improvements in nutrition related to SI processes. In reading the articles more closely, this is likely the product of two problems. The first is a lack of familiarity with standard measures of nutritional assessment on the part of researchers involved in the project. The second is an assumption that increased revenues from crops or livestock, usually male-controlled resources, will necessarily translate to improved household nutrition, making the systematic measurement of nutrition unnecessary. Studies have clearly demonstrated that gains in income do not necessarily translate to improved household nutritional status if men control these resources, though it may lead to improvements in living conditions, materials goods, and education (Blaney, Beaudry, & Latham, 2009; Quisumbing, 2003).

The first problem is easily remedied by some minor adjustments to the framework. Nutrition has been systematically studied in Africa for decades, and several models exist for measuring those aspects of nutrition outlined in the model, with dietary diversity and energy intake being the most common (see Carletto, Zezza, & Banerjee, 2013; DeHaen, Klasen, & Qaim, 2011; Dowler & Seo, 1985; and Masset, 2011). However, given that many of these measurements are not readily accessible conceptually to those outside of the nutrition and health sciences disciplines, there are other universal measures of nutritional status. One example is body mass index (BMI), a relatively simple calculation that uses the subject's height and weight and for which there are regional standards developed by the World Health Organization (2013). Incorporating additional project personnel who are familiar with nutritional assessment could solve both

barriers to proper nutritional assessment.

The juxtaposition of nutrition and food security in this particular literature, as well as agricultural development literature generally, in addition to the current funding climate, suggests that the Montpellier Panel might consider replacing nutrition with food security or add food security as an additional outcome. Initiatives such as Feed the Future recently have placed emphasis on food security, which, as a precursor to proper nutrition and the first battle to be fought in the war against malnutrition, has been given top priority. Most of the 22 articles (Table 1), with the exception of six, discussed nutrition in terms of food security. Yet again there was a general failure to assess food insecurity in a systematic manner. A well-established tool, the Household Food Insecurity Access Scale (HFIAS) v.3, is a nine-question survey tool used to measure perceptions of food insecurity, such as reduced quality or quantities of food and fear of going without food for periods of time. This tool is used almost universally by U.S. federal agencies working abroad and has been validated in cross-cultural contexts (Coates, Swindale, & Bilinsky, 2007). Using this food insecurity assessment would provide a mechanism for establishing baseline data as well as evaluating the success of various SI projects' impacts on household food security.

Social Science Imposter

This meta-analysis has revealed perhaps a deeper issue, which has contributed overwhelmingly to the previous two critiques. Though many of the teams writing these articles are interdisciplinary, there are few social scientists involved in the projects' design or implementation. Rather, scholars in disciplines far outside the social sciences seek to explain these phenomena in an act of disciplinary imperialism (Olsson, Jerneck, Thoren, Persson, & O'Byrne, 2015). The lack of understanding of the social sciences has resulted in problematic interpretations of outcomes associated with both nutrition and, to some extent, income.

Conclusion

SI's versatility has placed it at the forefront of agricultural development, particularly within the sub-Saharan African context, yet it has remained mostly outside the purview of academic dialogue. SI shows great potential for integrated ecological management while simultaneously embracing the social norms that exist within the socio-ecological system. Fulfillment of this potential through purposeful integration of community stakeholders and operationalization of community concepts in project design will increase SI's ability to promote community resilience and smallholder empowerment. Through increased intentional stakeholder involvement via strengthened community development components of the framework, SI can help promote local ideals within the food system and mitigate outside and "expert" influences on smallholder livelihoods and production practices.

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Review of health impact assessments informing agriculture, food, and nutrition policies, programs, and projects in the United States

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Abstract

Policies, programs, and projects related to agriculture, food, and nutrition can significantly affect public health. Health impact assessment (HIA) is one tool that can be used to improve awareness of the health effects of decisions outside the health sector, and increasing the use of HIA for agriculture, food, and nutrition decisions presents an opportunity to improve public health. This study identifies and reviews all HIAs completed in the United States on agriculture, food, and nutrition topics. Studies were identified from HIA

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databases, an Internet search, and expert consultation. Key characteristics were extracted from each study: type of decision assessed, location, level of jurisdiction, lead organization, methods of analysis, and recommendations. Twenty-five eligible HIAs that were conducted between 2007 and 2016 address topics such as regulations on land use for agriculture; food and beverage taxes; and developing grocery stores in food deserts. These HIAs have predominantly supported policy, as opposed to program or project, decisions. Four case studies are presented to illustrate in detail the HIA process and the mechanisms through which HIA findings affected policy decisions. Among other influences, these four HIAs affected the language of legislation and provided guidance for federal regulations. These examples demonstrate several findings: appropriate timing is critical for findings to have an influence; diverse stakeholder involvement generates support for recommendations; and the clear communication of feasible recommendations is highly important. There is substantial scope to increase the use of HIA in the agriculture, food, and nutrition sectors. Challenges include the paucity of monitoring and evaluation of HIAs' effects on health outcomes, and the limited funding available to conduct HIAs. Opportunities include integrating HIAs and community food assessments, and more widely sharing HIA findings to inform related decisions in different jurisdictions and to increase support for additional HIAs that address the food system.

Keywords
Health Impact Assessment; Policy; Food; Nutrition; Agriculture

Introduction

Agricultural activities, food systems, and nutrition impact human health through a range of important pathways, including short- and long-term consequences of changing the natural environment (Horrigan, Lawrence, & Walker, 2002); occupational risks and benefits (Mayhew & Quinlan, 2002); and dietary intake, which alone is one of the strongest individual determinants of health (Institute for Health Metrics and Evaluation, 2013). The impacts of agriculture, food systems, and nutrition on health are both positive and negative, and direct and indirect. Specific health risks from agriculture include antibiotic-resistant infections deriving from animal agriculture, respiratory conditions from air exposures to farm emissions, and the occupational risks of agricultural work, which include exposure to carcinogens and other physical dangers (Institute of Medicine & National Research Council, 2015; Neff, Merrigan, & Wallinga, 2015).

Additionally, food systems structure community-level food environments, which can significantly influence individual dietary decisions (Caspi, Sorensen, Subramanian, & Kawachi, 2012; Wang, Kim, Gonzalez, MacLeod, & Winkleby, 2007; Zenk, Mentz, Schulz, Johnson-Lawrence, & Gaines, 2016). Changes affecting the availability, accessibility, price, marketing, and retailing of food shape opportunities and incentives for purchasing and consuming nutritious foods (Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008), and nutrition is influenced by both physical and social settings (Saelens, et al., 2012). These factors result in poor diet being the leading risk factor contributing to poor health outcomes in the U.S. (Institute for Health Metrics and Evaluation, 2013). In contrast, agriculture and food systems policies can benefit health by promoting and enabling good nutrition, enhancing community development, and protecting the safety of workers, communities, and consumers (Institute of Medicine & National Research Council, 2015; Neff et al., 2015).

Despite the many connections described above and the significant role of food systems in shaping health outcomes, potential health impacts are rarely explicitly considered when designing policies, programs, and projects related to agriculture, food, and nutrition (Caraher & Coveney, 2004; Lang, Barling, & Caraher, 2009). Examining the health impact of food system policy and project decisions can also generate opportunities to leverage the health sector as an ally to advance legislation or project ideas. Making the case that food policies have important health effects can strengthen and expand a coalition by engaging a broader audience, such as the thousands of members of the American Public Health Association (APHA) and departments and boards of health, which exist in almost all

jurisdictions. Physicians in particular are widely viewed as credible spokespeople who may be seen as unbiased and without a financial interest, in contrast to the perceived interests of those most engaged in a given food system decision.

One tool to support greater awareness and consideration of the potential health effects of decisions made outside the health sector is health impact assessment (HIA) (Bhatia et al., 2014; Harris-Roxas & Harris, 2011). HIA is defined as "a systematic process that uses an array of data sources and analytic methods and considers input from stakeholders to determine the potential effects of a proposed policy, program, or project on the health of a population and the distribution of those effects within the population. HIA provides recommendations on monitoring and managing those effects" (National Research Council, 2011, p. 5). Methods of application vary greatly across HIAs, but each follows a set of six prescriptive steps, outlined in the publication *Minimum Elements and Practice Standards for Health Impact Assessment* (Bhatia et al., 2014).

HIA should not be confused with community food assessment (CFA), which may be more familiar to food and nutrition researchers and practitioners. CFA is primarily used as a tool to assess the needs and resources in a local food system so that appropriate responses can be developed. It may include an evaluation of the role of related sectors, such as transportation, in contributing to food security (Palmer, Chen, & Winne, 2014). HIA and CFA are similar in that they may utilize much of the same data, engage many of the same diverse stakeholders and community processes, and can vary in terms of comprehensiveness (Palmer et al., 2014). However, the two are distinct when it comes to purpose, scope, and timing. HIAs use data and stakeholder input to evaluate potential effects of specific proposed interventions, while CFAs primarily use them in a descriptive way, to characterize an area's food system. HIAs are conducted when decisions are pending, to predict future effects, while CFAs assess existing circumstances. HIAs also cover a wide range of sectors and are not limited to agriculture, food, and nutrition. In addition, HIAs can apply to a much broader geographic area than CFAs, which usually focus on a local scale. Possible avenues for increasing linkages between HIA and CFA are included in the discussion.

HIA has been used increasingly over the past 20 years to support decision-making in an array of sectors, including housing, planning, education, and criminal justice, at the federal, regional, state, and local levels, in the U.S. and globally (Cole & Fielding, 2007; Collins & Koplan, 2009). The use of HIA is endorsed by the National Research Council of the National Academies of Science, Engineering, and Medicine (National Research Council, 2011). In circumstances when a proposed policy, program, or project has the potential to affect health, HIA brings a health perspective to inform the design and/or implementation of the proposed initiative. The many significant links between agriculture, food systems, nutrition, and health make these important topics to consider applying HIA to, but there is a general lack of knowledge about HIA among researchers and policy-makers in these fields. The purpose of this article is to introduce HIA to a mainstream audience, provide key resources to conduct an HIA, review the state of HIA in these fields, and, using the four case studies, provide descriptive examples of the nature and scope of HIAs and illustrate the substantial impacts HIA can have on decisions.

Of the approximately 400 total HIAs completed or in progress in the U.S., relatively few have been related to agriculture, food, and/or nutrition (The Pew Charitable Trusts, 2015). This article complements recently published sector-specific reviews of completed HIAs on transportation, housing, planning, criminal justice, and education decisions, all of which follow a similar format of identifying all relevant studies, reviewing key characteristics, and exploring example cases (American Planning Association, 2016; Dannenberg et al., 2014; Gase et al., in press; Hom, Dannenberg, Farquhar, & Thornhill, 2017; National Center for Healthy Housing & National Housing Conference, 2016). Similar reviews of HIAs in additional sectors are in progress.

Methods

We conducted a systematic search and review of all HIAs focused on agriculture, food, and nutrition

completed in the U.S. as of June 2016. We defined these three categories as follows: *agriculture*—pertaining to food production, encompassing plant-based foods, animal products, and seafood; *food access and availability*—concerning access to and availability of food and food distribution, particularly where food can be purchased; and *nutrition*—relating to standards affecting the nutritional content of food and the provision of nutrition information to consumers, including nutrition-based purchasing incentives.

To identify HIAs, we searched two databases of completed HIAs. From the Health Impact Project database (The Pew Charitable Trusts, 2015), we selected all HIAs categorized under the sector "Agriculture, Food, and Drug." We identified additional HIAs by reviewing the full list of HIA titles for possible relevance. From the UCLA HIA Clearinghouse (n.d.) we selected all HIAs matching the search terms "agriculture," "food," or "nutrition." We conducted confirmatory searches using Google, Google Scholar, and Open Grey,[1] using the search terms "health impact assessment" AND ("agriculture" OR "food" OR "nutrition"). Collectively, these searches yielded 146 HIAs for detailed review.

HIAs were included if they (1) were conducted in the U.S., (2) were completed by June 2016, (3) had a report or executive summary available for review, (4) were referred to by the authors as "HIA," and (5) had a primary focus on a policy, program, or project related to agriculture, food, or nutrition. While many HIAs, particularly those focused on redevelopment projects or built-environment policies, assess food access or nutrition as one of the health determinants examined, this review only includes HIAs with a *primary* focus on agriculture, food, or nutrition. HIAs of tobacco, alcohol, and marijuana policies, programs, and projects were excluded because the pathways through which these products impact health are distinct from those connecting agriculture, food, and nutrition to health.

After excluding duplicates and studies not meeting the inclusion criteria, 24 HIAs were eligible for inclusion in this study. This list of eligible studies was reviewed by an external HIA expert, who identified one additional HIA for inclusion, for a final total of 25 HIAs in this review. HIAs were classified as pertaining to agriculture, food access and availability, or nutrition; many fit more than one category but were classified based on the best fit.

One of the study authors (Cowling) reviewed each of the reports included in order to extract the following key information about each HIA: location, year, lead organization, level of decision (federal, state, or local), decision assessed, data sources and/or methods, modes of stakeholder engagement, equity considerations, primary health impacts, and sample recommendations. A second author (Pollack) repeated data abstraction for a random sample of 20% of the reports to ensure the reliability of the information recorded. Selected details of each HIA are provided in the Appendix; the remaining information on each study is provided in the supplemental online file. In the findings, we summarize characteristics across these HIAs, focusing on ways in which the studies adhere to or depart from practice standards and highlighting novel data sources and analyses.

Of the 25 HIAs included in this review, four were selected for additional investigation. These HIAs were chosen because the results influenced decision-makers or were used by advocates, demonstrating the ability of HIA to affect decisions, empower stakeholders, and improve health. These four HIAs are not intended to be representative of all 25 HIAs reviewed, but rather to highlight the potential benefits of applying HIA in diverse circumstances. These studies were purposefully selected to represent a range of jurisdictional levels and topics: one is at the local level, two are at the state level, and one is at the federal level. Two pertain to agriculture, one to food access and availability, and one to nutrition. The authors of all four HIAs provided feedback on their case studies in response to invitations to review and edit the summaries provided.

Results

The included HIAs were published between 2007

[1] http://www.opengrey.eu

and 2016, with all but two published in 2010 or later, reflecting the relative infancy of HIA in these fields and the more recent growth in their use. Of the 25 HIAs, 40% focused on agriculture (*n*=10), 44% on food access and availability (*n*=11), and 16% on nutrition (*n*=4).

In addition to the national scope of the two federal-level HIAs, the geographic areas addressed by these HIAs fall within 14 states: five in California; two each in Florida, Hawaii, New Mexico, Tennessee, and Illinois; and one each in Ohio, North Carolina, Oregon, Wisconsin, Kansas, Virginia, Indiana, and New Jersey. Nonprofit organizations led the majority of these HIAs (*n*=16), with government agencies and academic institutions leading five and four, respectively; in many cases, multiple institutions collaborated. This breakdown by institutional type suggests that most of these HIAs were privately, rather than publicly, funded.

Two HIAs were conducted on decisions being considered at the federal level; seven on decisions at the state level; and 16 on decisions at the local level. Examples of agriculture-related decisions include the development of community gardens, policies promoting local food production, and the establishment of a concentrated animal feeding operation (CAFO). HIAs focused on food access and availability examined legislation restricting the location of food vendors, the development of grocery stores in food deserts, and modifications to a farmers market, among other examples. Nutrition-focused HIAs included mandated menu labeling, a tax on sugar-sweetened beverages (SSBs), and a waiver to exclude SSBs from federal food assistance purchases. The populations potentially affected by these decisions ranged dramatically in size, from a community of a few thousand residents (Mo'omomi Community-Based Subsistence Fishing Area HIA) to the tens of millions of recipients of federal food assistance (Proposed Changes to the Supplemental Nutrition Assistance Program [SNAP] HIA).

There was substantial variability in the scope of health impacts examined, data sources and methods employed, and presentation of results among the included HIAs; this is common for HIAs due to the flexible nature of the methodological guidelines. Most (*n*=18) of these studies examined health impacts linked to changes in food access, food security, or dietary intake, as well as a range of additional impacts, including employment, air quality, and social capital. HIAs typically rely on existing sources of information; all of the included reports cited a literature review of relevant topics and/or analyzed or presented findings from recent survey or census data. Some HIAs used novel data sources and methods, including economic analyses (HB 2800: Oregon Farm to School and School Garden Policy HIA, Potential Health Effects of Changes to the Kansas Corporate Farming Law HIA); reviews of administrative and legal documents (Rock Prairie Dairy HIA); modeling of projected traffic and air flows (The Potential Health Impact of a Poultry Litter-to-Energy Facility in the Shenandoah Valley, Virginia, HIA); and a comparative analysis of matched schools (Street Vendor Legislation and Student Nutrition in South Los Angeles HIA).

The HIA teams conducted stakeholder engagement using a variety of strategies: surveys of residents in affected areas, stakeholder interviews, focus groups, and community meetings. Most (*n*=17) HIAs mentioned using multiple techniques to engage stakeholders and elicit their opinions. A focus on equity—identifying and addressing systemic, avoidable, and unjust differences in factors important to health between population groups (SOPHIA Equity Working Group, 2014)—was included in these HIAs in several ways. Many of the HIAs had a primary focus on low-income or otherwise disadvantaged populations; others conducted analyses, presented results, or formulated recommendations specific to certain subpopulations, as defined by income, age, race, or ethnicity. Only two HIAs (South LA Fast Food HIA and Menu Labeling as a Potential Strategy for Combating the Obesity Epidemic HIA) did not explicitly mention any emphasis on sensitive subpopulations in the analysis or results.

Each HIA offered multiple recommendations, in many cases ranging in scope from broad suggestions—for example, to improve walkability—to very specific actions, such as revisions to policy provisions. Some recommendations were

definitive, while many encouraged additional investigation to reach firmer conclusions or evaluate impacts going forward. Equity-focused recommendations emphasized inclusiveness in decision-making and encouraged measures that protect against negative effects specific to vulnerable populations. While key recommendations targeted decision-makers with jurisdiction over the policy, program, or project in question, other recommendations focused on officials in related departments or agencies with the ability to impact extenuating circumstances. Additional recommendations also addressed a diverse set of stakeholders, including school officials, business owners, and parents.

To illustrate the contents of individual HIAs in greater detail, four descriptive case studies are presented to provide a sense of the HIA process, including circumstances that led to each HIA, how stakeholder opinions were integrated, the development of recommendations, and how findings were used.

Case Studies

Case Study 1: Growing for Kane Food and Farmland Ordinance HIA

Kane County, Illinois, is a productive agricultural region on the outskirts of Chicago, but due to economic and population pressure, much of its farmland is at risk of non-agricultural development. The county has implemented policies since 2001 to reduce farmland loss. In 2013, an amendment to an existing ordinance was introduced that would "offer incentives through the farmland protection program to diversify food crop acres and increase acres dedicated to food production" (Forbes, Hill, Hoff, & VanKerkhoff, 2013, p. 10). The Kane County Health and Development and Community Services departments jointly received funding from the Health Impact Project (a collaboration of the Robert Wood Johnson Foundation and The Pew Charitable Trusts) to conduct an HIA on this decision. The HIA examined possible health effects from changes in dietary consumption (if the available local produce led to increased consumption), and on the local economy, due to increasing local fresh food production.

Kane County is a rich agricultural area, yet faces significant diet-related health challenges, with low per-capita fruit and vegetable consumption and almost two-thirds of adults being overweight or obese. Based on existing literature, resident and farmer surveys, and local stakeholder input, the HIA projected the strongest likely health impacts of the proposed amendment would be reducing rates of chronic diseases and reducing health disparities among vulnerable populations. Less conclusive possible health effects, likely to be of smaller magnitude, included reduced obesity rates, improved social and emotional wellness, and increased life expectancy.

The HIA recommended that instead of amending an existing ordinance, the county should create a new separate ordinance, the Growing for Kane program, to fund temporary or permanent easements on leasing land for food production. The HIA developed additional policy and programmatic recommendations related to increasing production and distribution of healthy local foods. In the reporting phase, the HIA team shared findings and recommendations in formal meetings with representatives from several relevant city agencies.

In August 2013, the Kane County Board unanimously adopted the resolution proposing the Growing for Kane program. The HIA findings, particularly those demonstrating support from various stakeholders, were essential to the passage of the resolution. After the HIA's completion, researchers from Northern Illinois University conducted a formal evaluation of the HIA process and impacts, concluding that they successfully increased awareness of the decision's health implications and finding unanimous belief among interviewees that the HIA was useful (American Planning Association, 2016; Forbes, Hill, Hoff, & VanKerkhoff, 2013).

Case Study 2: HB 2800: Oregon Farm to School and School Garden Policy HIA

In 2011, the Oregon House of Representatives considered House Bill 2800, the Oregon Farm to School and School Garden legislation. The bill proposed two new programs: reimbursements for school meals incorporating Oregon food products, and grants for school gardens and agricultural education. With funding from the Health Impact

Project and the Northwest Health Foundation, a local public health research and advocacy organization, Upstream Public Health, conducted an HIA on this proposed legislation in 2010, to inform the vote in 2011 (Henderson et al., 2011).

Improving the variety and nutritional content of school meals has clear health benefits, but this HIA also sought to illuminate the less obvious potential results of economic changes and to bring a specific focus on low-income children, children of color, and rural communities. Using literature review, analysis of existing data, economic analysis of food procurement, and substantial stakeholder input, the HIA examined health effects from changes in employment, diet and nutrition, school garden education, environmental health, and social capital. Key decisions throughout the HIA process were informed by two advisory committees made up of diverse stakeholders, ranging from technical experts to advocates and representatives of affected population groups. The HIA team also held a communications workshop to train stakeholders in disseminating HIA results.

There were three primary recommendations. First, schools should only be reimbursed for food produced or processed in Oregon (as opposed to packaged or packed in Oregon) to maximize local economic benefits. Second, education program grants should be provided preferentially to schools with large populations of students from low-income households or serving a larger proportion of students of color or living in food deserts. Third, the education grants should be awarded to programs with multiple farm-to-school elements that include local food procurement, nutrition and garden education, local food and nutrition promotion, and community involvement (Henderson et al., 2011).

In early 2011, the HIA authors were invited to testify during a House committee hearing on the bill. The original bill was amended, fully incorporating two of the HIA recommendations and partially incorporating the third recommendation, and the amended bill passed in April 2011 (Henderson et al., 2011).

Case Study 3: Food Tax in New Mexico HIA

New Mexico repealed a statewide tax on grocery-store food in 2004, but by 2014 was considering proposals to reinstate such a tax—either at the state level or by granting cities and counties the option to enact a local food tax. With financial support from the Health Impact Project, the nonprofit organization New Mexico Voices for Children conducted an HIA on this decision, which was expected for a vote as early as the 2016 legislative session.

The HIA used initial interviews with a range of stakeholders, including community groups, community service organizations, and government agencies, and focus group discussions with community members, to identify the health determinants that would be the focus of the study. Three primary effects were selected for detailed analysis: families' economic security and nonfood spending; food spending, food security, and nutrition; and government spending. The HIA concluded that reinstating a tax on food would have an overall negative impact on health, with a minimal likelihood of certain positive health effects from increased government revenue. The study estimated that a food tax would cost the average New Mexico household US$350 per year—a cost that could affect households' ability to afford food or necessary health care or prescription medications. They concluded the tax would harm lower- and middle-income households the most.

In addition to recommending against a food tax, the HIA presented a range of recommendations to reform the state's tax revenue in alternate ways, including increasing tax credits for low-income families and instituting a minimum corporate franchise tax rate (Wallin, Casau, Jimenez, Bradley, & Kayne, 2015). Findings and recommendations were shared widely through a communications strategy that included targeted fact sheets, press coverage, posting key findings on social media, and presentations at hearings and meetings. This HIA provided valuable new information to a debate raised in the New Mexico legislature several times in the last few years and contributed to the defeat, once again, in 2016 of a bill reinstating a food tax (Think New Mexico, n.d.). Despite the 2016 outcome, this debate may not be over in New Mexico, and the HIA will continue to be useful in future years.

Case Study 4: National Nutrition Standards for Snack and a la Carte Foods and Beverages Sold in Schools HIA

The 2010 Healthy Hunger-Free Kids Act directed the U.S. Department of Agriculture (USDA) to align nutrition standards for all foods and beverages sold in schools during the school day with current dietary guidelines. In 2012, the Kids' Safe and Healthful Foods Project and the Health Impact Project worked with Upstream Public Health to conduct an HIA to inform the USDA's update to nutrition standards for foods and beverages sold outside of school meal programs. At the time of the study, the USDA had not yet proposed updated standards, so the HIA assessed a plausible hypothetical set of standards, developed with input from the HIA advisory committee, which would align with the 2010 Dietary Guidelines for Americans.

The key impacts examined were possible health effects via changes in diet and nutrition; school food services; other school revenue; and impacts specific to vulnerable populations. The HIA team conducted interviews with a broad range of stakeholders, including students, school administrators, and industry representatives. They used a difference-in-difference analysis of school districts in several states to understand the effects of previous changes in state legislation that mirrored aspects of the proposed federal regulations. The study concluded that reforming the standards would decrease students' consumption of unhealthy foods and beverages and would not lead to a decline in revenue for schools and districts, and that benefits would accrue disproportionately to vulnerable populations.

Based on these findings, the HIA team developed specific recommendations for the content of USDA standards for foods and beverages sold outside of school meal programs, and recommended policies and practices to ensure the effective implementation of those standards (Kids' Safe and Healthful Foods Project & Health Impact Project, 2012). Findings and recommendations were distributed to various audiences through public presentations, a policy brief, a press release, and postings in newsletters.

When the USDA subsequently developed these standards, they incorporated nearly all the HIA's recommendations (The Pew Charitable Trusts, 2015). New information provided by the HIA regarding possible impacts on food-service revenue for schools and districts was considered particularly useful and "this was the first HIA to inform a federal rule-making process" (The Pew Charitable Trusts, n.d., "Outcome," para. 1). These standards were implemented in 2014–15 and are in effect in all U.S. schools participating in school meal programs; evaluation research suggests these are effective overall, though they work best when incorporated alongside nutrition education or incentive programs (Cullen & Dave, 2017).

Discussion

This review identifies and describes all HIAs conducted on agriculture, food, and nutrition policies, programs, and projects in the United States. Of approximately 400 HIAs completed or in progress across the U.S., less than 10% to date have addressed these topics (The Pew Charitable Trusts, 2015). Across the HIAs reviewed here, key elements of the practice standards were clearly identifiable, and several common traits emerged. First, HIAs were more commonly used for policy rather than program or project decisions: 18 of the 25 HIAs, including all four case studies, involved a policy decision. Second, practitioners used diverse and sometimes creative sources of data to complete their assessments, and employed various means to engage multiple stakeholder groups, such as opinion surveys and community meetings. Third, nearly all the HIAs examined potential impacts through the lens of health equity, whether by applying HIA to a decision with the potential to substantially affect a vulnerable population; by focusing on equity dimensions of the decision in the analysis and recommendations; or by effectively engaging underrepresented stakeholders.

Lessons from Existing HIAs

These HIAs reveal a range of pathways through which agriculture, food, and nutrition decisions can affect health, which go beyond traditional conceptions of these links as being focused primarily on nutrition and food security. The wide variety of impacts highlights the importance of assessing

policies, programs, and projects in detail to elucidate unexpected relationships with health, particularly in regard to vulnerable populations, so that health disparities are not exacerbated. A common challenge of exploring indirect links—between policies outside the health sector and health outcomes—is the paucity of data documenting health impacts through a cascade of events. These pathways may have no or limited evidence, leading to difficult decisions about when to apply imperfect evidence or the level of confidence in its appropriateness to inform the decision at hand. In some cases this evidence may be contested, as in, for example, the impact of carcinogens such as Bisphenol A (BPA) in food packaging and the widespread use of genetically modified organisms in the food supply. These challenges arising in the conduct of HIAs highlight priorities for new research, particularly the need for more socio-ecological research that illuminates indirect linkages between upstream determinants and health outcomes in the fields of agriculture, food, and nutrition.

The case studies, in particular, illustrate how HIA findings and recommendations can inform policy decisions and exemplify several characteristics common to effective HIAs. A recent review of over 200 HIAs identified several factors that influence the likelihood of an HIA having an impact (Dannenberg, 2016); the four cases reviewed here are consistent with the findings of this larger review. First, the timing of the study must be appropriate so that findings and recommendations are released sufficiently in advance of a final decision. If information is provided too late, there will not be adequate time to consider the study's findings during decision-making or the opportunity to modify opinions or plans. An HIA can be conducted with a range of resources, depending on the time and resources available. If limited, a rapid HIA can be conducted in a few weeks, while a comprehensive HIA typically takes several months to two years. Second, stakeholder engagement is critical and best when done throughout the HIA process—from the initial screening to the final monitoring and evaluation—and involving a broad range of actors. Early and ongoing engagement helps to generate buy-in for study recommendations and involving vulnerable populations represents an opportunity to bring new voices to a decision and improve health equity. Third, recommendations should be presented in a clear, feasible, and targeted manner. Working closely with stakeholders helps to ensure that recommendations are realistic and have the potential to be adopted. Lastly, a clear and readable report and a dissemination plan are crucial to communicate and publicize findings. In each of the case studies, the HIA team used tailored dissemination strategies to reach various audiences. Such targeted dissemination may encourage decision-makers to act on an HIA's findings and recommendations and embolden advocates to use the findings to encourage particular decisions.

In terms of the applicability of HIA findings, several of the HIAs reviewed discuss the likelihood that a policy, program, or project under consideration in one location may be simultaneously or subsequently proposed elsewhere. For example, the *Menu Labeling as a Potential Strategy for Combating the Obesity Epidemic HIA* (Simon, et al., 2008) investigated a proposal to mandate menu labeling in California, which was subsequently considered in many other jurisdictions. In such cases, study findings may be useful in multiple locations. Some impacts and conclusions will be specific to particular environments, but often insights from an HIA can be more widely applicable. To facilitate shared learning, relevant HIA findings and recommendations should be disseminated among agriculture, food, and nutrition researchers, policymakers, and practitioners—for example, through publications or conference presentations. Widespread dissemination can increase the impact of each study by promoting health benefits and reducing health risks in different jurisdictions; and can lead to broader awareness of and appreciation for HIA as a decision-support tool, thereby generating interest in applying HIA in new settings.

A unique advantage of performing HIAs on agriculture, food, and nutrition decisions is the potential to link HIAs with CFAs, particularly those CFAs designed to include sectors outside of food and agriculture that contribute to a community's food security (Palmer, Chen, & Winne, 2014). HIA and CFA may be mutually beneficial; the ideal combination may be to conduct these

studies sequentially. If a CFA was previously conducted in an area where an HIA is planned, the CFA may provide substantial useful background information for the assessment, and vice versa. The information gathered for the initial study could reduce the resources required by building on the stakeholder relationships already established and utilizing the data sources previously compiled. In addition, since an HIA is intended to assess the implications of an actively pending decision, any subsequent CFA in the same area could serve as follow-up to the HIA. This would help to address one of the critical gaps in HIA practice—the paucity of monitoring and evaluation after initial studies are completed.

Agencies, organizations, or other groups conducting an HIA for the first time may benefit from partnering with an experienced researcher or agency that can advise on the HIA process. Potential collaborators may be identified through the Society of Practitioners of Health Impact Assessment (SOPHIA), a global network of HIA practitioners.[2] As is evident from the HIAs included in this review, many are collaborative efforts of multiple agencies or institutions.

Future Challenges for HIA

While this review identified cases in which HIA informed and influenced decisions, the ultimate impacts of these HIAs on health outcomes are currently unknown. This is an important limitation of HIAs generally; in most cases, there is no monitoring and evaluation of impacts once an HIA is complete, particularly of impacts on health outcomes (Dannenberg, 2016). The evaluation of the *Oregon Farm to School Policy HIA* (case study 3) provides an example of an assessment of the HIA process, but without an evaluation of effects on health outcomes (Diep, Henderson, & Rader, 2011). This lack of monitoring and evaluation is a common occurrence, despite many HIA reports including an implementation plan to assess such impacts; the *2010 Hawai'i County Agriculture Development Plan HIA* provides a good example of this type of plan. Several factors may contribute to the general absence of monitoring and evaluation: a lack of funding for these activities, the typical delay between a decision and its impact on health outcomes, and the difficulty in attributing impacts specifically to HIA. These challenges must be managed to generate evidence of the ability of HIA to drive improvements in health outcomes and develop greater appreciation among those outside the health sector of the value of investing in and using HIA.

In addition to the need for funding for monitoring and evaluation, there is a need for more institutionalized funding to conduct HIAs. Many of the studies included in this review were funded by the Health Impact Project, which has been a major source of funding for HIAs in the U.S. Relying on voluntary, philanthropic funding is likely not a sustainable model for HIA, however. To become more commonplace, HIA may require committed public funding, at various levels of jurisdiction, or cooperative partnerships with industry, as employed in the oil and gas sector in Alaska (Anderson, Yoder, Fogels, Krieger, & McLaughlin, 2013). Objectivity in the assessment and recommendations, however, may need to be more carefully managed if strong financial incentives exist for an industry partner.

Study Limitations

Several limitations may affect the conclusions of this review. First, one relevant HIA was excluded because no report or executive summary was publicly available. Additional eligible studies may not have been identified in the search process. We attempted to minimize the possibility of missing studies by searching multiple sources and also consulting an external expert. Second, this review focuses on HIAs completed in the U.S. Internationally, there are additional relevant HIAs that could provide valuable lessons and insights for U.S. researchers, policy-makers, and practitioners in these sectors. Third, the many HIAs of built environment projects and other decisions that substantially affect a local food system may also provide important examples to inform the understanding of the role of HIA in the agriculture, food, and nutrition sectors but were not included here.

[2] https://sophia.wildapricot.org/

Relevant HIAs from other countries and sectors should also be examined to inform the practice of HIA on agriculture, food, and nutrition policies, programs, and projects in the U.S. Finally, there was no explicit quality control of the HIAs included, and some HIAs that have been completed do not fully meet established practice standards (Bhatia et al., 2014; Schuchter, Bhatia, Corburn, & Seto, 2014). Our inclusion criteria specified only that the authors referred to the study as an HIA. It is possible that the term may have been misused, although the studies we included appear to adhere generally to these guidelines.

Conclusion

This review summarizes the use of HIA in the U.S. in the agriculture, food, and nutrition sectors, introducing potential applications of HIA to researchers, policy-makers, and practitioners in these fields who are unfamiliar with the tool. The number and type of completed studies suggest that HIA could be more widely used in these sectors. To date, these HIAs have been conducted in many states in several different regions, most often at the local level, and have been predominantly applied to policy decisions. Collectively, these studies suggest there is a need to conduct more socio-ecological research linking distal determinants to health outcomes to inform HIAs in these sectors; identify the potential for HIA findings to be used for similar decisions in different jurisdictions; and highlight the opportunity to link HIA with CFA. Common attributes of influential HIAs confirmed by this study include ensuring timing is appropriate to inform a decision; engaging stakeholders throughout the HIA process; developing clear and feasible recommendations; and producing a strong report that is widely disseminated. Challenges observed in these studies include a lack of monitoring and evaluation of the process and impacts of HIAs, and questions about sustainable sources of funding to conduct future HIAs.

Many other types of policies, programs, and projects in the food and agriculture sectors may benefit substantially from the application of HIA during the decision-making process. Possible examples span the processes of food production, transportation, and retail, including regulations on antibiotic use by livestock producers, tax incentives to encourage local food production and consumption, and advertising restrictions regarding false claims or foods with low nutritional value (Muller & Wallinga, 2014). In addition, research indicates that the health of low-income communities and communities of color is disproportionately negatively affected by determinants in the agriculture, food, and nutrition sectors, including living in food desserts and experiencing obesity and diabetes (Chang & Lauderdale, 2005; Walker, Keane, & Burke, 2010). Therefore, HIA can play an important role in identifying strategies to address health inequities stemming from agriculture, food, and nutrition decisions. Finally, applying HIA provides opportunities to broaden the coalition supporting a policy change or program proposal by giving health advocates both data and a reason to lend support, and may help to inform public opinion by identifying relevant health issues. Expanding the use of HIA in the agriculture, food, and nutrition sectors can help to modify decisions that may harm public health and can contribute to the adoption of health-promoting policies, programs, and projects across these sectors.

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Appendix. Key Characteristics of 25 Health Impact Assessments Focused on Agriculture, Food, and Nutrition in the U.S. and Included in this Meta-analysis (see note for explanation of acronyms)

HIA Title / Location / Year	Lead Organization	Level of Decision	Decision Assessed	Primary Health Determinants and Health Impacts Examined	Equity Considerations	Example Recommendation
I. AGRICULTURE						
Knox County Health Department Community Garden *Knox County, Tennessee 2010*	Knox County Health Department	Local	Decisions related to the placement and maintenance of community gardens	Access to healthy food; physical activity; community collaboration and cohesion	Recommendations highlight need to prioritize low-income communities for community gardens	Site gardens in food deserts
* **HB 2800: Oregon Farm to School and School Garden Policy** *Oregon 2011*	Upstream Public Health	State	Oregon House Bill (HB) 2800: Farm to School and School Garden Policy	Employment; diet and nutrition; farm-to-school and school garden K-12 education opportunities; environmental health; social capital	Considered vulnerable populations specific to each pathway	Amend HB 2800 to specify that schools can only get reimbursed for foods produced or processed in Oregon to increase economic activity in the state
Rock Prairie Dairy *Bradford, Wisconsin 2011*	Rock County Health Department	Local	Proposal to build the Rock Prairie Dairy, a concentrated animal feeding operation (CAFO)	Hazardous gas and particulate emissions; nuisance odors; groundwater quality; surface water quality; economic impact; traffic; noise; visual; insect-borne disease	Assessed impacts on vulnerable populations in terms of income, race, ethnicity, and age	Install vegetative buffers to help decrease aesthetic, noise, odor, and emission effects around the facility and manure application fields
2010 Hawai'i County Agriculture Development Plan *Hawai'i County, Hawaii 2012*	The Kohala Center	Local	Selected provisions of Hawaii County Agricultural Development Plan: local buying by government institutions and NGOs; agriculture for the local market; home, community, and school gardening	Hunger (food security) and diet quality (nutrition security); obesity; food-borne illness; economy; well-being and cultural connectedness	Farm-to-school buying assessed with a focus on vulnerable populations (Native Hawaiian and Pacific Islanders, SNAP eligible)	Facilitate collaboration between businesses, NGOs, and Department of Human Services to increase acceptance of cash vouchers, EBT, and credit cards at farmers markets
Urban Agriculture Overlay District *Cleveland, Ohio 2012*	Place Matters	Local	Establishment of an Urban Agriculture Overlay (UAO) district, which will permit intense urban agriculture uses: chickens, bees, livestock, urban farm, market gardens	Environmental hazards; empowerment; food access	Surveyed low-income and minority residents	Identify transitional neighborhoods with abundant vacant land and a fair housing market where the presence of an UAO district can have positive market impacts for adjacent homeowners

* **Growing for Kane food and farm ordinance** *Kane County, Illinois* *2013*	Kane County Health Department	Local	Amendment to the "Growing for Kane" food and farm ordinance, which would increase the number of farms that produce fruits, vegetables, meats, and dairy for human consumption	Food security; nutrition; employment; physical activity	Examined differences in health status by race and/or ethnicity and income; conducted geographic analysis of concentrated areas of vulnerable families in relation to fresh food availability	The Farm Bureau and Kane County should participate in linking procuring institutions with local growers for pre-season contracts
The Potential Health Impact of a Poultry Litter-to-Energy Facility in the Shenandoah Valley, VA *Shenandoah Valley, Virginia* 2013	Virginia Commonwealth University	Local	Developing a facility to convert poultry litter to energy	Air quality; water quality; economic effects; employment; other community factors	Impacts examined by income, race and/or ethnicity, and age	Ensure that the location of the facility is not only in an area of low population, but also in one with few older adults
Food System Plan to Promote Healthy, Local Food Production and Consumption in Davidson, NC *Davidson, North Carolina* *2014*	Davidson Design for Life	Local	Promoting the development of the local food system, including efforts to increase local production, processing, distribution, consumption, and disposal	Seven dimensions of health: physical, emotional, social, environmental, spiritual, intellectual, economic (occupational)	Quoted USDA nutrition recommendations specific to pregnant women and elderly populations	Plant edible landscaping whenever possible along streetscapes and within parks
Potential Health Effects of Changes to the Kansas Corporate Farming Law *Kansas* *2015*	Kansas Health Institute	State	Amendments to the Kansas Corporate Farming Law, which would allow any agricultural business to operate anywhere in the state	Jobs; property value and taxes; population; waste; antibiotic use	Special attention given to populations likely to be most affected, including people with respiratory conditions	Compensate neighboring property owners for negative externalities associated with livestock operations, such as property depreciation
Mo'omomi Community-Based Subsistence Fishing Area *Moloka'i Island, Hawaii* *2016*	The Kohala Center	Local	Proposed establishment of a CBSFA	Self-determination and control of resources; traditional marine resource management and transmission of ancestral knowledge; access to marine resources for family and community subsistence; commercial fish sales and commercial fisher income	Focus of the HIA is on a low-income area with a majority indigenous population	Support the CBSFA as a place for the study and teaching of traditional Native Hawaiian fishery management practices

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II. FOOD ACCESS AND AVAILABILITY						
Modifications to the Trenton Farmers Market *Trenton, New Jersey* *2007*	UCLA HIA Group	Local	Three possible alternative modifications to the Trenton Farmers Market: minor changes; full implementation of Project for Public Spaces recommendations—major remodeling; market outreach—e.g., satellite markets	Nutrition; physical activity; economics (vendors and surrounding community); social capital; public health services	Assessed impacts on three subpopulations, defined based on geographic proximity to the market and varying sociodemographic characteristics	Set up vendor stalls, especially those selling fresh fruits and vegetables, with EBT machines to take WIC and other government benefit cards
Development of Big Box Grocery in West Oakland *Oakland, California* *2011*	Alameda County Public Health Department	Local	Plan to develop a large ("big-box") Foods Company grocery store in a West Oakland neighborhood with no full-service grocery store	Access to healthy foods; jobs and economic development; traffic safety	Focus of HIA is a low-income community without an accessible grocery store	Consider pedestrian- and bicyclist-centered design to promote alternative modes of transportation
Impacts of Allocating Resources toward Access to Healthy Foods Strategies in an Underserved South Florida Community *Broward County, Florida* *2012*	Florida Public Health Institute	Local	Allocating funding from the Transforming Our Community's Health (TOUCH) Initiative to access to healthy foods strategies	Nutritional quality of foods and beverages available in schools; accessibility, availability, affordability, and identification of healthy foods in communities; jurisdictionwide nutrition policies and practices in early childcare settings; the number of baby-friendly hospitals	Focus of HIA is on access to healthy foods in disadvantaged communities	Establish a corner store network or co-op to enhance economic development and access to healthy foods
Development of a Full-Service Grocery Store Within a Food Desert *Indianapolis, Indiana* *2013*	Center for Health Policy, Indiana University	Local	Proposed development of a full-service grocery store in the Meadows community	Access to healthy foods; nutrition; obesity and related chronic diseases	Focus of HIA is a low-income community without an accessible grocery store	Support sidewalk expansion and increased transit to the area
Evaluating Transportation Access to Healthy Food Sources *Alachua County, Florida* *2013*	Amanda Marie Douglas (University of Florida)	Local	City of Gainesville and Regional Transit System Transit Development Plan; the "Mobile Food Market Feasibility Study"	Walkability and bikeability; public transit accessibility; access to healthy foods	Focus of HIA is on low-income and minority neighborhoods; children, people with disabilities, and elderly also examined as vulnerable populations	Begin supermarket carpool and/or shuttle service

South LA Fast Food *Los Angeles, California* *2013*	Community Health Councils	Local	Community plan that may modify regulations of a current ban on the development of new stand-alone fast food restaurants	Nutrition; quality of life; air pollution exposure; pedestrian injuries; physical activity	Not mentioned	Expand regulations to non–stand-alone restaurants
Proposed Changes to the Supplemental Nutrition Assistance Program (SNAP) *U.S.* *2014*	Health Impact Project	Federal	Changes to SNAP included in House and Senate bills during the 112th and 113th Congresses	Food insecurity and its impact on the risk of illnesses such as diabetes; diet, nutrition, and the risk of illnesses related to poor diet, such as obesity and heart disease; the impact of poverty on health and people's ability to afford essentials related to health, including housing, home energy, and medical care	Focus of HIA is on low-income populations eligible for federal food assistance	Raise the asset limit for SNAP eligibility
* **Food Tax in New Mexico** *New Mexico* *2015*	New Mexico Voices for Children	State	Reinstatement of a tax on food purchased for consumption at home	Family economic security: changes to nonfood living expenses; family economic security: changes to food budget, food insecurity, diet, and nutrition; changes in government spending: maintaining current services	Assessed impacts on vulnerable populations, including low-income children, communities of color, the working poor, and seniors	Consider legislation that addresses food desert zoning
Improving the Quality and Quantity of Food in Southwest New Mexico Food Pantries *New Mexico* *2015*	National Center for Frontier Communities	State	Revisions to the USDA's Emergency Food Assistance Program distribution formula	Access to healthy food (quantity and quality); diet-related health conditions for adults and children	Focus of HIA is on populations accessing food assistance	Establish a statewide advisory committee to review, study, and ultimately change the formula to more accurately reflect the need for healthy food supplies at the local level
Street Vendor Legalization and Student Nutrition in South Los Angeles *Los Angeles, California* *2015*	Community Health Councils	Local	Legislation to legalize sidewalk vending	Street vendor presence; snack and beverage consumption among students; bicyclist and pedestrian presence near schools	Focus of HIA is on schools in high poverty areas and with large Spanish-speaking populations	Continue to prohibit sidewalk and mobile food vending within 500 feet (152 meters) of school campuses

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Tennessee Food Desert Relief Act *Tennessee* *2016*	Prevention Research Center in St. Louis	State	Tennessee Senate Bill 1176: Food Desert Relief Act	Presence of obesity and chronic disease; employment; stress; environmental impact	Considered impacts on vulnerable populations including racial and ethnic minorities, those living in poverty, rural residents, elderly, and people with disabilities	Consider redefining "food desert relief enterprise" using criteria for nutritional content of "healthy food" and percentage of "healthy" products sold
III. NUTRITION						
Menu Labeling as a Potential Strategy for Combating the Obesity Epidemic *Los Angeles County, California* *2008*	County of Los Angeles	Local	California Senate Bill 120 (2007) and California Senate Bill 1420 (2008), which propose menu labeling	Obesity	Not mentioned	To maximize impact, use community education efforts, pricing incentives, or other strategies to increase the degree to which restaurant patrons use the posted information to select reduced calorie meals
* **National Nutrition Standards for Snack and a la Carte Foods and Beverages Sold in Schools** *U.S.* *2012*	Kids' Safe and Healthful Foods Project	Federal	Updates to USDA standards for snack and a la carte foods and beverages sold in schools	School district revenue and student health; diet and nutrition and student health	Assessed effects on low-income and ethnic minority students	USDA should establish nutrition standards for all foods sold regularly on school grounds outside of the school meal programs
California Senate Bill 622: Sugar-Sweetened Beverage Tax *California* *2014*	Community Health Councils	State	Proposed state bill to impose a $0.01 per ounce tax on SSB distributors	SSB consumption; healthy nutrition awareness; total short-term physical activity	Focused on impacts on low-income and households of color with children under age 5	Utilize tax revenues to make healthier drinks more accessible
SNAP Decisions *Illinois* *2014*	Illinois Public Health Institute	State	Requesting a waiver from the USDA to exclude SSBs from SNAP-eligible purchases	Diet and nutritional intake; diet-related health conditions; food security and economic hardship; stigma and stress; budget impacts from administrative costs to the state	Focus of HIA is on low-income populations eligible for food assistance	Rather than seek a waiver for restricting SSBs in SNAP as a stand-alone approach, combine restrictions with incentives and education

* HIA presented as a case study.

Abbreviations: CBSFA=Community-Based Subsistence Fishing Area; EBT=Electronic Benefit Transfer; HB=House bill; HIA=health impact assessment; NGO=nongovernmental organization; SSB=sugar-sweetened beverage; UAO=Urban Agriculture Overlay; USDA=U.S. Department of Agriculture; WIC=Special Supplemental Nutrition Program for Women, Infants and Children

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Assessing the impact of the EQIP High Tunnel Initiative

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Abstract

This study evaluated the U.S. Department of Agriculture Natural Resources Conservation Service (USDA NRCS) Seasonal High Tunnel Initiative, or HTI, that the USDA expects to strengthen local and regional food production by increasing the availability of fresh, locally grown food. Goals of the HTI include improved plant and soil quality, reduced nutrient and pesticide run-off, and increased availability of fresh vegetables and fruits for local food markets. This study explored the farm-level impacts of production via high tunnels among Indiana farmers relying on the infrastructure. We identify characteristics of farmers who have obtained high tunnels through the cost-share program, to better understand the types of farm enterprises that are using the HTI to date and the effects that high tunnel implementation may have on their farms' economic success and contributions to locally sourced food systems. Overall, results indicate that high tunnel users are able to extend the growing season, improve their

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farm's economic stability, and increase the quality and yield of their crops. Our survey also finds that those farmers who have self-funded all or a portion of their high tunnels report greater increases in their farm's economic stability from investing in high tunnels than farmers relying on the NRCS funds for their high tunnels.

Keywords
High Tunnels; Hoophouses; High Tunnel Initiative; Environmental Quality Incentives Program; Local Food Systems; Small Farms; Beginning Farmers; Diversified Farms; Specialty Crops; Know Your Farmer, Know Your Food Initiative

Introduction

High tunnels, or hoophouses, are plastic-covered, greenhouse-like structures for growing plants that are typically built directly over the soil to control the growing environment inside (Carey, Jett, Lamont, Nennich, Orzolek, & Williams, 2009). The low-cost structures are heated by passive solar energy and create favorable growing conditions for plants by protecting them from wind, rain, birds, and temperature extremes (Blomgren & Frisch, 2007; Conner, Montri, Montri, & Hamm, 2009). Growers can extend the growing season with a high tunnel, leading to earlier, later, and more frequent harvests, thereby producing more fresh produce year-round (Lamont, 2009). Increasing the availability of fresh produce, both in terms of adequate volume during the growing season, and supply during the fall and winter months in colder climates, can address a significant barrier to the further development of community food systems that are limited by low supply during the colder months (Martinez, 2010).

High tunnels may be particularly well suited to small-scale, diversified farms that sell their products into local food systems (Cole, n.d.). Research trials have demonstrated that the use of high tunnels makes it possible for farmers to increase the quality and yield of specialty crops, and to reduce the risk of weather-related crop damage and loss (Belasco, Galinato, Marsh, Miles, & Wallace, 2013; Knewtson, Carey, & Kirkham, 2010; Lamont, 2009). By extending their growing season, small farms can capture more revenue and retain their customer base for more months of the year (Martinez, 2010; Matts, Conner, Fisher, Tyler, & Hamm, 2015). Because they are relatively inexpensive investments that facilitate the intensification of production on small plots of land, high tunnels also offer opportunities for beginning and low-income farmers, and those with a small land base (Conner, Waldman, Montri, Hamm, & Biernbaum, 2010; Waldman, Conner, Biernbaum, Hamm, & Montri, 2012). In addition, high tunnels work particularly well for urban-agriculture initiatives because they help producers maximize production in small spaces (Broadway, 2009; Colasanti & Hamm, 2010; Huff, 2015).

The Seasonal High Tunnel Initiative (HTI) was piloted in 2009 as part of the Know Your Farmer, Know Your Food initiative, which brings together staff from across the USDA to coordinate, share resources, and publicize USDA efforts related to local and regional food systems (Farm News, 2009; USDA, n.d.; USDA NRCS, 2011). Broad goals of the initiative are to support diversified farmers and ranchers, as well as businesses involved in regional food networks, to strengthen the connection between farmers and consumers to reinvigorate rural economies, promote job growth, and increase access to healthy food in America (USDA, n.d.). Thus, from its inception, the HTI was aimed at small-scale, diversified farms that sell directly to consumers through local food systems. The HTI is funded through the Natural Resources Conservation Service's (NRCS) Environmental Quality Incentives Program (EQIP) and offers a cost-share incentive of up to 90% to farmers interested in constructing a new high tunnel. The NRCS's goals for the HTI include (1) improved plant and soil quality, (2) reduced off-site movement of nutrients and pesticides, (3) improved air quality through reduced transportation from farm to market, and (4) reduced energy use through local consumption (USDA NRCS, 2015). Farmers are investing in high tunnels to improve the viability of their farms through increased and extended productivity, diversified growing systems, and reduced risk of crop damage and loss (Belasco et al., 2013).

This exploratory study provides an analysis of the benefits of growing with high tunnels in general and the effects of the cost-share incentive provided

by EQIP for use by policy-makers, key stakeholders, and farmers. We identify the characteristics of the farmers who have obtained high tunnels through the cost-share program to better understand the types of farm enterprises that are have used the EQIP to date, and the effects that implementing high tunnels may have on farms' economic success and contributions to locally sourced food systems. Through a survey of farmers using high tunnels in the state of Indiana, we address the following questions:

1. What is the overall impact of using high tunnels in terms of crop yields, crop quality, farm profit, and farmers' quality of life?
2. Do farmers who obtained their high tunnels with support from EQIP differ from those who purchased some or all of their tunnels without support from the EQIP program?

To understand any differences among high tunnel users, we differentiate between those who only have EQIP-funded high tunnels and those who have self-funded one or more of their farm's high tunnels. Analyzing the outcomes of the first five years of the program, this study is the first to provide an understanding of the effects of the HTI from a whole-farm perspective.

Literature Review

Increasing the adoption of season-extension technology is important for addressing a key barrier in the supply chain to developing more robust local and regional food systems in the many parts of the U.S. with a limited growing season (Conner et al., 2009; Mount, 2012). According to former USDA Deputy Secretary Kathleen Merrigan, "high tunnels create favorable conditions enabling farmers to grow vegetables, berries, and other specialty crops in climates and at times of the year in which it would otherwise be impossible…Farmers who sell their high tunnel produce locally benefit from the extra income, and the community benefits from the availability of fresh, locally grown food" (USDA NRCS, 2011, para. 1). Consumers at three Michigan farmers markets indicated that they were willing to pay a price premium for early- or late-season salad greens, spinach, and tomatoes; for example, they were willing to pay up to US$3.00 extra per head of lettuce in the winter season (Conner et al., 2009). A policy report identified high tunnels as a critical infrastructure gap for increasing the distribution of specialty crops in Indiana (Meter, 2012).

Growing in high tunnels also offers the potential for improving the productivity and viability of the small-scale, diversified farms that produce food for local food systems. An informal survey of state extension vegetable specialists indicated that the majority of high tunnel users in the U.S. are beginning farmers operating small-scale, diversified, direct-market operations (Carey et al., 2009). While many benefits of using high tunnels have been identified in research trials, there has not been an adequate study of farmers' lived experiences of integrating high tunnel production into their existing farm systems. A small case study in Michigan found mixed results in terms of farmers' success in increasing their farm's profitability or meeting management goals (Conner et al., 2010; Waldman et al., 2012). In terms of improving profitability and quality of life for farmers, high tunnels were not always used to their full potential (Conner et al., 2010; Waldman et al., 2012). A systematic assessment of the economic impacts, season-extension potential, and other production benefits at the farm level is needed to fill this gap.

The HTI is designed to provide a streamlined application process and enhanced flexibility to better serve small-scale operations and diversified farm systems (USDA NRCS, 2015). The criteria for HTI cost share eligibility for Indiana farmers is based on the ranking system for the Indiana NRCS specialty-crop program, which ranks each applicant based on their property's conservation activities and their farm's needs (USDA NRCS, 2015). Cost share recipients are required to grow crops directly in the soil in their tunnel (thus aquaponic or greenhouse systems are not allowed), and they must plan supportive conservation practices to address environmental concerns associated with the installation and use of high tunnel systems such as erosion, irrigation, and runoff (USDA NRCS, 2015).

The cost of high tunnel infrastructure varies depending on the size of the tunnel chosen, features and material components selected (basic and

upgraded), and construction costs. The average high tunnel costs approximately US$3.25 per square foot (0.09 square meter), or US$7,000 for a 2,160 square foot (201 m²) tunnel (Huff, 2015). However, costs vary by region, with additional reinforcements such as higher gauge hoops and plastic and heavier steel required in northern and eastern regions to withstand harsh winters adding to the overall cost (Huff, 2015). The plastic covering of a high tunnel has an average four to five year lifespan before the plastic must be replaced (Huff, 2015). The Indiana NRCS cost-share funds US$3.85 per square foot, with a maximum payment cap of US$8,385 (USDA NRCS, 2015).

The HTI is part of a suite of programs and incentives designed to meet the needs of populations of farmers who are deemed historically underserved, defined by the USDA as groups that "have not participated in or that in the past have received limited benefits from USDA programs" (USDA NRCS, 2015). The following groups are included in this category: (1) socially disadvantaged farmers and ranchers, (2) beginning farmers and ranchers (defined as those farming fewer than 10 years), and (3) limited-resource farmers and ranchers. For instance, farmers in these categories are eligible for higher cost-share rates of up to 90% and are placed in high-priority funding pools. According to the National Sustainable Agriculture Coalition (NSAC), its analysis of USDA data indicates that the HTI has been strongly utilized by beginning farmers, who made up 51% of program contracts in 2013. Historically underserved producers (in all categories combined) accounted for over 70% of HTI contract holders in 2013, while representing just 26% of participants in EQIP programs in general (NSAC, 2014a, 2014b).

To our knowledge, the only research to date on the HTI is a study that analyzed the nationwide distribution of NRCS-funded high tunnels in relation to county-level biophysical, market, and socio-demographic data, to understand which factors influence the adoption of high tunnels through the HTI (Foust-Meyer & O'Rourke, 2015). This study found that farmers' geographic location was most correlated with the incidence of NRCS-funded high tunnels. Not surprisingly, farmers located in higher latitudes were more likely to have purchased a high tunnel through the HTI, where farmers most benefit from technologies to extend the growing season. In addition, farmers' proximity to urban areas with higher median household income was related to their participation in the HTI, and female farm operators were proportionately more likely to obtain high tunnels through the HTI. Finally, farmers in or near metropolitan counties with robust local food systems (high direct-to-consumer sales) were most likely to adopt high tunnels through the HTI (Foust-Meyer & O'Rourke, 2015). Our study assesses the farm-level impacts and benefits of using high tunnels and determines whether those impacts differ for farmers who purchased their own tunnels compared to those who obtained their tunnels through the EQIP program.

Methods

This exploratory survey examines the outcomes of participation in NRCS's EQIP HTI and also compares those farms with only EQIP-funded high tunnels to those whose high tunnels are all or in part self-funded. We build on earlier case studies of high tunnel users through a quantitative-focused survey that was mailed to farmers across Indiana, USA (Waldman et al., 2012).

Study Site

While Indiana is known for its commodity agricultural products like corn, soybeans, wheat, pork, and poultry, the state also has specialty crop producers distributing through local food system venues (Meter, 2012). Specialty crops are defined as "fruits and vegetables, tree nuts, dried fruits, horticulture, and nursery crops, including floriculture" (USDA Agricultural Marketing Service, n.d.). In 2012, 2,935 specialty crop farms were operating in Indiana (USDA NASS, 2015), a slight increase from 2,925 in 2007 (USDA NASS, 2007). The Indiana division of the USDA NRCS began administering the EQIP HTI cost-share program to Indiana farmers in 2012, three years after the USDA approved the HTI and other states began to offer the cost-share program. Interest in and demand for the program among the state's farmers have grown since 2012, with over 170 tunnels constructed on farms since its inception. This

represents an investment of nearly US$1.5 million in Indiana (A. Heichelbech, personal communication, February 20, 2015). In comparison, over 10,000 farms had installed new high tunnels nationally due to the cost-share program by 2014 (Starmer, 2014). In addition to these investments from the USDA, growers have personally invested significant funds in high tunnels.

Sampling, Instrumentation, and Data Collection Approach

Since there is currently no comprehensive list of high tunnel owners in Indiana, the research team followed a convenience sampling approach, which suffices in exploratory research (Schutt, 2006). Procedures included garnering as much contact information as the Indiana NRCS office could disclose for HTI participants (143 names, with city and county of residence); using online databases (whitepages.com and county GIS platforms) to garner mailing addresses; incorporating respondents who had reported owning a high tunnel in a previous survey administered by our research group (Valliant, Farmer, Dickinson, Bruce, & Robinson, in press); and incorporating names of our research group's personal and professional contacts who have a high tunnel. Additionally, one county extension educator hand-delivered the questionnaire (and return envelopes) to 14 growers who use high tunnels. The unsystematic selection process is a limitation to this study's results. In total, the questionnaire was distributed to 178 farmers (see the instrument in the Appendix).

While the paper instrument was the primary tool for data collection, an electronic option was also made available. Every survey included a US$5 cash incentive to encourage participation (Dillman, Smyth, & Christian, 2008; Singer, 2012). We followed a modified Dillman tailored-design survey method (Dillman et al., 2008) for distributing the questionnaire and collecting responses. The survey was mailed to 164 contacts. The four-phase approach included (1) a postcard announcing the survey soon to follow, (2) the survey one week later, (3) a reminder postcard to nonrespondents two weeks after that, and (4) a follow-up survey mailed to nonrespondents two weeks thereafter. We then followed up with a phone call to nonrespondents in order to evaluate the underlying issues for the nonresponse.

The survey consisted of six sections that solicited data through 38 questions. Section 1 included questions about farm location, number of high tunnels, EQIP-funded high tunnels, and descriptive information on farmers' use of their high tunnel(s). Section 2 was composed of questions concerning growers' perception of the value of the high tunnel for their farm. Section 3 queried farmers about the distribution approaches they utilized. Section 4 asked farmers about the crops they produce in their high tunnels, production issues and challenges, research needs, and common practices they employ. Section 5 asked about farm characteristics and economic issues. Section 6 queried participants for demographic information.

Data Management and Analysis Approach

We input data into an online version of the questionnaire that was built through Qualtrics software. Data were analyzed using SPSS 23.0. Descriptive and cross-tab statistics were used to calculate general results for demographic variables, farm characteristics, distribution type (direct-to-consumer or otherwise), and general mean scores related to Likert-style questions. Based on farmer responses, we created a dichotomous variable to compare farmers that (1) had only EQIP-funded high tunnels (n=47) or (2) had no EQIP-funded or had a combination of EQIP- and self-funded high tunnels (n=56). We used analysis of variance (ANOVA) to compare results related to the continuous variable questions (as well as the Likert-style responses), and chi-square analysis to explore the differences in categorical variables (e.g., distribution method, gender, and education) between the two groups of farmers.

We also performed a binary logistic regression to compare the two groups (EQIP-only [1] vs. Combo/Self-funded [0]) to define key points of differentiation between the two. The six covariate variables included (1) likelihood of purchasing a future high tunnel without EQIP-funding cost-share support, (2) percentage of household income earned through off-farm employment, (3) effect of the high tunnel(s) on improving farm economic stability, (4) educational attainment (bachelor's

degree vs. no bachelor's degree), (5) their perception of the utility of high tunnels in reducing pest problems, and (6) their perception of the utility of high tunnels in improving harvest quality.

Results

Of the 178 questionnaires distributed, 118 were returned (6 of these were electronic). Nine were returned with insufficient addresses, four responses noted that the high tunnel was not yet erected, one person did not have a high tunnel, and one person declined to participate. One hundred and three questionnaires were deemed usable, and with an adjusted sample of 164, we had a 62.8% response rate. The mean participant age was 36.98, with the vast majority of respondents being the farm owner (92.2%); 27.2% identified as female, and 48.5% of respondents had attained a bachelor's degree or higher education (see Table 1). Most respondents had an annual farm income of less than US$49,999, with nearly 20% making less than US$5,000 from their farms. Most (82.6%) respondents were located in hardiness zone 5, with 17.4% in hardiness zone 6. The average proportion of revenue from specialty crops, when compared to total farm revenue, was 40.8% (median of 26.25%). Table 1 provides further details on the demographic characteristics of respondents, while also differentiating and providing significance indicators for differences between those farmers who have only EQIP-funded high tunnels ("EQIP-only"; 45.6%) and those who have only or in part self-funded high tunnels ("non-EQIP-combo"; 54.4%).

We compared demographic and farm experience variables for the EQIP-only high tunnel users and the non-EQIP-combo group and found several statistically significant differences. The two groups demonstrate differences ($p<.05$) for gender and age. EQIP users were more likely to be older (5.61 mean years) and female than the farmers who had purchased some or all of their high tunnels themselves. The non-EQIP-combo farmers earned more household income from the farm and had been growing in high tunnels for a longer period of time ($p<.01$). Last, the EQIP-only farmers were more likely to have a higher educational attainment level. The data also point to significant differences, and some marginal ones, between the two groups, with the EQIP-only farmers earning less in gross specialty crop sales, less in dollars per square foot of high tunnel production, farming fewer acres, having fewer high tunnels, and being less likely to invest their own money in future high tunnel

Table 1. Descriptive and Comparison Results of Demographic Data Overall and Between Groups

Category	Subcategory	EQIP-only (*n*=47)	Non-EQIP-combo (*n*=56)
Average Age**		40.27 mean 41.00 median	34.34 mean 35.00 median
Gender*	Female	34.05%	19.65%
	Male	65.95%	80.35%
% of household income*	Farm supplies	29.46 mean 16.00 median	42.11 mean 30.00 median
Years Farming		23.89 mean 25.00 median	19.69 mean 13.50 median
Years Using High Tunnels***		3.68 mean 2.00 median	6.67 mean 5.00 median
Educational Attainment**	Some high school	2.13%	19.64%
	High school/GED	12.77%	17.86%
	Some college	19.15%	14.29%
	Associates/Tech	4.26%	10.71%
	Bachelor's	36.17%	30.36%
	Graduate	25.53%	7.14%

Levels of statistical significance: *p=.10; **p=.05; ***p=.010

purchases (see Table 2).

We also analyzed 20 variables on the value to a farm's bottom line of producing in high tunnels (see Table 3). This included variables on farm profit, product diversification, production during the shoulder seasons (late fall and early spring), as well as pest and disease issues (see questions 13, 14, and 19 in the Appendix). Of these 20 variables, seven were found to be significantly different between the two groups. Non-EQIP-combo farmers were more likely to indicate in the survey that growing in high tunnels increased overall farm profit, overall yields, the farm's economic stability, allowed the harvesting of warm-season crops earlier in the season, improved the quality of the harvest, and reduced pest problems (vertebrate problems in particular).

Lastly, we used binary regression analysis to answer the following research question: *Do farmers who obtained high tunnels only through the HTI*

Table 2. Descriptive and Comparison Results of Farm Characteristic Data Overall and Between Groups

Category	Subcategory	EQIP-only (*n*=47)	Non-EQIP-combo (*n*=56)
Farm's Gross Income	Less than US$5,000	30%	11%
	US$5,000–US$9,999	15%	11%
	US$10,000–US$49,999	28%	34%
	US$50,000–US$149,999	13%	30%
	US$150,000–US$349,999	2%	2%
	US$350,000–US$499,999	6%	4%
	US$500,000+	4%	5%
Gross Specialty Crop Income **	Less than US$200	11%	2%
	US$200–US$999	17%	7%
	US$1,000–US$9,999	30%	26%
	US$10,000–US$24,999	28%	26%
	US$25,000–US$49,999	0%	15%
	US$50,000–US$99,999	4%	15%
	US$100,000–US$249,999	7%	6%
	US$250,000–US$499,999	0%	4%
	US$500,000+	2%	0%
Gross sales from HT per square foot [a] **		US$.012 mean US$.0007 median	US$.029 mean US$.0014 median
Acres*	1–10 acres (0.4–4.0 ha)	43%	41%
	11–30 acres (4.5–12.1 ha)	26%	16%
	31–100 acres (12.6–40.5 ha)	9%	29%
	100+ acres (40.6+ ha)	23%	14%
# of High Tunnels***		2.09 mean 2.00 median	3.89 mean 3.00 median
Likelihood of purchasing another HT without EQIP funding ***		2.65 mean 3.00 median	3.39 mean 3.00 median
Distribution Method	Direct to consumer only	57%	66%
	Nondirect to consumer/Combo direct/nondirect	43%	34%

*p<.10; **p<.05; ***p<.010

[a] Calculation based on gross sales and gross high tunnel square footage.

Table 3. Mean Scores (Standard Error) for Farmer Responses to Three Likert-style Batteries of Questions

	EQIP-only Mean/Standard Error	Non-EQIP-combo Mean/Standard Error
1–5 likert scale (1=strongly disagree to 5=strongly agree)		
13A. Increasing overall farm profit**	3.47 (.173)	3.98 (.120)
13B. Adding products/diversifying	3.20 (.198)	3.51 (.142)
13C. Increasing fall/winter/spring production	3.93 (.167)	4.09 (.138)
13D. Harvesting warm season crops earlier in the season*	3.68 (.169)	4.06 (.125)
13E. Harvesting warm season crops later in the season	3.75 (.163)	3.51 (.139)
13F. Harvesting cool season crops earlier in the coldest of months	3.30 (.237)	3.23 (.203)
13G. Increasing cash flow in fall/winter/spring	3.22 (.208)	3.50 (.179)
13H. Shifting some of the summer workload to fall/winter/spring	2.80 (.200)	2.83 (.174)
13I. Improving quality of harvest products***	3.57 (.166)	4.17 (.117)
13J. Reducing pest problems*	3.09 (.166)	3.51 (.167)
1–6 scale (1=strongly disagree to 6=strongly agree)		
14A. Improved farm's economic stability**	4.50 (.196)	5.00 (.106)
14B. Improved quality of life	4.52 (.185)	4.52 (.120)
14C. Significantly increased crop yields**	4.57 (.164)	5.00 (.104)
14D. Significantly reduced negative environmental impacts	4.31 (.179)	4.56 (.149)
1–5 likert scale (1=extremely worse to 5= extremely improved)		
19A. Disease problems in the crop	4.17 (.167)	4.22 (.129)
19B. Insect problems in the crop	3.80 (.169)	3.92 (.153)
19C. Weed problems in the crop	4.12 (.136)	4.24 (.127)
19D. Vertebrate pest problems**	3.55 (.202)	4.04 (.146)
19E. Maintaining soil quality	3.79 (.189)	3.67 (.156)
19F. Quality of harvested product	4.60 (.118)	4.75 (.065)

*p<.10; **p<.05; ***p<.010

differ from farmers who purchased some or all of their tunnels using their own funds or other non-EQIP funds*?* Our regression model tested the differences between the two groups of farmers (dependent variable) in relation to six variables (see Table 4). This model met statistical parameters (Hosemer Lemeshow score of p=.629) and was statistically significant (p=.000). Three variables were identified as significant, and they were accurate in predicting group placement 68.4% of the time: the likelihood of purchasing another high tunnel without the EQIP cost share, the percentage of income coming from off-farm employment, and improved farm economic stability. First, as the likelihood someone would purchase a future high tunnel without the EQIP cost share increased, the chances of them being an EQIP-only high tunnel user decreased. Second, as the proportion of one's income coming from off-farm employment increased, so did the chances of them being an EQIP-only high tunnel user. Third, as respondents' scores denoting the improved farm economic stability increased, the chances of them being an EQIP-only user decreased. In summary, the EQIP-only high tunnel users depend less on farming operations for household income, are less inclined to purchase a future high tunnel out of pocket, and did not find that high tunnels improved the quality of their harvest as much as the non-EQIP-combo farmers indicated.

Discussion

Overall, the study provides evidence that at least in the state of Indiana, the HTI is enabling farmers to extend the growing season and increase the

Table 4. Summary Statistics for Binary Stepwise Logistic Regression Model in which EQIP-only and Non-EQIP-combo are Compared for Most Salient Distinguishing Variables
Independent variables retained in step 2 are listed in order of their *Exp(B)* score, with asterisks denoting significance level.

	Model 1
	Step 3
Model Sign. / Step Sign.	.000 / .015
Hosemer Lemeshow	.629
Chi-square, Model/Step	20.785 / 5.875
-2 Log Likelihood	116.272
Nagelkerke	.262
Percentage Accuracy	68.4% (EQIP-only 61.4%; non-EQIP-combo 74.5%)
Variables	***B* (S.E.; Exp[B]); *p***
Likelihood of purchasing a high tunnel without NRCS funding cost-share support	–0.389 (0.201; 677); 0.053*
% of household income derived from off-farm employment	0.017 (0.006; 1.017); 0.006***
Improved farm economic stability	–0.601 (0.256; 0.548); 0.019**
Education (bachelors degree vs. less than bachelors)	n.s.
Reducing pest problems	n.s
Improved harvest quality	n.s
Constant	2.469 (1.092; 11.812); 0.024**

S.E.=Standard Error; n.s.=not significant
*p<.10; **p<.05; ***p<.010

availability of locally grown food, based on this self-reported questionnaire and those who participated. Specifically, analysis of the results from this survey suggests three salient points. First, high tunnel users across the board (both those solely EQIP-funded and those self-funded or partially self-funded) indicate positive outcomes from growing specialty crops in high tunnels. Second, those farmers with high tunnels funded solely by EQIP earn a smaller percentage of their household income from their farms, compared to those who funded all or a portion of their own high tunnels. The most striking variable distinguishing solely EQIP-funded and self-funded or partially self-funded farmers is the economic impact of the high tunnel for farm operations. In sum, there are differences between the two groups that indicate that farmers who rely more heavily on their farms for household income and have invested more of their own resources in high tunnels have also experienced the greatest economic benefit from their tunnels. In this section, we discuss the ramifications and implications of these findings.

Overall Outcomes for High Tunnel Users

All high tunnel users in Indiana who responded to the survey (both solely EQIP funded and some/all self-funded) generally reported that growing specialty crops in high tunnels has positive effects on their farms' earnings and their own quality of life. Growers in both groups specifically indicated that growing crops in high tunnels allowed them to increase their overall farm profit and improve the economic stability of their farms. This increased economic stability is likely due to the improvements growers reported with the quality and yield of their crops. In addition, growing with high tunnels enabled them to extend the growing season into the cooler months of the year, thereby earning an income in more months of the year.

These findings are important because, as noted by Waldman and colleagues (2012) and based on our review of the literature, there has not been a systematic assessment (beyond case studies) of the economic impact of using high tunnels, or of growers' experiences with high tunnels. Existing evidence for the production benefits of growing

specialty crops with high tunnels has been based on crop trials on research farms that may not take into account growers' experiences with integrating high tunnels into routine whole-farm management. Improving farmers' economic stability and increasing their profits is a core goal of the Know Your Farmer Know Your Food initiative, and thus an indication that the program has had a positive impact.

Characteristics of EQIP-funded vs. Self-funded or Partially Self-funded High Tunnel Farmers

Farmers in our sample who only have high tunnels funded by the EQIP program differ from those funding all or a portion of their own high tunnels in a number of respects. They are less dependent on their farm for household income, and mostly manage smaller farms. They earn less income from their specialty crops, less in dollars per square foot of high-tunnel production, and manage fewer high tunnels. They are also less likely to invest their own money in additional high tunnels in the future (see Table 2). The USDA defines farms with a gross cash farm income (GCFI) of US$10,000 or less as noncommercial or lifestyle farms (Hoppe, MacDonald, & Korb, 2010). Farmers in the EQIP-only funded group are typically older, likely reflecting the prevalence of owner-operators managing a lifestyle farm as a second career, hobby, or following retirement (Ahearn & Newton, 2009). It is not surprising that the EQIP-only funded group has a higher percentage of graduate-level education, reflecting the fact that farming may not be their primary career or occupation. These findings are consistent with the results of a previous study suggesting that small-scale specialty-crop farmers who make less than US$10,000 in annual revenue from their farm are most likely to take advantage of the HTI (Foust-Meyer & O'Rourke, 2015). Women make up more of the EQIP-only group, reflecting NSAC's preliminary analysis of national data, showing that female owner-operators have higher participation rates in EQIP programs than they do in other USDA programs (NSAC, 2014). The findings suggest that, overall, the growers who have more "skin in the game," or who have relied on their personal funds to invest in a high tunnel, are more motivated to utilize their high tunnel effectively. In general, these farms are larger with higher gross incomes and thus more capital to invest in high tunnel infrastructure. Likewise, they invest more of their labor in their high tunnel, as they are more reliant on their farm for income than the farmers in the EQIP-only group.

Significance of Years of Farming Experience for Economic Success with High Tunnels

The most striking variables distinguishing solely EQIP-funded and some or all self-funded farmers are the years one has personally farmed using a high tunnel, and the economic impact of the high tunnel for their farm operations. Those farmers who had more experience with high-tunnel production were more likely to have funded at least one of their own tunnels, as opposed to experimenting with a high tunnel for the first time through the EQIP program. This is likely because the use of high tunnels has been increasing in the U.S., and while the cost-share program was approved nationally in 2009, the state of Indiana only implemented the program in 2012. Thus some specialty-crop farmers in Indiana were using high tunnels for years before the program was implemented. As a result, the farmers who had invested in their own tunnels were able to use the EQIP program to add additional tunnels to their operation, thus expanding their high-tunnel production.

Given that the self-funded or partially self-funded farmers had gained experience with high tunnel production prior to the EQIP program, it is not surprising that they reported better economic gains from their tunnels than their less-experienced counterparts. Likewise, the EQIP-only group reported less success with improving the quality of their harvested products with high tunnels, possibly because they have less experience with high tunnel production, or perhaps because they are more likely to grow crops that do not show the same boost in quality. Because the self-funded or partially self-funded farmers rely on their farms for a greater share of their household income, they may invest more time in and attention to their high tunnels than their part-time counterparts, and therefore report more economic success with their high-tunnel production.

Policy Implications

We expected, based on national data, that beginning farmers would be more likely to obtain EQIP funding than their more experienced counterparts. For instance, beginning farmers made up 51% of EQIP cost-share recipients in 2013 (Huff, 2015), whereas 39.6% of our complete sample in Indiana (both EQIP-only and non-EQIP/combo) is beginning farmers. In addition, in our sample the EQIP-only group reported more years of farming experience than the non-EQIP/combo group, although the difference was not statistically significant (23.89 mean years of farming experience, compared to 19.69 years, respectively). This is more divergent when considering the median scores, with EQIP-only farmers having 25 years experience to the non-EQIP-combo farmers having 13.50 median years of experience. One possible explanation is that the cost-share program was only implemented in 2012 in Indiana, three years later than it was introduced in other states. It is possible that because the non-EQIP-combo group of farmers are generally younger and rely more heavily on their farms for income, some of them chose to invest in their own high tunnels rather than wait for the possibility that the EQIP program would be funded in Indiana.

The HTI, initially piloted under the Know Your Farmer, Know Your Food initiative, is well suited for the small-scale, diversified farms that sell their products into local food systems (Cole, n.d.; Farm News, 2009; Robillard, 2015; USDA NRCS, 2011; USDA, n.d.). Our data show that participation in the Indiana HTI reflects this programmatic focus on small farms that supply local food markets. Because high tunnels are a relatively low-cost investment that can be made up in just 1 or 2 years in many cases (Carey et al., 2009), the cost does not deter committed, commercial growers from investing in their own tunnels. Our study finds preliminary evidence that the program incentivizes small operations that may not have otherwise to experiment with a high tunnel, and that the infrastructure is relatively easy to adopt successfully. Thus the implications of our study for the HTI are that it incentivizes first-time users to adopt high tunnels and supports experienced growers in expanding their operation by adding additional tunnels to their farms. Taken together, the impact of the HTI is an increase in the volume of specialty crops grown for local food markets in the growing season and significant increases in off-season availability of fresh produce. The HTI also boosts the farm income of first-time users and especially more experienced, commercially scaled direct market farms, thus potentially boosting rural economies and local food systems.

Limitations and Future Research

Our study findings are limited by the relatively small size of the survey population (178), as the population of farmers that have utilized the HTI cost-share and invested in their own high tunnels in Indiana is relatively small overall. While our 63% response rate is better than the norm for mailed surveys (Dillman et al., 2008), the opportunity for nonresponse bias is still very present. To understand how nonresponse bias may affect these results, we attempted to solicit an abridged dataset from nonrespondents via telephone interviews (22% of nonrespondents were reached). The supplementary results suggest that the 22% of nonrespondents were having (1) some kind of challenge or problem with installing their high tunnel (e.g., it had yet to be installed), (2) difficulty in fully using their high tunnel, or (3) challenges in managing their farm, in general. These patterns among nonrespondents indicate that findings may be skewed toward positive experiences implementing high tunnel production on farms. In addition, the small sample creates a potential for bias in our findings that EQIP-only farms report lower economic impact of their high tunnels, because there is a larger proportion of small farms in that group. We cannot say if farm size and EQIP participation is correlated, or test whether larger farms in the EQIP-only group reported higher scores for the question about high tunnels "increasing overall profit," because the number of these farms in the sample is too small for a robust analysis.

This sample of farmers using high tunnels in Indiana prevents us from generalizing to farmers in climates with harsher winter seasons in the upper Midwest or Northeast, or those in the western and southern regions of the U.S. In addition, we are

not able to generalize to areas where specialty crop production is more common and economically important than it is in Indiana, such as parts of the Upper Midwest, Northeast, Pacific coast, and urban areas where high tunnels may be more prevalent. Lastly, the small sample size limits the reliability of our observations in regards to differences between the two groups (EQIP-only and combo), and thus this analysis should be taken as preliminary and exploratory.

Qualitative research is needed to explore farmers' experience with using high tunnels in more depth. For instance, interviews with this population could identify the factors that explain why some farmers report very positive experiences with their high tunnels, while others have not used them to the same capacity or have experienced challenges with high-tunnel production. In addition, we would like to further explore and understand the significance of farmers' full-time or part-time status and the percentage of income they earn from their farms for their success in using high tunnels.

Conclusions

Overall, our results suggest that the HTI is meeting its stated goals of increasing the availability of fresh produce for local food markets and is enabling farmers to extend the growing season and improve the quality of their specialty crops. The survey provides evidence that in addition to these general goals, growing under cover allows farmers to improve the yield of their crops and generally reduce pest problems. Therefore, continuing the cost-share program could potentially improve the viability of specialty crop farms over time in a number of ways. We add to the very limited research assessing the farm-level economic impacts of the High Tunnel Initiative, demonstrating that farmers have increased their financial viability by growing under cover. We also provide greater depth of understanding about the types of farmers who have depended on the HTI to provide funding for a high tunnel and those who have invested their own funds in constructing one or more high tunnels. In the big picture, the study contributes to society's understanding of a key technology that can increase the viability of mostly small-scale farms that supply local food system initiatives.

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Appendix. Survey Instrument

Dear Indiana farmer,

Indiana University and Purdue University are working together to learn from Indiana's farms that have a high tunnel. We define a high tunnel as a structure covered in plastic that one can walk through upright in order to grow and maintain vegetables, fruit, flowers, herbs, etc.

If your farm has a high tunnel – even one that is unused right now – please complete this questionnaire as your insight is vital. Findings will be used to: (1) write a technical guide for high tunnels growers, (2) design and conduct high tunnels production trials at Purdue, and (3) develop outreach events to educate high tunnel operators. This survey is being conducted under the direction of Drs. James Farmer (IU School of Public Health) and Liz Maynard (Purdue College of Agriculture). Telephone: (812) 856-0969, email address: jafarmer@indiana.edu.

Every precaution will be taken to maintain the complete confidentiality of your responses and farm information. Your responses will be combined with data from roughly 400 other farms. Only aggregated numbers will be shared. You will not be identified in any reports from this project. You may stop participation at any time without loss of incentive. This questionnaire should take approximately 20 minutes to complete. If you have questions about your rights as a research participant or concerns about the study, you may contact the Indiana University Human Subjects Office at (812) 856-4242 or irb@iu.edu.

Enclosed you will find a $5 bill as an incentive for your participation in this important study.

Sincerely,

James Farmer, Ph.D.
Indiana University

Liz Maynard, Ph.D.
Purdue University

Growers survey: High tunnels and Indiana farms

Section 1. Introduction

1. In which Indiana county is your farm located?	_____		
2. How many high tunnels does your farm currently have?	_____	☐ if 0 *end survey & mail it in*	
3. How many total square feet of space do you have within your high tunnels?			
4. How many of your farm's high tunnels were purchased using NRCS EQIP funds?	☐ All	_____	☐ None
5. How many of your farm's high tunnels were purchased with the help of a loan from FSA?	☐ All	_____	☐ None
6. Of all the high tunnels on your farm, how many does your farm **presently** use **in any way**?	☐ All	_____	☐ None (*Skip to* ***#7***)

7. Please indicate how your farm uses your high tunnel(s), and the approximate % of high tunnel area given to each purpose throughout the year.

☐ **A.** To grow vegetables, melons or herbs	_____%
☐ **B.** To grow berries or tree fruit	_____%
☐ **C.** To grow flowers, bedding plants or nursery crops	_____%
☐ **D.** For storage	_____%

8. When did your farm **START** to grow crops in your first high tunnel? Year: _____

9. If your farm **STOPPED** growing crops in high tunnels, when did you stop?

☐ Not applicable: We still use our high tunnel

Year: _____

If your farm STOPPED growing crops in high tunnels, please skip to ***#15 at the top of Section 4***

10. Please mark the months of the year in which your farm is **now growing more** because of the high tunnels. ☐ All

☐ None ☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec

11. Mark any months in which your farm now **harvests** – when it didn't used to - because of the high tunnels. ☐ All

☐ None ☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec

2

12. Please indicate the approximate dimensions of your high tunnels:

Length	Width	Height	# of High Tunnels this size

Section 2. Value of the high tunnel for your farm

13. Please rate your high tunnel's current usefulness in each of the following ways:	Not at all Useful	Somewhat Useful	Useful	Very Useful	Extremely Useful
A. Increasing overall farm profit	☐	☐	☐	☐	☐
B. Adding products / diversifying	☐	☐	☐	☐	☐
C. Increasing fall/winter/spring production	☐	☐	☐	☐	☐
D. Harvesting warm season crops earlier in the season	☐	☐	☐	☐	☐
E. Harvesting warm season crops later in the season	☐	☐	☐	☐	☐
F. Harvesting cool season crops in the coldest of months	☐	☐	☐	☐	☐
G. Increasing cash flow in fall/winter/spring	☐	☐	☐	☐	☐
H. Shifting some of the summer workload to fall/winter/spring	☐	☐	☐	☐	☐
I. Improving quality of harvested products	☐	☐	☐	☐	☐
J. Reducing pest (insects, disease, weeds, mammals, etc.) problems during production	☐	☐	☐	☐	☐

14. Please rate your level of agreement with the following statements: *Adding a high tunnel has...*	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
A. Improved the farm's economic stability	☐	☐	☐	☐	☐	☐
B. Improved our quality of life	☐	☐	☐	☐	☐	☐
C. Allowed us to significantly increase crop yields	☐	☐	☐	☐	☐	☐
D. Allowed us to significantly reduce negative environmental impacts	☐	☐	☐	☐	☐	☐

3

Section 3. Sales from the high tunnel

15. How much of the products from your high tunnel (by weight) are:	None	Less than half	More than half	100%
A. Sold direct to final consumer	☐	☐	☐	☐
B. Sold direct to grocer / restaurant / institution	☐	☐	☐	☐
C. Sold to an aggregator / food hub / distributor	☐	☐	☐	☐
D. Sold to a food processor	☐	☐	☐	☐
E. Sold or donated to a food bank / similar initiative	☐	☐	☐	☐
F. Sold to Other distribution channel:	☐	☐	☐	☐
E. Distributed in Indiana	☐	☐	☐	☐
F. Distributed out of state	☐	☐	☐	☐

16. What distribution channels / venues has your farm **added** in order to sell high tunnel grown products?	

Section 4. High tunnel production

17. Please list your **SIX** most financially important high tunnel crops: (for example, winter greens, lettuce, tomatoes, basil, etc.)		

18. Considering your overall experience, how does yield in a high tunnel compare to yield in the field/garden? Please mark the response below**.** High tunnel yields:

Decreased 50% +	Decreased 25 to 50%	Decreased 5 to 25%	Neutral ± 5%	Increased 5– 25%	Increased 25 – 50%	Increased 50% +	Do not know
☐	☐	☐	☐	☐	☐	☐	☐

19. Generally speaking, how does **production** in the high tunnel compare to production in the field?							
	Extremely worse	Slightly worse	No change	Slightly improved	Extremely improved	Do not know	Not applicable
A. Disease problems in the crop	☐	☐	☐	☐	☐	☐	☐
B. Insect problems in the crop	☐	☐	☐	☐	☐	☐	☐
C. Weed problems in the crop	☐	☐	☐	☐	☐	☐	☐
D. Vertebrate pest problems	☐	☐	☐	☐	☐	☐	☐
E. Maintaining soil quality	☐	☐	☐	☐	☐	☐	☐
F. Quality of harvested product	☐	☐	☐	☐	☐	☐	☐

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20. Please consider the following research topics and mark those that you would like to see research completed on. If there is a specific crop(s) you have in mind for a specific topic, please list that in the far right column.

	Check if Interested	Specific Crop(s)
A. Evaluating types / varieties	☐	
B. Crop scheduling: planting dates and harvest dates	☐	
C. Harvest practices	☐	
D. Stand establishment	☐	
E. Row, bed and/or in-row spacing	☐	
F. Irrigation methods / scheduling	☐	
G. Temperature mgmt. (row covers, venting, heat storage, insulation)	☐	
H. Light (supplemental lights, types of plastic covering, etc.)	☐	
I. Soil fertility / plant nutrition	☐	
J. Insect management	☐	
K. Disease management	☐	
L. Weed management	☐	
M. Vertebrate pest management (*voles, deer, birds*)	☐	
N. Low cost small tool and equipment development	☐	

21. Which practices/items are **commonly** used for growing crops in high tunnels on your farm**? (*Check all that apply*)**		
A. Production System	☐ Not organic	☐ Certified Organic
	☐ Organic, not certified	☐ Other:
B. Soil Fertility and Plant Nutrition	☐ Synthetic fertilizers	☐ Foliar feeding
	☐ Organic fertilizers	☐ Fertigation
	☐ Compost	☐ Cover crops
	☐ Manure	☐ Other:
C. Irrigation	☐ Drip	☐ Well water
	☐ Sprinkler	☐ Municipal / other public water supply
	☐ Hand	☐ Surface water
	☐ Automated on/off	☐ Runoff from high tunnel roof
	☐ Other:	
D. Disease Management	☐ Resistant varieties	☐ Fungicides (including biologicals)
	☐ Environmental management	☐ Sanitation
	☐ Crop rotation	☐ Cover crops
	☐ Grafting	☐ Other:

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E. Weed Management	☐ Plastic mulch or weed barrier	☐ Hand hoeing
	☐ Cover crops	☐ Machine cultivation
	☐ Herbicides	☐ Solarization
	☐ Hand pulling	☐ Flaming
	☐ Organic mulch (*example: straw, leaves*)	☐ Other:
F. Insect Management	☐ Insecticides (including biologicals)	☐ Row covers
	☐ Release natural enemies	☐ By-hand removal
	☐ Provide habitat/food for naturally occurring natural enemies	☐ Crop rotation
		☐ Other:
H. Heat	☐ Fossil fuel (*example: natural gas, propane*)	☐ Only occasional for frost/freeze protection
	☐ Biomass (*example: wood, corn*)	☐ Routine, to keep air above freezing in winter
	☐ Passive solar	☐ Routine, to keep optimum range for crop growth
	☐ Geothermal	☐ Other:
I. Other	☐ Automated or manual venting	☐ Moveable
	☐ Double wall plastic covering	☐ Single wall plastic covering
	☐ Growing on tables	
	☐ Geothermal	☐ Other:

Section 5. Your entire farm operation

22. Please list the amount of land that you:

a. Farm: _____ acres
i. Of the land you farm, how many acres do you own? _____ acres
ii. Of the land you farm, how many acres do you use to raise specialty crops? _____ acres

23. In what year did you personally begin farming, for yourself or others? _____

24. How many years have you personally farmed using high tunnels? _____

25. In a typical year, what is the value of your farm's gross income?

☐ Less than $5,000	☐ $50,000 to $149,999	☐ $500,000 to $999,999
☐ $5,000 to $9,999	☐ $150,000 to $349,999	☐ $1 million to $4,999,999
☐ $10,000 to $49,999	☐ $350,000 to $499,999	☐ $5 million +

26. In a typical year, what is the value of your farm's revenue from specialty crops sales?

☐ Less than $200	☐ $10,000 to $24,999	☐ $100,000 to $249,999
☐ $200 to $999	☐ $25,000 to $49,999	☐ $250,000 to $499,999
☐ $1,000 to $9,999	☐ $50,000 to $99,999	☐ $500,000 +

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27. In a typical year, what proportion of your specialty crops revenue comes from high tunnel production? ☐ 0% ☐ 1-25% ☐ 26-50% ☐ 51-75% ☐ 76-99% ☐ 100%

28. In a typical year, what is the dollar value of your farm's sales from high tunnels? $ _____

29. How much money has your farm spent **out of pocket** on high tunnel infrastructure?
☐ Less than $999 ☐ $1,000 to $4,999 ☐ $5,000 to $9,999 ☐ $10,000 to $19,999 ☐ $20,000+

30. How likely is your farm to purchase a future high tunnel **without** NRCS or other cost share funding?

Not at all likely	Not very likely	Neutral	Somewhat likely	Very likely
☐	☐	☐	☐	☐

Section 6. Demographics & conclusion

31. What describes your relationship to the farm? Check all that apply	☐ Owner or co-owner	☐ Employee	☐ Other:

32. In what year were you born?		**33.** What is your gender?	

34. What percentage of your household income:

a. Does the farm supply?	%
b. Comes from off-farm employment?	%

35. May we contact you with follow-up questions? If so, please provide your phone number. Be sure to provide the area code.

36. How much schooling have you completed?
☐ Less than high school ☐ High school diploma / GED ☐ Some college ☐ Associate / technical degree ☐ Bachelor's degree ☐ Graduate / professional degree

37. Please list post-high school ag education/training/workshops that you have completed or are currently enrolled in:

38. What are the most SERIOUS CONCERNS and/or GREATEST OPPORTUNITIES you consider with your farm's high tunnel operations? **If your farm DOES NOT USE your high tunnel,** please share your reasons for that.

7

Thank you for completing this very important survey!

Please use the stickers enclosed to seal your survey and drop it in the nearest mailbox.

J. Farmer
1025 E. 7th St.
Bloomington, IN 47405

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Mapping potential foodsheds using regionalized consumer expenditure data for Southeastern Minnesota

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Abstract

The theoretical concept of a foodshed is nearly a century old, while the tools used to model them—computer software coupled with spatial and statistical datasets—are ever-evolving. In a previous study (Galzki, Mulla, & Peters, 2014), foodshed maps have been created in Southeastern Minnesota that display the potential for local food system capacity in the region. Several assumptions were made based on data and software limitations that make the former results quite theoretical; this study attempts to move those results closer to reality by updating, where relevant. We utilized data produced by a model developed at the University of Minnesota to more effectively estimate regional food expenditures to create a representative diet in the region. We used current land-use data along with site-specific crop yields to analyze the potential food capacity of the region. We used optimization software to allocate food supplies to 53 cities in an attempt to feed all residents in the region and minimize food transportation distances. Improvements in software capacities allowed us to incorporate larger datasets, resulting in more detailed maps and statistics that better represent the potential of local foods in the region. The optimization model indicated the region is capable of sustaining its population entirely on locally derived foods. Each resident can be fed on approximately one-third of a hectare (0.85 acre) of land in the region. The average distance a unit of food travels from

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farm to grocery store was found to be 15.6 km (9.7 miles). Results also show that 90% of the cultivated land remains in surplus after meeting the food demands of the region, minimizing the impacts on the local agroeconomic system. The surplus of pasture land is smaller, but over half the pasture land in the region is in surplus after food needs are met. We explore an alternative land-use scenario that removes environmentally sensitive cropland from cultivation to illustrate the impact conservation efforts may have on a potential local food system. The updated results of this study bolster the evocative effect of mapping foodsheds and provide a more realistic illustration of how the region could sustain itself on locally derived foods.

Keywords
Geographic Information Systems (GIS); Foodshed; Local Food System Capacity; Food System Mapping; Minnesota

Introduction

The term foodshed was originally introduced as analogous to watersheds. Instead of geographical landforms guiding the flow of water to an outlet, as in a watershed, foodsheds describe the economic forces that guide the flow of where food is produced and how it is transported to an outlet such as a city where it is consumed (Hedden, 1929). This concept introduced nearly a century ago was revisited to help illustrate how food systems work and to suggest that food sources must be protected (Getz, 1991). Foodsheds have been recently used to discuss a more locally reliant food system addressing issues such as food security and sustainability concerns as well as social and environmental impacts of food systems (Hendrickson, Kloppenburg, & Stevenson 1996; Bills, Peters, & Wilkins, 2009). The importance of a local food system is reflected in the benefits associated with it; these include local economic impacts, health and nutritional benefits, increased food security and sustainability, potential energy usage reductions, increased use of ecologically sound production and distribution methods, and the enhancement of social equity and democracy for a community (Feenstra, 1997; Martinez et al., 2010).

While foodsheds started as a conceptual idea, recent attempts to map them are producing visuals that illustrate local food system potential. A number of foodshed maps have been created for areas across North America as well as areas overseas (Peters, Bills, Wilkins, & Fick, 2009; Hu, Wang, Arendt, & Boeckenstedt, Boeckenstedt, & Hu, 2011; Kremer & DeLiberty, 2011; Musavi & Holden, 2013). These often represent theoretical footprints that display what a local food system could look like on the landscape. An optimization model developed for New York State (Peters et al., 2007) considered an ideal diet, census population data, agricultural land-use data, and site-specific crop yield data to display the geographical extent of food demands in New York. This model was adapted to a region in Southeastern Minnesota by Galzki et al. (2014) and further updated here.

This study is one of a set of research projects funded by the University of Minnesota Southeast Regional Sustainable Development Partnership as part of its Southeast Foodshed Planning Initiative. The region has a decades-long local foods history that has cultivated a system continually growing and evolving today. This is evidenced by the number of producers, community supported agriculture farms, farmers markets, cooperative grocery stores, value-added local products on the shelves of natural food and mainstream groceries alike, as well as current developments around institutional markets, aggregation and distribution centers, and financing tools. Furthermore, fertile soils found in Southern Minnesota yield a high agricultural productivity in the region. When estimating each state's ability to supply itself with local foods, Timmons, Wang, and Lass (2008) found that Minnesota has the highest potential in the country; the study estimated the state can supply 90% of its food needs with locally grown food. Due to the amount of current local food framework and support mechanisms coupled with the high potential for agricultural food production, this region is a prime candidate for analysis of local food capacity.

Study Area

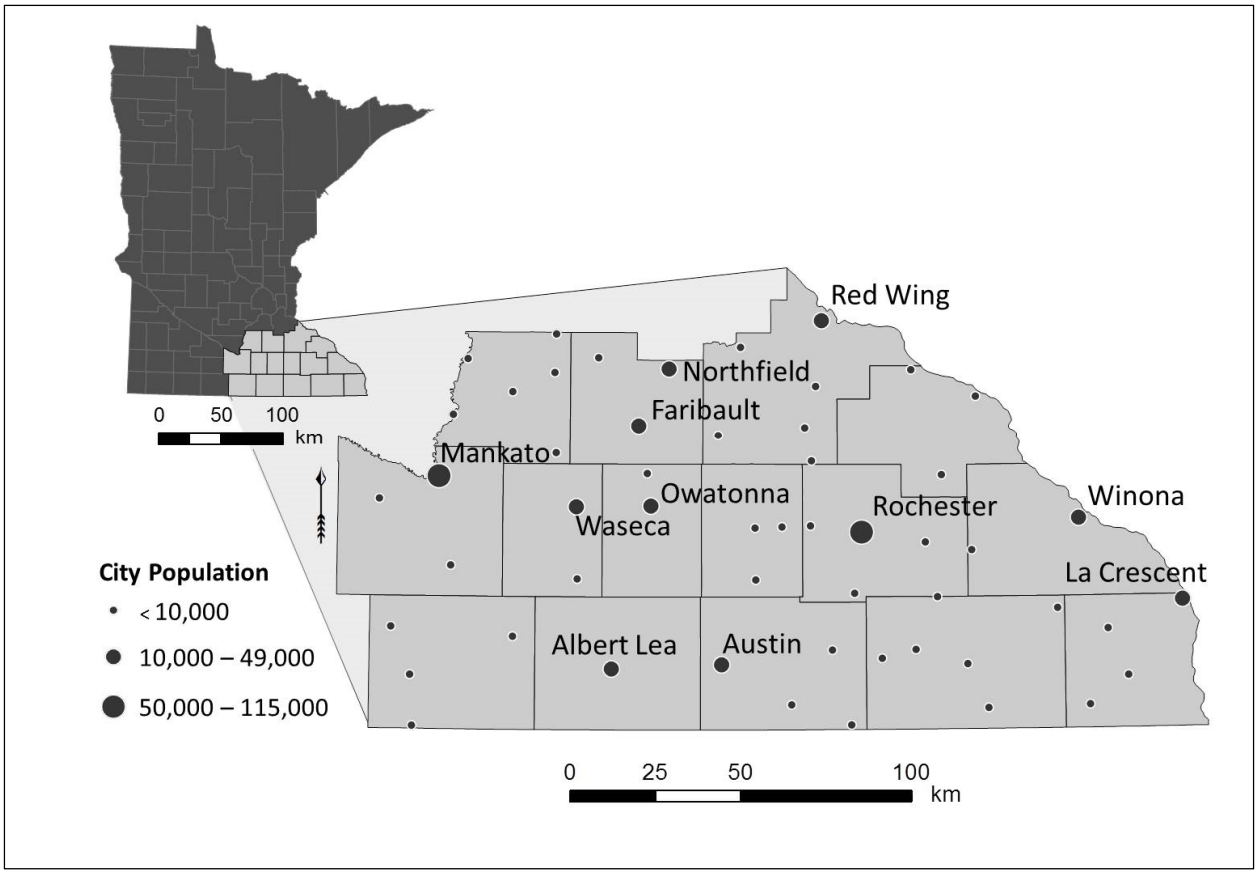
A 15-county region was defined in Southeastern Minnesota that acts as a boundary for both population data and agricultural production potential data within the foodshed model. Individual

foodsheds are centered on population centers. It is assumed all food is delivered to this center directly from where it is produced, and the population will acquire food products from it. A population center was generated for every grocery outlet in the region, which resulted in 53 cities being used in attempt to represent the current system of food distribution (Figure 1). A Thiessen polygon analysis of these cities was used to aggregate census block data. In other words, residents of rural areas surrounding the 53 cities were assigned to their nearest population center, as it was assumed this is where they would acquire grocery products. The total population in the region is just over 620,000 people, which is largely dispersed in small towns and rural areas. Over 40 of the population centers have 10,000 or fewer residents. Rochester, the largest population center in the region, has 115,000 residents based on the Thiessen polygon analysis.

Materials and Methods

To determine potential food supply in the region, production zones were created which act as food supply points within the optimization model. Former studies utilizing this model employed 5 km (3.1 mi) by 5 km (3.1 mi) production zones (Galzki et al., 2014; Peters et al., 2009). Frontline's premium solver platform with an LP/QP (linear programming/quadratic programming) extended engine was utilized for this optimization (Frontline Systems, Inc., 2005). This extension, designed for large scale optimizations, implies higher computing power and increased the amount of data that can be accommodated by the model. Production zone size was decreased to 2 km (1.2 mi) by 2 km (1.2 mi) to increase detail in resulting maps and statistics. The amount of perennial and cultivated land was calculated for each zone. Within the model, annually cultivated lands create a supply of fruits,

Figure 1. Extent of the Study Area in Southeastern Minnesota and the 53 Cities Used as Distribution Points with Aggregated Population



vegetables, and grains in the region and also include considerations for livestock feed. Since cultivation in Minnesota is restricted by its growing season, anticipated use of preserved and processed foods, such as canned vegetables in the winter, were also considered. Perennial lands, which represent pastured areas, are used to supply meat, milk, and eggs in the region.

Food demand in former studies has been based on a theoretical ideal diet based on food guide pyramid recommendations (Peters et al., 2009; Galzki et al., 2014). This 2300 kcal day^{-} diet consisted of 170 g (6 oz.) of meat per person per day, with 40% of total calories coming from fat. This ideal basket of food originally created with New York climate considerations was termed a human nutritional equivalent and was adapted to Minnesota growing conditions covered in detail in previous work (Peters et al., 2007; Galzki et al., 2014). The diet accounted for seasonal food availability, as well as storage and processing losses with preservation methods.

To create a diet that more closely represents what residents in the area are consuming, recent economic survey data were analyzed. The most recent consumer expenditure survey at the time of analysis (U.S. Bureau of Labor Statistics, 2013) was utilized; this survey details categorical food expenditures and how they vary based on 10 demographic categories. In a process outlined by Wang (2011) and refined by Dietrich (2013) as part of the University of Minnesota's Southeast Foodshed Planning Initiative, these data were coupled with American Community Survey county-level demographic statistics to determine region specific food expenditures (U.S. Census Bureau, 2013). The consumer expenditure survey has two data categories that weren't considered because their constituents are too ambiguous to fit into the foodshed model. Food away from home largely represents restaurant expenses, and the miscellaneous foods category includes things such as frozen meals, spices, and condiments. By excluding these categories, the representative diet created considered only at home common food expenditures (Table 1).

The categories found in the consumer expenditure survey were aggregated into 7 groups for easy comparison to the ideal diet used previously by the model: grains, meat and eggs, fruit, vegetables, dairy, oils, and sweets. Since the ideal diet was modeled in portion size and not expenditures, prices for all constituents of the ideal diet were determined using historic 2008 retail food prices from the Bureau of Labor Statistics (n.d.) or fruit and vegetable prices from the Economic Research Service (n.d.). All prices were determined in 2008 US dollars for consistency. Once all commodity prices had been catalogued, the ideal diet was compared to regional consumer expenditures, and all portion sizes in the ideal diet were scaled to match current Southeastern Minnesota expenditures. Recent estimates of average daily per capita calorie

Table 1. Categories and Brief Descriptions of the Consumer Expenditure Survey Used

Category	Brief Description
Cereal	Flour, cereal, rice, pasta, etc.
Bakery products	Bread, cakes, rolls, cookies, etc.
Beef	All cuts of beef excluding canned
Pork	All cuts of pork excluding canned ham
Other meat	Hot dogs, lunchmeat, lamb, etc.
Poultry	Chicken, turkey, other poultry
Seafood	Canned, fresh, and frozen seafood
Eggs	Eggs
Milk products	Fresh milk and cream
Other dairy	Butter, cheese, ice cream, yogurt, etc.
Fresh fruit	Apples, bananas, citrus, etc.
Processed fruit	Frozen fruit, juices, dried, canned
Fresh vegetables	Potatoes, lettuce, carrots, etc.
Processed vegetables	Frozen and canned vegetables, dried beans, etc.
Sweets	Sugar, candy, jam, etc.
Oils	Margarine, oils, salad dressings, etc.

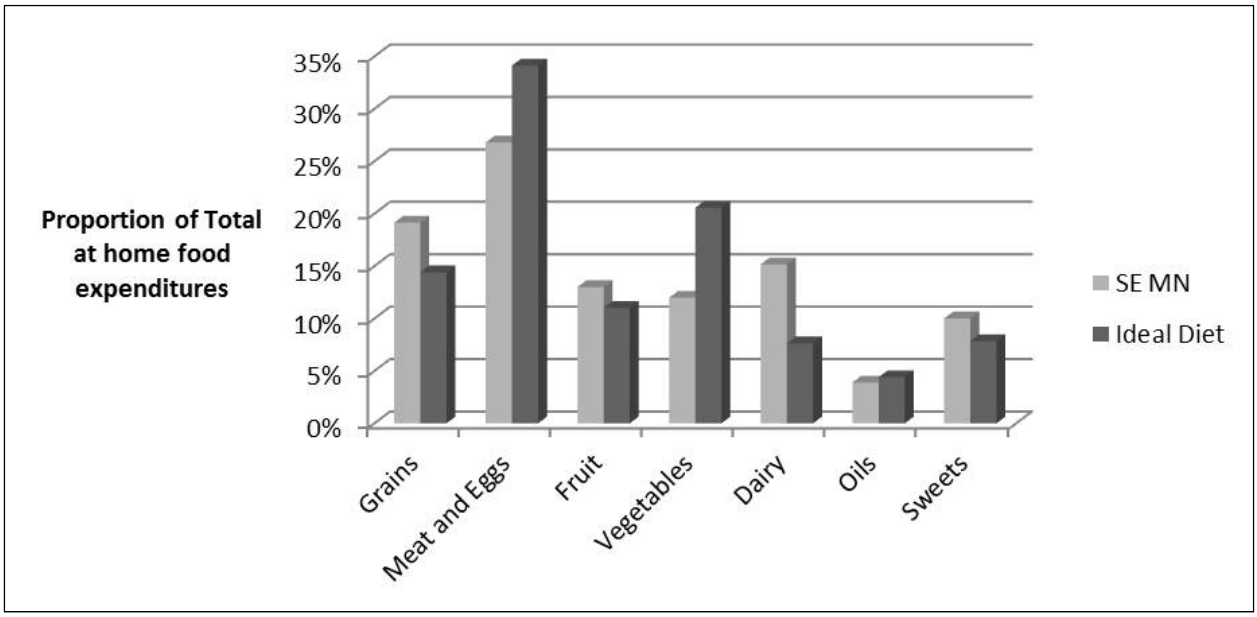
intake for the United States are just under 2,600 kcal (USDA Economic Research Service, 2014), so the representative diet was scaled to reflect these data (Appendices 1 and 2).

Based on consumer expenditure analysis, distinct variance was observed in the ideal diet used in previous studies and the representative diet created here. Most notably, expenditures on vegetables in the region were half of what the food guide pyramid recommends for the ideal diet. The region is also spending less on meat and eggs. The regional expenditures are much higher for dairy products than the ideal diet, and sweets, grains, and fruit expenditures are slightly more than what is seen in ideal diet expenditures (Figure 2).

The representative diet created for the region was then translated into agricultural land demand by analyzing crop yields for each of the constituents of the diet. The original model used New York state crop yields; the model was adapted to Minnesota specific crop yields using five-year USDA National Agriculture Statistics Service (USDA NASS) (2011) data for all counties in the region. Crop yield goals were used when NASS data were not available (Rosen and Eliason, 2005). Processing losses, as well as adjustments for inedible portions, were both accounted for. Additionally, feed crops were considered when determining land demands. A serving of beef, for instance, includes both the pasture land needed for grazing cattle in addition to annually cultivated land used to grow livestock feed. Because of these considerations, meat and dairy products require both pasture and cultivated land within the model.

Food demand was determined for each of the 53 cities based on the representative diet and population data. Supply of both cultivated land and pasture land was calculated for each of the 2 km (1.2 mi) by 2 km production zones created in the region. Straight-line distances from each production zone to each city were also calculated, which the model used to minimize the sum of delivery distances from farm to supply point. The structure of the optimization was described previously by Peters et al. (2009). Frontline's Risk Solver Platform was used to carryout optimization within Microsoft Excel (Frontline Systems, Inc., 2005). A single spreadsheet was used containing a variable matrix that allowed the optimization software to explore every possible allocation scenario of delivering food products, derived from both cultivated and pasture lands, from each of the 6000 production zones to each of the 53 cities used in the region. The variable matrix was constrained by

Figure 2. Comparison of the Proportion of At-Home Expenditures for the Ideal Diet and the Representative Southeastern Minnesota Diet



both the production potential within each zone and by the maximum production demanded by each population center. A distance matrix was used in the model that contained distances from each of the 6000 zones to each of the 53 cities. Finally, an equation summed the total distances of delivered food products for each allocation scenario, and the optimization determined the scenario with the lowest delivery distance in which either all food demand was met, or all agricultural supply was exhausted in the region.

Alternative Land-use Scenario

An alternative land-use scenario was explored to determine the potential impact of removing marginal cropland from cultivation in environmentally sensitive landscapes. Based on the constituents of the representative diet used, pasture land is both in higher demand and lower supply in the region. In this alternative scenario, a portion of annually cultivated lands was converted to pasture land where cropland was both marginal for productivity and environmentally vulnerable based on the indices described below. Annual cultivation in vulnerable areas can lead to environmental concerns such as soil degradation and surface water contamination. By removing a portion of land from cultivation, these issues can be addressed; also increasing the supply of pasture land would result in a decrease in foodshed size, implying reduced delivery distances.

Two indices were employed to determine lands suitable for removal from cultivation. The crop productivity index (CPI) was developed by the Natural Resources Conservation Service in Minnesota and represents a rating of potential yield of one soil against another. Ratings range from 0, or lowest productivity, to 100, or maximum productivity (Minnesota IT Services, n.d.). Due to a marginal production potential, cultivated land was selected based on 30 m grid cells with CPI ratings of 50 or less to be considered for conversion to pasture. A second index, the environmental benefits index (EBI), ranks lands based on their potential ecological benefit. The EBI values land that would benefit when removed from cultivation based on three different ecological concerns. The first represents a soil degradation risk based on the Universal Soil Loss Equation.[1] The index also evaluates lands that have potential for providing quality habitat based on several habitat considerations. Finally, a high value is given to lands associated with a surface water quality risk based on both proximity to surface waters and overland flow paths. Each component contributes 100 points to the EBI with values ranging from 0 to 300; higher values indicate areas that would more strongly benefit from removal of annual cultivation (Minnesota Board of Water & Soil Resources, n.d.). Lands where CPI is under 50 were intersected with areas that had EBI scores above 150 to represent both low-productivity and ecologically valuable land parcels. Characteristics of such lands suitable for conversion include cultivated areas with steeper slopes, shallow topsoil, close proximity to surface waters, or areas important for local biodiviersity.

Results

Even though daily caloric intake in the representative regional diet increases by nearly 300 kcal, the diet is made up of more products with higher food yields per acre, such as grains, and is lacking in meats and vegetables, which have lower food yields per acre. Due to the breakdown of the representative regional diet, it requires a smaller agricultural footprint than one following food guide pyramid recommendations with fewer calories. Based on this regional representative diet and Minnesota specific crop yields (Appendices 1 and 2), each person in the region requires 0.16 ha (0.39 ac) of cultivated land and 0.18 ha (0.46 ac) of pasture land to supply their nutritional demands for the year. The ideal diet used in a previous study within the region required the same amount of cultivated land, but an additional 0.05 ha (0.12 ac) of pasture land was needed, making the agricultural footprint of the ideal diet larger despite how it provides fewer calories.

Using the updated regional diet, total agricultural land demand per person in Southeastern

[1] The Universal Soil Loss Equation is a widely accepted empirical formula developed by the USDA that estimates soil erosion by rainfall impact and surface runoff (USDA ARS, n.d.).

Minnesota is just under 0.35 ha yr (0.85 ac yr). With 620,000 residents in the region, this translates into a total agricultural land demand of approximately 214,000 ha (530,000 ac). According to the Multi-Resolution Land Characteristics Consortium's (2011) National Land Cover Dataset, the 15-county study area in Southeastern Minnesota contains nearly 1,700,00 ha (over 4,000,000 acres) of agricultural land cover including both perennial pasture land and annually cultivated land, which is more than enough to sustain the population on local foods. However, within the region, 85% of all agricultural land is devoted to annual cultivation. Most of the western portion of the region contains flatter slopes and productive soils, where cultivation is focused. The eastern edge of the region is dominated by high-relief bluff lands draining to the Mississippi River and is where more of the pasture land exists. The proportion of cultivated and pasture lands, as well as their locations within the region, largely influence foodshed size and food delivery distances.

Considering food demands of the representative regional diet, regional population data, and the availability of cultivated and pasture land, the model concluded that it is feasible for Southeastern Minnesota to feed itself entirely on locally derived foods. The extent of each foodshed is again largely determined by the proximity of a city to cultivated and pasture land. The model outputs are mapped and illustrate both cultivated foodsheds and pasture foodsheds (Figures 3 and 4).

Of the 1,426,000 ha (3,500,000 ac) of annually cultivated land in the region, less than 10% is needed to provide the entirety of cultivated food demands of the population. Cultivated land is both in higher supply in the region and in lower demand based on the constituents of the representative diet, which is reflected in the small footprint defined by cultivated foodsheds and small food delivery distances relative to pasture land considerations. The average distance a unit of cultivated food travels within the modeled scenario is 10.8 km (6.7 mi).

As for pasture lands, 250,000 ha (620,000 ac) exist in Southeast Minnesota. Of these available pasture lands, just under half are needed to provide for the local pasture food demand. Smaller supply of pasture lands coupled with a higher dietary demand translate into larger foodsheds and increased food travel distances. A unit of food derived from pasture land travels an average of 30 km (18.6 mi) to get from farm to distribution center. When cultivated and pasture food distances are combined based on their proportion of the total regional diet, the average distance each unit of food travels within the region is 15.6 km (9.7 mi).

The amount of agricultural land needed to meet food demands is only part of the actual areal coverage of the foodshed. Agricultural lands are intermixed with forest lands, urban areas, surface water, wetlands, and other land forms. Delivery paths are also included in the foodshed footprint, so if a parcel of agricultural land is not adjacent to the city it's delivered to, the cells along the delivery route are included. Thus, actual size of the foodshed footprint differs from agricultural land demanded in resulting statistics (Table 2).

Alternative Land-use Scenario

In this hypothetical scenario, cultivated lands that were defined as low productivity and ecologically valuable were removed from annual cropping practices to increase pasture land availability. Again, the overall goal is to explore the impact of one potential scenario of utilizing the large surplus of cultivated land in the region to benefit soil and water resources. Approximately 26,000 ha (63,000

Table 2. Agricultural Land Demand, Foodshed Footprint Size, and Food Delivery Distances for the Current and Alternative Land-use Scenarios

	Current Land Use			Alternative Scenario		
	Cultivated	Pasture	Total	Cultivated	Pasture	Total
Agricultural Land Demand (ha)	98,600	114,700	213,300	98,600	114,700	213,300
Foodshed Footprint (ha)	328,000	1,505,200	1,546,000	342,800	1,569,600	1,618,800
Food Delivery Distances (km)	10.8	29.9	15.6	11.1	23.7	14.2

Figure 3. Cultivated Foodsheds in Southeastern Minnesota

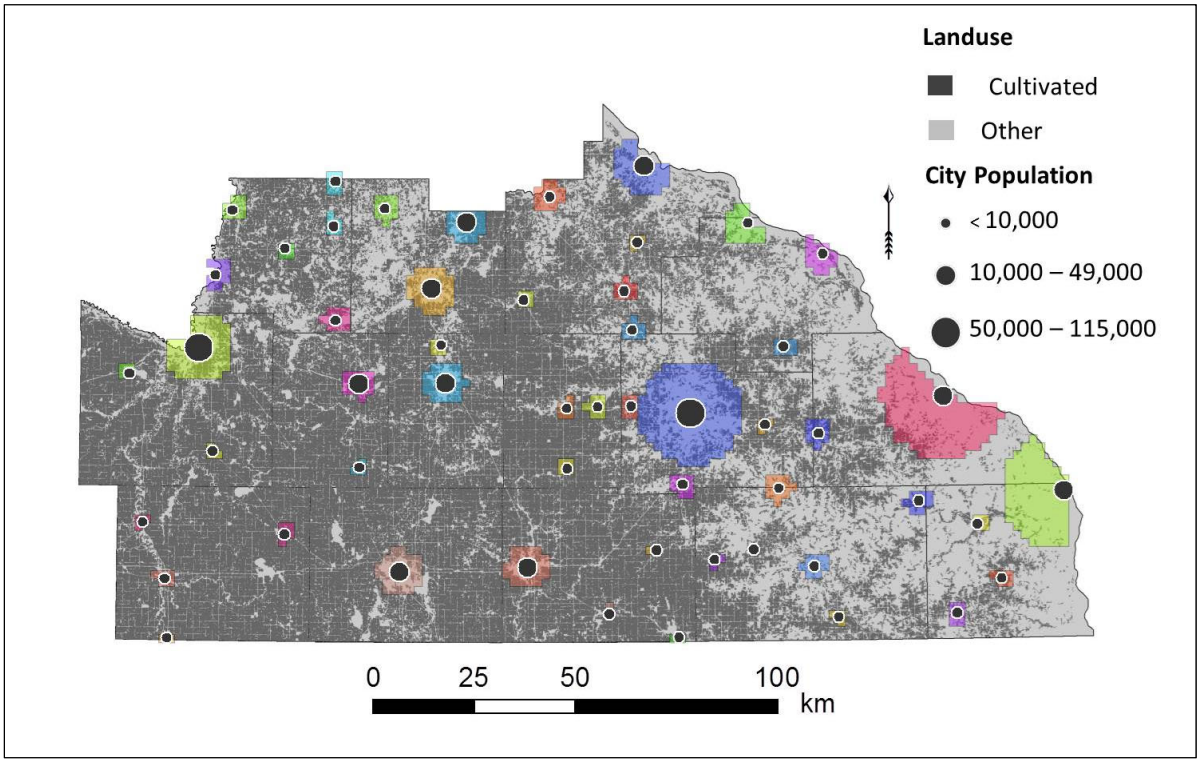
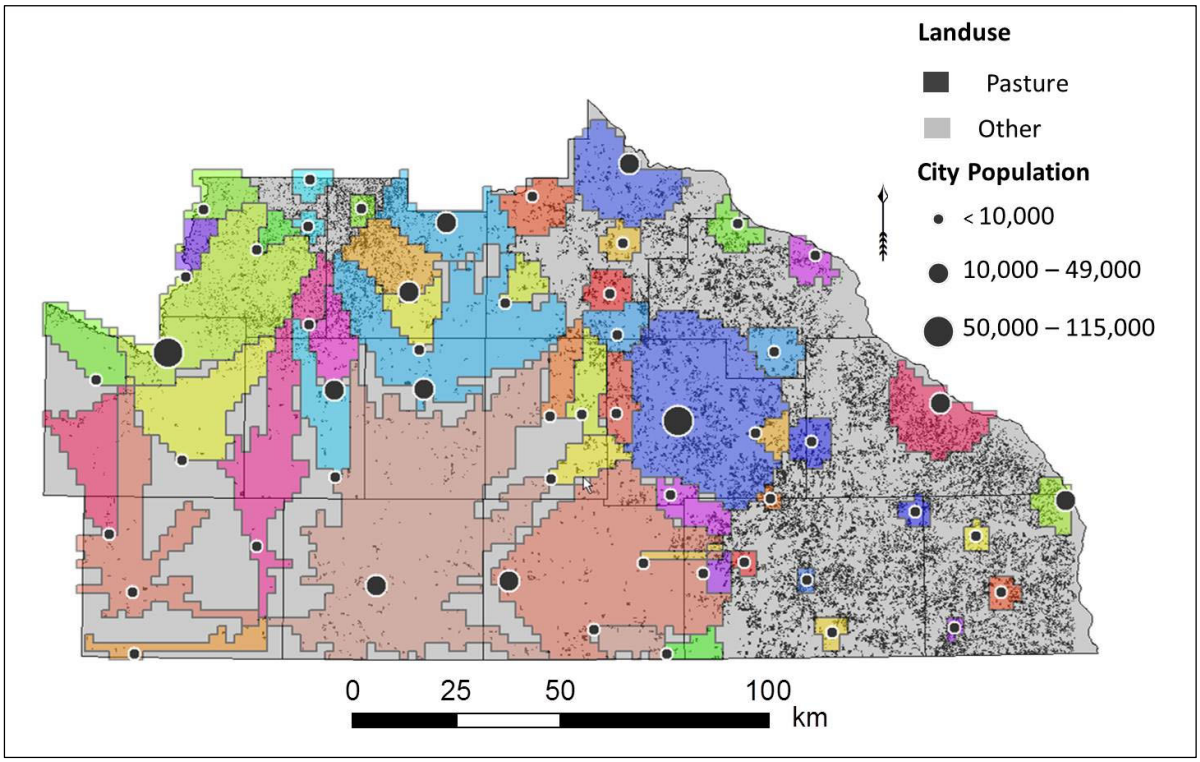


Figure 4. Pasture Foodsheds in Southeastern Minnesota



ac) were removed from cultivation and added to the potential supply of pasture land, which represents less than 2% of the available cultivated land in the region. This small-scale conversion would not only reduce potential pressure on soil and water resources in vulnerable areas, it also decreases the average total food delivery distance from 15.6 km (9.7 mi) to 14.2 km (8.8 mi). Since the model optimizes delivery distances and not foodshed footprint size, the footprint actually increases. This data artifact is a reflection of smaller more dissected parcels of pasture land that are closer in proximity to cities. Although they reduce delivery distances and satisfy the optimization, they require an increased number of delivery paths and thus a slight increase in footprint size (see Table 2).

Discussion

Soil and water conservation is simply one example of how an agricultural land surplus can be explored to further increase the benefits of utilizing local foods. From an economic standpoint, 90% of the regional cultivated land could be dedicated to commodity crops. When regional NASS land rental rates are used to value this land surplus, it could provide over $800 million to the local economy. If agricultural land in Southeastern Minnesota is dedicated solely to provide local foods to Minnesotans, the 15-county area could supply all of the cultivated food demands and over 70% of the pasture food demands to the entire state's population of over 5 million people. When figuring the other 30% of pasture food needs could easily be met by Minnesota lands outside this region, one can conclude that Minnesota can theoretically be fed entirely on Minnesota grown foods based on the assumptions made in this study.

Although assumptions are made throughout this modeling process that create theoretical results, recent updates to the methodology and data inputs make these results much closer to reality than past iterations. The results found here illustrate local food potential in the region and have been disseminated to local stakeholders, stimulating interest in local foods and advancing the regional/local foods conversation. Demand for local foods in the region continues to grow, as do the number of farms that produce them (Low & Vogel, 2011; Martinez et al., 2010; National Farm to School Network, 2017; National Restaurant Association, 2014). Most of the growth to date has been associated with direct-to-consumer marketing. With consumer interest expanding beyond direct domestic purchases, the complex challenges of developing robust, fully-functioning local food systems have become more apparent. In addition, promotion of local food systems and associated sustainable production practices are now being embraced for their multiple social and natural resource benefits by professional societies such as the American Planning Association and the Academy of Nutrition and Dietetics (American Planning Association, 2007; Tagtow et al., 2014). For the first time, the environmental impacts of food production and the idea of sustainable diets for long-term food security have been included in the recommendations for revised federal dietary guidelines (Dietary Guidelines Advisory Committee, 2015). In Minnesota, public health and other partners are now also attempting to increase access to local foods as a health-improvement and equity strategy (Minnesota Department of Health, n.d.; Minnesota Food Charter, n.d.). This has also increased institutional demand for local foods in school and hospital cafeterias. Such demand significantly outweighs available supply, and public institutions purchasing large quantities of food cannot match the premium prices producers have been receiving via direct-to-consumer or tight intermediary markets such as restaurants. These developments are amplifying the ongoing challenges of aggregating supply from numerous farmers to meet high demand, adequate transportation, timely distribution, and satisfactory farmer income and livelihood. The results from this study provide additional information and encouragement to decision-makers in business and government to promote supportive policies and enterprise development investments in their local food systems.

Foodsheds in this study were created with widely available data. The original model developed for New York was updated with Minnesota specific crop yields, but it could be replicated for nearly any part of the country based on local crop or soil productivity data. Other data including population and land-use are available nationwide.

With relative ease, this model could create foodsheds in nearly any part of the United States, or worldwide if appropriate data exists. Therefore local food potentials could be explored in nearly any geographical area and may lead to similarly informative results.

Conclusions

Based on the methods explained in this study, the 15-county region in Southeastern Minnesota has the theoretical capacity to feed itself entirely on locally derived foods. The model found that New York State could only feed one-third of its population on local foods. Although the extremely large population of New York City is an outlier affecting these results, it is encouraging to note the results of the model in the Midwest without the influence of a very large metropolitan area. The average distance a unit of food would travel in Southeastern Minnesota is 15.6 km (9.7 mi) compared to 49 km (30 mi) in New York State. Alternative land management techniques can be explored that not only reduce this travel distance to 14.2 km (8.8 mi), but could also reduce pressure on soil and water quality degradation.

Achieving a functional, viable local food system that is an integrated, significant component of a locale's overall food system has many hurdles, as noted above. Given the assumptions made in this modeling effort, the Southeastern region, and the state of Minnesota as a whole, have the capacity to meet the food requirements of local populations on locally produced foods. Illustrating this potential with foodsheds will hopefully evoke thought, inspire visions, and cultivate change in the region's food system. Foodshed maps could be generated for any region in the world with the potential for similarly illustrative results. Although these illustrations lack an economic analysis for the feasibility of local foods, they can and have been used to advance the conversation of local foods in the region. They offer a planning tool to move toward a reality of agricultural land clustered around population centers to meet some percentage of food self-reliance and the creation of a sustainable food system for future generations.

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Appendix A. Constituents of the Ideal Diet for Summer Months as Well as Average Yields for Southeastern Minnesota and Estimated Consumption for Each Processed Constituent

	Average Yield	Estimated Consumption (g/person/day)
GRAINS		
Wheat	43 bu/ac	219.7
Rye	30 bu/ac	1.5
Corn	145 bu/ac	17.5
Oats	73 bu/ac	11.0
VEGETABLES		
Carrots (fresh)	400 cwt/ac	16.7
Endive/escarole (fresh)	180 cwt/ac	0.3
Lettuce (fresh)	300 cwt/ac	22.1
Spinach (fresh)	150 cwt/ac	2.2
Squash, winter (fresh)	300 cwt/ac	3.9
Beets (canned)	10 t/ac	1.2
Bell peppers (fresh)	200 cwt/ac	2.4
Cabbage (fresh)	400 cwt/ac	2.3
Cauliflower (fresh)	150 cwt/ac	0.8
Cucumbers (fresh)	250 cwt/ac	3.3
Eggplant (fresh)	250 cwt/ac	0.5
Onions (fresh)	500 cwt/ac	11.7
Snap beans (fresh)	3 t/ac	4.3
Tomatoes (fresh)	270 cwt/ac	36.7
Green peas (frozen)	1.5 t/ac	3.3
Green peas (canned)	1.5 t/ac	3.5
Potatoes (fresh)	167 cwt/ac	41.2
Sweet corn (fresh)	7 t/ac	11.2
FRUIT		
Blueberries (fresh)	50 cwt/ac	6.8
Strawberries (fresh)	100 cwt/ac	24.4
Apples (fresh)	140 cwt/ac	88.9
Cherries (fresh)	45 cwt/ac	3.1
Grapes (fresh)	60 cwt/ac	19.5
Plums (fresh)	80 cwt/ac	33.8
Pears (fresh)	100 cwt/ac	32.3
Apple juice	8,840 lbs/ac	106.8
Grape juice	4,180 lbs/ac	46.8
DAIRY		
Milk — whole (3.7%)*	4,917 lbs/ac	987.3
PULSES		
Beans - black	2,361 lbs/ac	0.6
Beans — kidney	2,361 lbs/ac	0.6
Soybeans	47 bu/ac	0.7

	Average Yield	Estimated Consumption (g/person/day)
NUTS AND SEEDS		
Sunflower seeds	1,105 lbs/ac	0.3
MEAT AND EGGS		
Beef*	1,561 lbs/ac	37.0
Pork*	1,800 lbs/ac	30.8
Chicken*	1,577 lbs/ac	47.8
Eggs*	3,721 lbs/ac	26.6
OILS		
Canola oil	1,527 lbs/ac	1.0
Soybean oil	2,823 lbs/ac	16.5
Sunflower oil	1,517 lbs/ac	0.1
SUGARS		
Beet sugar	30,000 lbs/ac	70.3

* Yield values represent pounds of processed edible product

Appendix B. Constituents of the Ideal Diet for Winter Months as Well as Average Yields for Southeastern Minnesota and Estimated Consumption for Each Processed Constituent

	Average Yield	Estimated Consumption (g/person/day)
GRAINS		
Wheat	43 bu/ac	214.0
Rye	30 bu/ac	1.5
Corn	145 bu/ac	17.1
Oats	73 bu/ac	10.7
VEGETABLES		
Carrots (fresh)	400 cwt/ac	33.9
Squash, winter (fresh)	300 cwt/ac	7.9
Spinach (frozen)	150 cwt/ac	14.8
Beets (canned)	10 t/ac	1.4
Cabbage (fresh)	400 cwt/ac	2.6
Cauliflower (frozen)	150 cwt/ac	1.7
Onions (fresh)	500 cwt/ac	13.3
Snap beans (frozen)	3 t/ac	2.8
Snap beans (canned)	3 t/ac	2.8
Tomatoes (canned)	270 cwt/ac	59.1
Green peas (frozen)	1.5 t/ac	3.2
Green peas (canned)	1.5 t/ac	3.4
Potatoes (fresh)	167 cwt/ac	40.2
Sweet corn (frozen)	7 t/ac	6.2
Sweet corn (canned)	7 t/ac	6.2
FRUIT		
Apple juice	8,840 lbs/ac	104.0
Grape juice	4,180 lbs/ac	45.6
Blueberries (frozen)	50 cwt/ac	4.2
Strawberries (frozen)	100 cwt/ac	20.3
Apples (fresh)	140 cwt/ac	99.9
Cherries (frozen)	45 cwt/ac	1.9
Plums (canned)	80 cwt/ac	25.6
Pears (fresh)	100 cwt/ac	36.4
DAIRY		
Milk — whole (3.7%)*	4,917 lbs/ac	999.3
PULSES		
Beans — black	2,361 lbs/ac	0.6
Beans — kidney	2,361 lbs/ac	0.6
Soybeans	47 bu/ac	0.8
NUTS AND SEEDS		
Sunflower seeds	1,105 lbs/ac	0.3
MEAT AND EGGS		
Beef*	1,561 lbs/ac	37.4

	Average Yield	Estimated Consumption (g/person/day)
Pork*	1,800 lbs/ac	31.2
Chicken*	1,577 lbs/ac	48.4
Eggs*	3,721 lbs/ac	26.9
OILS		
Canola oil	1,527 lbs/ac	1.0
Soybean oil	2,823 lbs/ac	16.7
Sunflower oil	1,517 lbs/ac	0.1
SUGARS		
Beet sugar	30,000 lbs/ac	71.0

* Yield values represent pounds of processed edible product

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Merging opposing viewpoints: Analysis of the development of a statewide sustainable local food advisory council in a traditional agricultural state

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Abstract

Food policy councils (FPCs) are a useful way for interested groups to work together to create mutually beneficial change within the food system. Often formed through grassroots organizing or commissioned by governmental entities, FPCs have been successful at tackling challenges within food systems by creating forums to address issues whose roots ordinarily are in disparate parts of these systems. Little peer-reviewed research exists, however, examining the formation of state-level FPCs, particularly among states known for their conventional production practices. In this case study, we explored the process of forming a statewide FPC in North Carolina from 2007 to 2009. The objectives were to (a) qualitatively examine the two-year process of forming a statewide FPC in a traditional agriculture state, and (b) identify the factors that led to its formation. To do so, we developed an in-depth interview guide for interviewing eight individuals, including government stakeholders, conventional agricultural producers,

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sustainable agricultural producers, philanthropists, and legal representatives. We used qualitative analysis methods to analyze the transcripts, drawing on John Kingdon's agenda-setting and policy-formation theory to guide analysis. Results indicated that four factors drove the formation of the North Carolina state-level FPC: (1) stakeholder involvement, (2) diverse partnerships, (3) stakeholder ability to compromise, and (4) a conducive political setting. While the small sample size prevents us from causally interpreting our results and generalizing our findings, this preliminary research may provide insight for other states, especially those with a predominately traditional agriculture system, that are interested in forming state-level FPCs.

Keywords
State Food Policy Council; Case Study; North Carolina; Policy; Food System

Introduction

According to the Agriculture Sustainability Institute at the University of California, Davis, a food system is typically defined by five major components: production, processing, distribution, consumption, and waste management (Sustainable Agriculture Research and Education Program, n.d.). The U.S. food system has evolved significantly over the last 100 years, such that its components contribute severely to obesity, environmental degradation, and economic and health disparities (Drewnowski & Darmon, 2005; Drewnowski & Specter, 2004; Lakdawalla & Philipson, 2002; Wackernagel et al., 2002). The food system depends heavily on fossil fuels for production, processing, and distribution, which adversely affects the environment, concentrates wealth in the hands of a few large producers and multinational organizations, and contributes to farmland loss, particularly by farmers of color (Hinson & Robinson, 2008; Lobao & Meyer, 2001; Solomon et al., 2007). Nevertheless, many argue that conventional agriculture production supported by synthetic chemicals (pesticides and fertilizers) is the only way to meet burgeoning domestic and global food needs (Connor, 2012; Seufert, Ramankutty, & Foley, 2012). Food system stakeholders often have diverse and conflicting interests, which makes it difficult to identify simple solutions to these food systems problems. Food policy councils (FPCs) are one way for interested groups to work together to create change within the food system that mutually benefits all parties (Harper, Shattuck, Holt-Giménez, Alkon, & Lambrick, 2009). FPCs can also help draw attention to grassroots initiatives to improve local food systems and can act as a voice for these issues and concerns by recommending policies to local, state, and federal government (Borron, 2003; McCabe, 2010).

An FPC consists of representatives and stakeholders from various sectors of the food system (Harper et al., 2009). They typically include anti-hunger and food justice advocates, educators, members of nonprofit organizations, concerned citizens, government officials, farmers, grocers, chefs, workers, food processors, and food distributors (Harper et al., 2009). "Councils range from informal groups without a steering committee to more formal groups with a chair and executive committees. Those more formal groups sometimes included several subcommittees, or 'task forces' that specialize in researching and make recommendations on certain topics" (Harper et al., 2009, p. 27). Harper and colleagues (2009) found three main ways that FPC members are chosen: self-selection; application (reviewed by the exiting council, an executive board, or the initiating community members); and election, nomination, or appointment (chosen by governmental officials or an executive board). There are FPCs serving rural areas and tribal communities, as well as advising on food policy issues at the state and regional level.

The goal of FPCs is to bring diverse stakeholders together, identify and develop solutions to problems within the local food system, and offer recommendations for policy change (Harper et al., 2009). FPCs are often formed through grassroots organizing, but can also be commissioned by governmental entities (Harper et al., 2009). The first FPC in the U.S. started in Knoxville, Tennessee, in 1982 to help those struggling to meet food needs after aid program cutbacks, and to improve food equity, supply, and cost (Knoxville-Knox County Food Policy Council, n.d.). The number of FPCs in the U.S. and Canada rose sharply from 1990 to

2009 (Harper et al., 2009). The growth continues: the Community Food Security Coalition directory listed 92 FPCs in the U.S., Canada, and the Tribal Nations as of 2010 (Scherb, Palmer, Frattaroli, & Pollack, 2012). By 2015 the Food Policy Network project at Johns Hopkins University listed 282 FPCs in the U.S., Canada, and Tribal Nations (Food Policy Network, 2015a). Few of these are state-level FPCs, however: 32 percent of councils operate at the county or district level, 22 percent operate at the city or municipality level, 19 percent operate regionally, 13 percent influence counties and cities together, just 12 percent influence states or provinces, and two percent operate within tribes (Food Policy Network, 2015b).

There has been little peer-reviewed research examining food policy councils, and even less that has examined state-level organizations. A 2012 case study by John Cotton Dean explored the "challenges and opportunities" experienced by the Iowa state-level FPC, noting that it carried out a number of activities such as promoting local foods, streamlining the state's food stamps application process, and submitting food and agricultural policy recommendations to the governor (Dean, 2012). While these activities may have strengthened the food system, they were only described qualitatively by study participants. There is no evidence that the policy recommendations presented to the governor were ever implemented (Dean, 2012). Further, no outcomes such as a change in the food insecurity rate or an increase in food stamp utilization were measured to examine the impact of food policy council activities on the food system (Dean, 2012). A 2012 national survey of 56 FPCs by Scherb et al. found that 85 percent were engaged in policy activities at the time of the survey (Scherb et al., 2012). The authors stated that "few" FPCs mentioned evaluating their policy work, however, and they called for more rigorous evaluation efforts of FPC processes, impacts, and outcomes (Scherb et al., 2012). A 2015 qualitative study by Coplen and Cuneo noted that the Portland Multnomah Food Policy Council (PMFPC) in Portland, Oregon, had several achievements, including a healthy corner store initiative, a beginning farmer training program, and changes to zoning codes to expand urban agriculture. But this FPC was disbanded in 2012 due to its "waning relevancy," and no evaluation of its effects on the food system were measured (Coplen & Cuneo, 2015, p. 102).

Background

North Carolina is home to a number of county- and municipal-level FPCs. North Carolina formerly had a statewide FPC, formed in 2001, which came together with the help of the Drake University Agriculture Law Center, which had received a grant from the USDA to help establish FPCs in key states. The North Carolina FPC was active through the life of the grant, but because it lacked state-implemented legislation to mandate its existence as a state-sanctioned entity, it was disbanded at the end of the grant cycle in 2003. There was still interest among its members and others involved with the state food system in having a state FPC. The Center for Environmental Farming Systems (CEFS), a partnership between North Carolina State University, North Carolina Agricultural and Technical State University, and the North Carolina Department of Agriculture and Consumer Services, revived the idea of a statewide FPC in 2008.

As part of a more comprehensive initiative to develop a strategic action plan for building North Carolina's local food economy, CEFS led a series of statewide and regional meetings and listening sessions with interested individuals (Curtis, Creamer, & Thraves, 2010). Working Interest Teams (WITs) were formed around a variety of food-related issues, including a team that discussed forming a council. Members of this WIT drafted policy language and sent it to their legislators in various regions of the state. One member of the North Carolina House and one of the North Carolina Senate had already considered such legislation and instructed staff to draft the initial legislation for a statewide food policy council based on the draft language provided by the WIT. They then attracted co-sponsors. The bill passed the House but was subsequently pulled from legislative consideration because certain stakeholder parties had not been engaged adequately in the development process. The bill was sent to a subcommittee, whose members referred it back to the stakeholder group to discuss. The subcommittee worked with the stakeholder group to modify the language of

the bill to be more representative of all viewpoints. The bill was returned to the Senate, and in August 2009 the bill to create the North Carolina Sustainable Local Food Advisory Council was passed. The sustainable agriculture groups involved in the establishment of the council wanted the word "sustainable" in the title as it depicted the food system that they envisioned. Conventional agriculture representatives were able to accept inclusion of the word because the bill used the USDA definition of sustainable from the 1990s (Farm Bill, 1990), with which they felt comfortable.

The council, officially coined the Sustainable Local Food Advisory Council, was established in August 2009. The membership fluctuated, but there were between 24 and 27 members (Figure 1), based on suggestions by stakeholder organizations and appointed by one of four state officials: the commissioner of agriculture, the speaker of the house, the pro tempore, and the governor.

The council met monthly and established three subcommittees: Health, Wellness, Hunger, and Food Access; Economic Development and Infrastructure; and Land, People, and Natural Resources. These subcommittees and, in turn, the council focused on issues such as the availability of quality crop insurance products, zoning and extraterritorial jurisdictions, the use of SNAP (formerly known as food stamps) and WIC benefits at farmers markets to help low-income North Carolinians to access healthy foods, development of policies for the use of school garden produce in cafeterias, and Whole Farm GAP (Good Agricultural Practices) certification.

Figure 1. Sustainable Local Food Advisory Council Representation

- Sustainable farming
- Conventional farming
- State Commissioner of Agriculture
- State Health Director
- Commercial fishing
- Grange
- Farm Bureau
- 3 University (sea grant, agriculture, public health)
- Legal profession
- Nongovernmental organizations
- Department of Public Instruction
- State Office of Extension
- Food bank
- Food service and/or retail
- Land Conservation
- Economic Development
- Processing

In 2012, the sunset date of the council was extended to July 31, 2017, from the original 2012 date. During 2012, the council began to seek additional funding from federal and private sources due to statewide budget cuts. But following a shift in state political party power, not only was a Republican governor elected to replace the Democratic governor, but the legislature came under Republican control for the first time in 200 years. The council was eliminated as of July 2013 per State Law 2013-360, Section 13.4. Ironically, the WIT had decided on legislative action to establish the council to protect against being eliminated at the whim of a single governor's executive order; nevertheless, it was still eliminated easily through legislative action with the change in leadership.

After the elimination of the council, 12 of the organizations that had representation on the NC Sustainable Local Food Advisory Council continued to meet, including representatives of government, universities, Extension, farm bureau, and nonprofits. Representatives from these organizations are working to reformulate a council. Keeping in mind the lessons learned during their time as the council, the group is determining how to structure a new council and what its role in the state will be. The new state-level FPC in North Carolina is striving to achieve a balance between freedom and ties to government to affect policy change that supports local food systems across the state, while sustaining itself as an independent entity.

Some research exists concerning FPC activities (Harper et al., 2009; Scherb et al., 2012; Walsh, Taggart, Freedman, Trapl, & Borawski, 2015), but the efforts that go into forming a food policy council at the state level require more elucidation. This is particularly true for states with a strong conventional agriculture presence such as North Carolina (the leading producer of hogs in the nation), as more conflicts between invested stakeholders may arise when forming a FPC. There may be lessons for states and municipalities interested in state-level food policy councils, especially those that have

both strong conventional and strong sustainable agriculture systems.

For this exploratory case study, we examined the realities of forming a statewide food policy council, a relatively new development as there are currently only eight statewide FPCs, in a state dominated by conventional agriculture production, through interviews with a diverse group of stakeholders. The objectives were to investigate qualitatively the two-year process of formation (2007 to 2009) and to identify the factors that ultimately led to the creation of a statewide FPC. We used John W. Kingdon's model of agenda setting theory and policy formation to guide our analysis and place our findings in the context of the literature on policy change and network development. Kingdon states that political change happens when three "streams" come together: problem recognition, policies, and politics (1995). Problem recognition means that a particular problem has been brought to attention, and that there is a general consensus that the problem needs to be addressed. The second stream, policies, refers to an actual policy in place, which could solve the problem. Politics signifies that a political climate is open and receptive to change. All three streams of Kingdon's model were satisfied at the time of council formation, allowing for political change to occur.

Methods

Sampling Strategy and Recruitment

We identified potential interview participants using a purposive sampling frame. We chose participants based on suggestions from key informants who were known to the authors and were heavily engaged in the creation of the legislation, because those involved in the process of council formation were not publically known. From this pool, we selected and invited people for interviews based on their level of participation in developing and implementing the legislation, with further advice from CEFS staff. All potential participants were contacted and informed of the purpose of the interview and asked if they were still willing to participate. If the participant agreed to be interviewed, an appointment was scheduled to conduct the interview via telephone. All eight participants invited to participate completed interviews. To maintain confidentiality, we refrain from using names throughout this paper.

Procedures

Using a structured interview guide, we conducted interviews with a diverse group of eight participants who were key players in the formation of the food council. These participants represented a conventional farming organization, conventional livestock production, a sustainable agriculture organization, food safety advocacy, state agencies, a philanthropic organization, and the legal field. The University of North Carolina at Chapel Hill Institutional Review Board approved the study. Prior to each interview, each participant was told the purpose of the study and that participation was voluntary, was asked for permission to audio-record the interview, and was provided an explanation that the recording and transcript would be kept confidential. The interviews lasted between 45 to 60 minutes. Interviews were conducted until we began to hear the same information from respondents; we stopped adding new interviewees at eight participants. All interviews were conducted via telephone and audio-recorded. Recordings were transcribed verbatim.

Interview Guide

The interview guide consisted of 20 questions about the process of developing the statewide FPC. Questions were primarily open-ended and included follow-up probes. We included questions about the background of the participant in the food system; political, social, economic, and organizational conditions surrounding the policy-making process; interested parties and their involvement; influence of interested parties; stakes held by interested parties; success of strategies; timelines; and significance for future policy-making. Sample questions included "How was the decision made about what people or organizations should be at the table during this process?"; "What means did [name of organization] use at these points to influence the policy-making process?"; and "In what ways was [name of organization] effective in getting the Food Policy Council legislation passed?"

Data Analysis

We analyzed the interview transcripts using content analysis (Berg & Lune, 2014). We developed a codebook of themes and subthemes based on the questions of interest, the questions asked during the interview, and any themes that emerged during an initial review of the transcripts. Two research staff coded each of the transcripts within Microsoft Word, then met to review the coding of each transcript and reconcile any differences (Willging, Waitzkin, & Nicdao, 2008). Research staff then reviewed the themes and subthemes to determine which were most salient. Those themes and subthemes found to be most relevant to our research objectives were summarized, looking for agreement and disagreement among participants.

Results

Preliminary results from this exploratory qualitative study indicated that four factors led to the formation of the North Carolina statewide FPC: stakeholder involvement, diverse partnerships, stakeholder ability to compromise, and conducive political setting. We used John Kingdon's model of agenda setting theory and policy formation to help interpret our interview data. Results are divided into four subsections, each examining a different factor that led to council formation.

Factor 1: Stakeholder Involvement

Stakeholder involvement was one theme that arose from our qualitative data analysis. It considers how strong leadership from key stakeholders was vital to council formation and examines their reasons for involvement with the North Carolina state FPC, as well as benefits and drawbacks of their participation.

Strong Leadership. The effort to build the council was spearheaded by a horticulture professor from a state university that specialized in sustainable agricultural practices, who brought together stakeholders to shape the legislation for the state FPC and employed a communications consultant to facilitate the process. Individuals at the university had the initial idea to write a funding proposal to work on developing a sustainable, local food economy in North Carolina and were the lead organizers of this process.

Two other strong key leaders in the formation of the council were individuals from a sustainable agriculture organization and a statewide foundation. The sustainable agriculture organization representative chaired the Foundations and Baselines WIT and provided leadership for rebirth of an FPC as the game-changing idea from the WIT. Having a vast amount of experience in both sustainable food systems development and food assessment, he was able to lead the WIT in developing the idea. The statewide foundation representative was very knowledgeable in policy-making and contributed his expertise to the WIT, helping to mediate as needed. The foundation eventually provided a grant to the NC Department of Agriculture and Consumer Services to support the initial operations of the FPC.

Study participants described the engagement of strong stakeholders who led negotiations and encouraged compromise. A participant from conventional animal production also applauded the work of the professor who led the council formation effort:

> Dr. [X] has worked so hard and has gotten so much grant money and has really done such good work for my university…and for the agriculture community and you have to want to support somebody that is so passionate about what they believe in.

With many varying opinions among stakeholders, it was important to make sure that productive conversation continued and that the legislative process kept moving forward, despite debate and disagreement. A representative from the farmer advocacy organization described the actions of a fellow stakeholder whose leadership skills were praised by several interviewees:

> …He was extremely diplomatic, and at one point in a meeting, he just sort of looked at everybody and said, "What's it going to take to make this happen?"

Stakeholders appreciated his determination to produce "something powerful," along with his knowledge and expertise in policy-making.

The strong leadership of stakeholders who were involved was also described by three stakeholders as crucial to building momentum and excitement behind the FPC legislation, as well as to developing support for the idea prior to the initiation of the legislative process. A participant representing the legal profession emphasized this point:

> …Before [the initiating organization] announced any sort of legislative effort, they created an infrastructure for understanding what it would be about and communicating about it. So…they sort of organized a network of supporters before there was a piece of legislation and so the legislation sort of grew into that.

A remark from the representative of the farmer advocacy organization highlights the importance of strong leadership to the development of a FPC, especially one with statewide reach:

> Whenever you have people doing things that they're not accustomed to—that might be out of the ordinary—it makes them uncomfortable. So not just anybody is going to be a driver in this; you have to have the right personalities involved and a lot of people with diplomacy.

Motivations for Involvement. It is important to highlight what specifically motivated the involvement of stakeholders. The reason most often cited by study participants was to help bring together knowledgeable people from all sectors of food and agriculture to make progressive change. Others cited that they wanted to help North Carolina farmers make more money and diversify their markets, to build the North Carolina economy, and to promote the local food movement at the state level. Others became involved because working on policy regarding a state FPC was within the scope of their organization's mission. Two participants went a step further, saying they had hoped the council would further a specific interest of their organization, such as sustainable farming or urban gardening. Participants felt inspired to share personal expertise in areas such as public policy, community outreach, and FPCs. Many stakeholder organizations contributed their own resources toward passage of the legislation, primarily staff time spent tracking the legislation, staff travel, attending meetings, reviewing the language in the bill, and providing feedback.

Another motivator discussed by study participants was benefits to their organizations, or to the agricultural community and to the public. One main benefit reported was attention that the council could bring to the local and sustainable food movement. Developing new partnerships among members of the FPC was another important benefit discussed. Anticipated partnerships included conventional agriculture and nontraditional agriculture working together, and linking consumer and producer representatives. Four participants mentioned projected benefits for their organizations, such as networking, increased business once the issues received more attention, increased ability to fundraise, and using council resources. Multiple participants discussed potential benefits for farmers and the people of North Carolina, including improvements in the economy, improvements in health, and development of new markets for farmers.

Drawbacks to Involvement. While there were many benefits to participating in council formation that helped stakeholders to persevere, there were drawbacks as well. For example, the representatives of stakeholder organizations faced some anger and backlash from those they represented who were against formation of such a council. A representative from a conventional growers group put it this way: "There were people on my side of the table, for lack of a better term, that were...unwavering, not willing to compromise, were not having it, were not hearing it, and didn't want to do anything to help."

Factor 2: Diverse Partnerships

Diverse partnerships contributed to the formation of the council, through increased sharing of ideas among council formation stakeholders, as well as increased ability to reach target audiences when advertising and rallying support for the council. Political and conventional agriculture partnerships may be the most important of all partnerships in

the formation of a state FPC in a state dominated by conventional production practices. We conclude this section with a caveat: although diverse partnerships were important in council formation, participants cautioned against "having too many people at the table."

Individuals representing diverse sectors such as higher education, nonprofits, conventional and sustainable agriculture, and the political and legal systems contributed to the development of the FPC. The North Carolina Department of Agriculture (NCDA) was also a key player in forming the council. According to a study participant who was a sustainable agriculture advocacy group representative, NCDA representatives "spoke a lot in some of the committee meetings that we went to in support of the bill, representing the Department of Agriculture because there were a lot of questions like, 'We've got the "Got to be NC" program, why do we need this council?' So talking about why it was important for the Department of Agriculture to participate in this. So, they were also pretty influential." Another important figure in developing the legislation was a former gubernatorial aide who was able to help the stakeholders navigate the legislative process. He checked in with both legislators and other stakeholders and helped keep the process moving. Participants applauded these diverse partnerships. A representative from the state Department of Agriculture stated:

> I think most of us who were involved and who got involved realized that it was important to have, quote, "all" of agriculture and food stakeholders, a wide range...I think these kind of things, to be successful, you have to have a broad range, a diverse group of folks to come together and, frankly, that becomes part of the challenge.

Another interview participant explained:

> Dr. [X] really did an amazing job trying to pull together all kinds of people to make up the working groups [WITs], she really did. And I think that worked well. Everything that she did leading up to the introduction of the legislation was excellent; there was momentum behind it, there was a lot of idea sharing.

These diverse partnerships influenced the process of forming the FPC by spreading the word about benefits of a FPC to their colleagues. Many members, in turn, advocated for their state legislators to vote in favor of the legislation:

> One organization that has a lot of membership of sustainable growers…they got the word out to their membership about this, and I know that there were growers who communicated with their elected officials [about the benefits of a state FPC].

Importance of **Political and Conventional Agriculture Partnerships.** Partnerships involving representatives from conventional agriculture may be particularly important in forming a statewide FPC, especially in a state such as North Carolina where the conventional agriculture industry has a major presence. Many stakeholders gave the conventional animal production participant credit for not derailing the process. A participant, who was a representative from a farmer agency, explained it this way:

> The group that was the lynchpin group in getting the bill passed was [conventional animal producer trade organization]. And I want to tell you why: because if they had gotten spooked, if they were not willing to go and allow this to happen, then the other aspects of conventional ag, we would have had to say, "Look, folks, we can't do this."

The leaders from the conventional agricultural sector realized that they needed to be a productive part of FPC formation, or else the bill would not serve their interests. As the representative from a conventional animal production organization said:

> I think we need a seat at the table, but the purpose is not to dilute what they want, it's to be part of it. I said [to my constituents], "They're going to figure out a way to do it,

> and you might hate worse what happens if you don't allow me some room."

In addition to partnerships with conventional agriculture producers, political partnerships may also be particularly important for forming a statewide FPC. Members of the North Carolina General Assembly were particularly influential, co-sponsoring the bill in the State House and Senate and remaining supportive throughout the process. State legislators also played important roles: House and Senate sponsors and their staffs were responsible for drafting the legislation. One participant from an environmental nonprofit described one state representative's motivation for passing the bill:

> [He] has got a lot of sustainable farmers in his district, and he wants to grow that industry. He heard about this idea at a conference that he went to in the mountains and loved it and right from the get-go was like, "I'm going to make this happen, ya know, I want to do something positive for sustainable ag." So, he was going to make sure that something good came out of this in the end.

A different participant from the conventional animal production organization pointed out that key policy-makers were also helpful in a more tangible way:

> There's something, sadly, there's something about an elected official being in the room or at the table that forces people to consider the other viewpoints, not just stand strong in their own stance, not just plant their feet down and not move. Because somebody has to be there to sort of massage it along.

It is important to mention one caveat. Although participants described the importance of diverse partnerships in council formation, they also cautioned about having too many people involved. One mentioned that drafting the legislation took longer because "so many people were at the table." As one sustainable agriculture representative described: "I really thought there was going to be more opportunity for meaningful input, but there really wasn't. It was a much...there were, I don't know, sixty people on this advisory committee, and you just can't [get meaningful input from everyone with those numbers]." At the beginning, many participants had concerns about the large number of people engaged in the process of developing the legislation, and that it would unnecessarily prolong the process. Some were worried that those against the creation of a statewide FPC could stall the process by continually bringing up more concerns. This did not occur, however.

Factor 3: Stakeholders' Ability to Compromise

This subsection discusses two areas of compromise that arose in the formation of the council: compromise to draft legislation and compromise on council composition.

Compromise to Draft Legislation. Significant legislation-drafting issues included the process of drafting the policy, the question of who would have a say in the specific wording, the location of council meetings, and how the bill would be shepherded through the state legislature.

Key stakeholders discussed specific pieces of the legislation prior to the drafting. Most group members, however, only saw the post-drafting finished product. At that point, members were given the opportunity to provide comment and decide with their constituents whether to support the legislation and work to garner membership support for the bill. After the original draft was released, several negotiation meetings were held. The representative from the sustainable agriculture advocacy group noted that these negotiations "did not happen in the Senate or House Committee meetings. They happened with these interest groups that then brought bills back to [legislative] representatives. It was all a really big learning process for me. Like, 'Oh, *we* do it [negotiate on the language of the bill]? Wow.'"

The final draft of the legislation needed editing to accommodate the interests of the diverse stakeholders. In particular, the definitions of "sustainable" and "local" needed to be agreed upon. At one point, one of the conventional agriculture groups asked that the word sustainable be removed from

the legislation. Other stakeholders, however, felt that removal of the word sustainable from the legislation would change the nature of the council and thus the purpose of the bill. Organizations had different opinions of how local should be defined. Some thought that the definition should include all food grown in North Carolina, but others questioned how meaningful that would be considering the size of the state and the proximity of other states. The representative from a conventional agriculture organization made the point that if North Carolina taxes were spent on council recommendations, then local would have to be defined for geopolitical reasons as grown or produced within North Carolina. The conventional animal production organization was particularly concerned that the definition would result in precluding less sustainable methods of animal production, while other groups thought local should also imply sustainable. The representative from the sustainable agriculture organization elaborated on the complexity of the issue:

> If you're in some eastern counties, CAFOs [concentrated animal feeding operations] are local agriculture, so now you have to make another definition on top of it and ask, "Are they sustainable?" and "How do you define that?" and "How does that work with the food access issues and the affordability of food?" There's just a whole other Pandora's box of issues that are going to have to be dealt with.

However, after much discussion, a compromise was made to use the USDA definition of sustainable (Farm Bill, 1990):

> "The term sustainable agriculture means an integrated system of plant and animal production practices having a site-specific application that will, over the long term:
> - satisfy human food and fiber needs;
> - enhance environmental quality and the natural resource base upon which the agricultural economy depends;
> - make the most efficient use of non-renewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls;
> - sustain the economic viability of farm operations; and
> - enhance the quality of life for farmers and society as a whole."

After these negotiations, the word sustainable was allowed to stay in the bill. Similarly, the group members ultimately decided that local would indicate foods from the state of North Carolina.

Compromise on Council Composition. There were also many concerns about who would hold a seat on the council, how many seats there would be, who would appoint individuals to fill these seats, the proportion and type of farmers included, which groups would be represented, and whether stakeholder organizations would continue to be represented. The sustainable agriculture organizations and farmers that introduced the bill, not anticipating the high level of interest of the more traditional groups, had already negotiated among themselves to determine a list of those who would sit on the council. A compromise was made to pare this list back and better include the traditional agriculture groups. The representative from the conventional animal production organization explained, however, that their intention was not to dominate the council, but be a part of it:

> I mean some of my people wanted it to be all farmers, nothing but farmers, half sustainable and half conventional, but that doesn't work. I think we need a seat at the table, but the purpose is not to dilute what they want, it's to be part of it.

This representative expressed concern that several organizations that his organization felt "had extremist views" and had "slandered traditional agriculture on the Internet" were on the initial council member list. After the final list was made, two interviewees still thought that it included too many seats to be productive. Overall, however, the stakeholders reached a consensus.

Factor 4: A Conducive Political Setting

A conducive political setting for legislation passage of the state FPC was highly important. There was no requirement for state funding attached to the bill for the council; if it had been part of the bill, political representatives may not have supported the bill. Worth noting, however, is that while the political setting at the time was conducive, the subsequent change in political climate—election of a Republican governor—made elimination of the council possible.

The North Carolina state FPC was created at a time when the political, economic, and social atmosphere were supportive. Three participants mentioned this political window of opportunity, discussing how the House sponsor was already interested in the issue and how the Senate sponsor, a powerful figure in agriculture, was also on board to support the council. Both legislators represented farming districts, and their influence aided greatly in passing the bill and creating the council. A representative from an environmental safety nonprofit further explained the critical timing of this bill:

> I think the timing was really good for the issue. [It was] something that a lot of people had been hearing something about, and I think a lot of legislators had been hearing something about it and wanting to know, "What could benefit my district?" and "What can I do for this?" and "It's something in my district that people care about." And it's not a high conflict sort of thing. It's not the kind of thing that's going to take something away from somebody else. It's not going to add a new burden of regulation to anyone, so it had those kinds of things going for it.

Economically, the idea for the North Carolina state FPC was developed at an ideal time. The director of a state-level foundation stated that his organization had an initiative that year to support local food activities, with funding set aside for that purpose. As the FPC aligned with the goals of that initiative, the foundation could fund it. Four other participants spoke of the economic opportunity associated with the sustainable and local food movements, and that they are among the sectors of agriculture currently showing growth. They also discussed the economic challenges the state was facing, with more people beginning to farm either out of necessity or opportunity.

Five stakeholders also discussed increased public interest in local and sustainable food. The FPC was created when these issues were becoming important to consumers. The representative from the sustainable agriculture organization described this interest:

> I think local foods has transformed from a kind of, how do you say, a niche, to kind of, ya know, it's not just a granola thing eaten by people in Chapel Hill, Carrboro, or whatever, it's more of a part of the arsenal of the agricultural industry, food industry in North Carolina.

Another study participant mentioned that North Carolina has many resources and strong players because of the large academic and health care presence in the state, noting that this contributed to the creation of the FPC as well.

One noteworthy caveat is that there was no state funding allocated along with the bill for the council. This may have helped garner political support and ease passage because there was no direct financial impact on the state budget. A representative from a farmer advocacy agency stated that the State Department of Agriculture "was willing to take it [the council] as long as it did not force them to spend extra money because they didn't want to have to be committed to spending, ya know, two or three or four hundred thousand dollars on something out of their very, very tight budget that was being slashed."

Discussion

This exploratory qualitative case study found that four factors ultimately drove the formation of the 2009 North Carolina state FPC: stakeholder involvement, diverse partnerships, stakeholder ability to compromise, and a conducive political setting. It is important to note that although the council was established through legislative action in August 2009, North Carolina's political leadership

changed in 2013, and the council was eliminated as of July 2013 per State Law 2013-360, Section 13.4. Thus one of the factors that allowed for the council's creation—the political setting—also led to its elimination. An important lesson for other states interested in state-level FPCs would be to strategize tactics that protect councils from elimination through legislative action due to a changing political climate.

Our results are consistent with a 2012 case study by Dean regarding the Iowa state-level FPC. Although the primary aim of that study was to explore the challenges and opportunities faced by the Iowa FPC, it was determined that diverse partnerships and strong leadership were factors in the creation of the Iowa FPC (Dean, 2012). To the best of our knowledge, no other studies have explored the factors that lead to the creation of a state-level FPC.

We have used John Kingdon's model of agenda setting theory and policy formation to guide our analysis and place our findings in the context of the literature on policy change and network development. According to Kingdon, political change happens when three "streams" come together: problem recognition, policies, and politics. Problem recognition means that a particular problem has been brought to attention, and that there is a general consensus that the problem needs to be addressed. In the case of the North Carolina FPC, a general consensus existed that local food issues needed addressing, as demonstrated by the activity of CEFS and the WITs. This satisfies the first stream of Kingdon's model. The second stream, policies, refers to an actual policy in place which could solve the problem. The policy must be technically feasible and compatible with the values of the population. There were already functioning state-level FPCs in other states, such as the Iowa Food Policy Council; thus this stream is also present. The stream of politics means that the political climate is open and receptive to change. This final stream was clearly present, as one of the four factors that led to the formation of the state FPC was a conducive political setting. With the three streams of Kingdon's model satisfied at the time of council formation, political change could occur. The formation of the state FPC shows a engagement of policy process theory with practice, and our study is consistent with the literature on agenda setting and policy formation.

Strengths of this study include diverse representation among study participants. In addition, to the best of our knowledge this is the first peer-reviewed study to explore factors that contributed to the creation of a state-level FPC. This study has several limitations, however. Above all, the sample size of eight individuals does not allow us to generalize to a larger population or to interpret our results causally. In addition, this study used a purposive sampling strategy, so researchers relied on their own judgment when choosing members of the population to participate in the study, which may have influenced the study results. Our research is therefore exploratory, not conclusive. We do believe that our findings are instructive for and illustrative of the issues other states with industrial agriculture sectors would encounter during FPC formation.

Conclusion

Although the North Carolina state FPC dissolved in 2012, understanding the factors that led to council formation may be helpful for other states and municipalities considering a state-level food policy council. Our research is exploratory, however; future research should further examine the challenges and opportunities of FPCs, using larger sample sizes and testing for reliability and validity using strategies such as triangulation and member and document validation.

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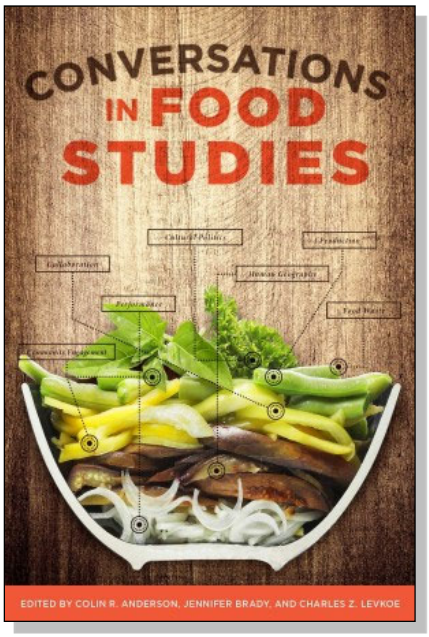
Food studies: Adding nuance to the sustainable food systems dialogue



Review by Keith Williams *
College of the North Atlantic, Carbonear Campus

Review of *Conversations in Food Studies,* edited by Colin R. Anderson, Jennifer Brady, and Charles Z. Levkoe, (2016). Published by University of Manitoba Press, Winnipeg. Available as paperback and ebook; 312 pages. Publisher's website: https://uofmpress.ca/books/detail/conversations-in-food-studies

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My motivation to review *Conversations in Food Studies* grew from a desire to understand how we can approach complex problems—changing attitudes and beliefs about diet, incorporating social and environmental values into agricultural production, and addressing structural inequalities—to reduce poverty and food insecurity.

My work with various communities both in Canada and abroad has yielded this insight: the technical barriers to achieving a just and sustainable food system (such as growing food all year in northern climates and increasing crop yields) are more easily overcome than the socio-cultural and behavioral barriers. What is critical for food system transformation is an understanding of the human component; this is the task of food studies scholars. This defining volume tackles socio-cultural obstacles to a just and sustainable food system

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through work reported in a cross-sectional snapshot of predominantly Canadian scholarship, in the interdisciplinary field of food studies.

In this volume's foreword and introduction, Koç and Levkoe, Brady, and Anderson, respectively, advocate for a deep interdisciplinarity in food studies, including exploring interepistemic approaches to food that incorporate the knowledge systems of "farmers and fishers, Indigenous peoples and scientists" (Levkoe et al., p. 4). The editors are aware, however, that "the overall scope of the interdisciplinary work in the book is relatively narrow" and that "there is much work to be done to engage with and to draw in other perspectives to develop a more interdisciplinary and transdisciplinary field of food studies" (Levkoe et al., p. 13).

The section "Re-Presenting Disciplinary Praxis" examines participatory visual approaches to food system representation as a polyvocal challenge to established power relationships. One case discussed in a chapter in this section profiles a university student who makes a sculpture to represent her personal "food ecology" due to her aversion to what she perceives as the finality of text (Cadieux, Levkoe, Mount, & Szanto). This case provides grounds for deprivileging text, a practice that could improve participation by those for whom academic research is not accessible. Another chapter explores performance as a participatory lens through which to view food system elements: "…'performer' and 'spectator' are made more mindful of the ecology around them" (Szanto, Wong, & Brady, p. 61). The authors' fresh and provocative approach introduces tantalizing ways that performance could advance our understandings of knowledge, power, and perspective in food systems. The first two chapters resonate with the work of Al Etmanski, a Canadian community developer who identifies patterns to scale social innovations; for example, create an appropriate "container for your content" (Etmanski, 2015, p. 61), suggesting that the appropriate "container" can breathe "life into issues that affect us all" (Etmanski, 2015, p. 73). The embodied, and participatory, nature of visual and performative approaches enliven our understandings of the food system in a way that academic writing cannot.

The section entitled "Food System Governance" opens with a chapter on governance lessons from both agriculture and fisheries (by Lovitt, Mount, Khan, & Clement), which is a strength, since most food system–related studies focus on either fisheries or agriculture, reflecting society's reductive approach to understanding and managing the food system. Elizabeth Beaton (2009) writes that rural Nova Scotians engage in a pluriactivity of livelihoods, including fishing, small-scale agriculture, forestry, and more; I see similar pluriactivity in rural Newfoundland. Equitable and authentic food system interventions can only happen when multiple relationships, among and within stakeholder groups, are considered—which requires a level of integration that is challenging from a governance perspective as fisheries and agriculture are normally found in different provincial and federal portfolios. Lovitt et al. recommend focusing on social and ecological goals for governance rather than simply assuming that "small-scale" equals "environmentally friendly" and just. The authors profile Off the Hook, a small direct-marketing initiative between rural fishers from Digby County and urban consumers in Halifax, Nova Scotia's capital, using a community supported agriculture (CSA) model. The fishers receive a premium price for their fish in Halifax, which helps them to remain economically viable. A model based on premium prices catering to an urban elite could drive the business to supply fish exclusively to that market, excluding lower-income consumers who lack the disposable income to pay for premium-priced seafood. In addition to meeting the demands of their urban market, Off the Hook sells fish dockside in Digby, but it is unclear if their model includes provisions for lower-income consumers to access affordable local fish. Although Lovitt et al. contribute to the conversation on what constitutes a just and sustainable community supported fisheries (CSF) model, it would also be valuable to learn about models that include access for lower-income consumers—if such models exist.

"Un-doing Food Studies: A case for flexible fencing" does not challenge the nascent discipline of food studies, as the title suggests, but challenges assumptions underlying the alternative food system movement. Sprague and Kennedy examine how

the cultural politics of various alternative food networks (AFNs) maintain inequitable power relationships. Many of the AFNs studied rely on social transformation via the attitude, behavior, change (ABC) model, i.e., "if people were aware of where their food came from and experienced the taste of locally grown food, they would buy, grow, and eat more local food" (p. 208). Most AFN approaches to food system change place consumers as the change agents. While empowering in one sense, foisting the responsibility for food system change predominantly on consumers serves to reinforce the neoliberal status quo with its entrenched inequities. Nonetheless, Sprague and Kennedy criticize the ABC lexicon as insufficiently nuanced to effect significant social transformation. The authors of this chapter shed light on the structural inequities in some common AFN activities; their call to create more inclusive and equitable alternatives to existing AFN activities is long overdue.

"Scaling Learning in Agri-food Systems" comprises the book's final two chapters. Braun and Bogdan profile two Albertan cases: producers transitioning to sustainable farming, and rural women increasing their household, and community, food security. Braun and Bogdan suggest that reflection on routine practices, such as cooking and shopping, leads to incremental perspective transformations and consequently to behavior change. More than individual agency or externally imposed legislation, social practice theory maintains that behavioral change is fostered through the "development and enactment of practices themselves" (p. 304). Their use of social practice theory helps to unravel the "practice" element of transformative learning in the two cases presented. Social practice theory is an intriguing framework to approach one of the most intractable barriers to food system transformation: behavior change.

Sumner's (2015, and Sumner & Wever in this book) critical food pedagogy supports alternatives to the current dysfunctional food system; examines explicit and implicit food system power relationships; and takes an emancipatory and anticolonial stance. In their chapter, Sumner and Weaver identify school gardens as significant sites of food learning and strongly advocate for allocated government funding. Two years ago I led a program evaluation of the community gardens in Brandon, Manitoba (Williams & Leadbeater, 2015). Our key findings were that 98% of respondents viewed community gardens as "places of learning" and approximately 60% felt that their community connections increased because of community gardening. Funding for the community gardens was based on "soft money" and relied heavily on volunteer support (Williams & Leadbeater, 2015). Community gardens, like school gardens, have significant social impact and should also be considered for allocated government funding. The authors cite Guthman's (2011) exhortation that "those who want to teach people how to make better food choices should spend more time reforming the policies that allow bad food in the first place" (p. 337) and offer us an expanded concept of critical food pedagogy that includes advocacy and direct action.

Very few of the chapters in this volume deal explicitly with rural communities, and none discusses food in First Nations communities. The focus of study was predominantly urban, and from Canada's central and western provinces. A national-level study by Tarasuk, Mitchell, and Dachner (2016) revealed that 12.0% of Canadian households experienced food insecurity in 2014. In that same year, and of the provinces and territories surveyed (all but the Yukon, Ontario, and Newfoundland and Labrador), Nunavut had the highest level of food-insecure households (46.5%) Northwest Territories had the second highest at 24.1%, and Nova Scotia and New Brunswick ranked third and fourth with household food insecurity levels of 15.6% and 15.2%, respectively (Tarasuk et al., 2016). It is imperative to have a sense of the food studies landscape in northern and Indigenous communities and in the Atlantic Provinces, given the high rates of household food insecurity in those areas.

This lively collection of diverse food studies papers delivers on its promise of boundary-testing interdisciplinarity. The insights presented within its pages reflect an intellectually sophisticated dialogue on food studies in Canada, providing hope for equally sophisticated food system interventions. My training in the agricultural sciences, rooted in a positivist and implicitly neoliberal worldview,

offers up a simple solution to food insecurity: grow more food more efficiently, and distribute it more effectively. However, after reading this book I see that a truly transformative approach to food systems change will require researchers to "get their hands dirty" with other stakeholders—such as farmers, fishers, Indigenous people, and more—in ways that are broadly accessible, respect different knowledge systems, and challenge status quo power relations. 

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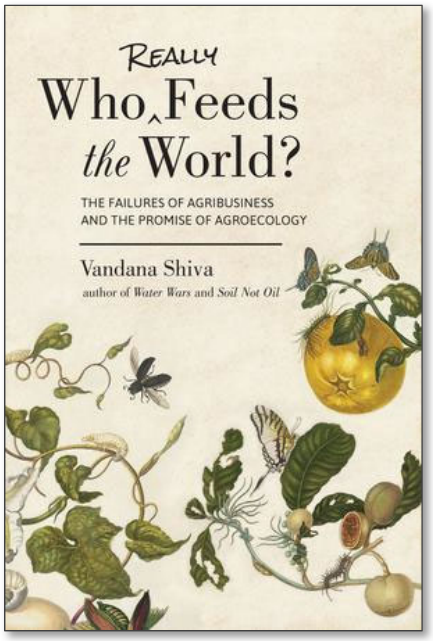
How should we feed the world?

Review by Nathan Collins*
University of Kansas



Review of *Who Really Feeds the World? The Failures of Agribusiness and the Promise of Agroecology,* by Vandana Shiva. (2016). Published by North Atlantic Books, Berkeley, California. Available as paperback and ebook; 192 pages. Publisher's website: https://www.northatlanticbooks.com/shop/who-really-feeds-the-world/

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Citation: Collins, N. (2017). How should we feed the world? [Book review]. *Journal of Agriculture, Food Systems, and Community Development, 7*(3), 215–216. http://dx.doi.org/10.5304/jafscd.2017.073.005

Vandana Shiva's *Who Really Feeds the World?* focuses on the ever more critical issue of food security. Throughout the book, Shiva juxtaposes the current global food system and her feminist agroecological solution to demonstrate the failing of the former and the potential of the latter. Each chapter does an excellent job of laying out the shortcomings of the current agribusiness model. The author pulls no punches and makes no attempt to hide her position that agroecology feeds our planet, while agribusiness is slowly killing it. There is little in the way of nuance; her goal is clearly to out agribusiness as being at "war" with the planet and the life that depends on it. To validate this claim, the author describes several areas in which agribusiness has served to destroy a diversity of life and may end up severely damaging the planet's food sources.

Shiva identifies a deep and growing food crisis in her introduction, and from there begins to explain two adversarial agricultural paradigms as she sees them. The first paradigm is the cause of the current food crises—not as an accident but as a basic aspect of the paradigm's design. This paradigm separates humanity from nature and emphasizes the commodification of the planet's bounty.

* Nathan Collins is a PhD student in sociology at the University of Kansas. He is currently focusing on issues related to the environment, labor, and the impact of patenting seeds that came about with the creation of GMOs and/or patentable germplasm. Nathan's recent research emphasizes the impact that the patenting of seeds has had on farmers' labor, autonomy, and prosperity. He can be reached at nrcollins@ku.edu.

The second paradigm is the solution to the current food crisis. The second paradigm calls for a return to "traditional" small-scale farming and away from the perception that seed and soil are dead material to be used by humanity. It emphasizes humanity's place as a part of nature and renewal, returning to the earth that which we take.

Each chapter follows a simple and consistent framework of comparing the two paradigms to dispel misconceptions promoted by agribusiness corporations. The pattern is clear from the title, *Who Really Feeds the World?,* and from each subsequent chapter heading such as "Biodiversity feeds the world, not poisons and pesticides," "Women feed the world, not corporations" or "Localization feeds the world, not globalization." These chapters emphasize the two paradigms and the beliefs and values that follow when people accept one paradigm or the other. The differences between the two paradigms are seemingly endless; even their basic definitions of what food is do not align.

Each chapter oscillates between outlining the current failings of agribusiness and outlining the potential benefits of adopting agroecological ways of farming. Anyone who loves Shiva's work or ecological activism, in general, will enjoy this text; however, for others it may be less useful. This book, while enlightening for those unaware of current global ecological issues, adds little to the discussion. *Who Really Feeds the World?* serves as a rallying cry more than a deep critique. Shiva undoubtedly understands the immensity of the problem she is describing, but her analysis often falls short of the full scale of the issue when suggesting agroecological responses.

If, as she convincingly argues, the agribusiness model is so detrimental to the world, why is it so pervasive? If agroecology is superior, why do so many refuse to use it? She puts some of the blame on international politics (farm subsidies in the global north and trade deregulation devastating global markets); however, these issues do not explain why those in the global north prefer genetically modified seeds and monocropping. A deeper exploration of economic pressures would more thoroughly explain the current state of food production. For example, the role of the International Monetary Fund (IMF) and World Bank in pushing monocropping, and the focus on commodity production in countries struggling to feed themselves, should not be ignored. Additional emphasis on the benefits of genetically modified crops as superior commodity crops, when coupled with an explanation of the problematic nature of this style of agriculture, could ultimately flesh out the issue without undermining Shiva's argument. Commodity crops may, in fact, be worse when looked at using an input-to-nutrition scale, as Shiva does, but this is not the measure used by the large corporations benefiting from the sale of these products. The lack of emphasis on the benefits of commodity crops for those who produce them results in a straw man for Shiva to knock down rather than a more nuanced argument against the practice. Another shortcoming is Shiva's use of wellness models with no regard or explanation for the rubrics her adversaries use in analyzing the same practice. This is not to discount Shiva's position nor the issues she raises; however, in order to dismantle a dominant paradigm, it may be better to use, or at least reference, the master's tools.

While the author's argument for agroecology suffers from an incomplete comparison with its adversary, the overall explanation of the problem concerning food sovereignty is excellent. The importance of reclaiming control over the idea of food—reframing it as sustenance rather than commodity—cannot be overstated. Vandana Shiva understands the failures of the current system and outlines them clearly. There may be no one better to explain agroecology than Shiva, with her extensive knowledge of and experience with its implementation. The book reflects her expertise and can serve as an extensive guide to the failings of the current system.

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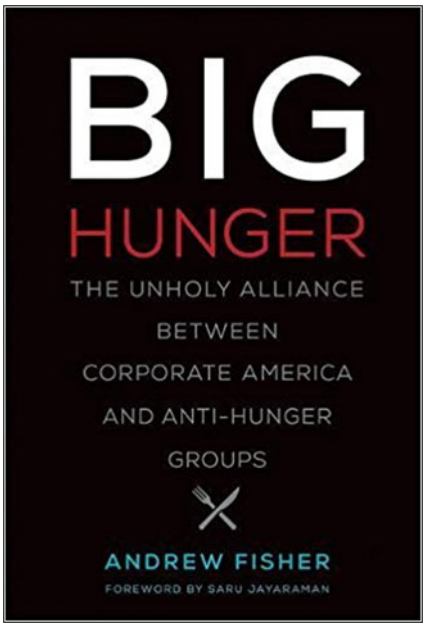
A response to the U.S. anti-hunger movement's mantras: Deserving objects of assistance, daily (Pyrrhic) victories, and protracted states of emergency



Review by David V. Fazzino II*
Bloomsburg University of Pennsylvania

Review of *Big Hunger: The Unholy Alliance between Corporate America and Anti-Hunger Groups,* by Andrew Fisher. (2017). Published by The MIT Press, Cambridge, Massachusetts. Available as hardcover and ebook; 360 pages. Publisher's website: https://mitpress.mit.edu/books/big-hunger

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Citation: Fazzino, II, D. V. (2017). A response to the U.S. anti-hunger movement's mantras: Deserving objects of assistance, daily (Pyrrhic) victories, and protracted states of emergency [Book review]. *Journal of Agriculture, Food Systems, and Community Development, 7*(3), 217–219. http://dx.doi.org/10.5304/jafscd.2017.073.010

Andrew Fisher, a co-founder of the Community Food Security Coalition, masterfully reveals the corporate collusion that dominates much of the anti-hunger movement in the United States, in a no-holds-barred account. In eight chapters he takes the reader on a journey through the depths of agreements that further disempower and stigmatize those on the margins of society. Fisher balances this with the hope that systematic change is already taking place in the form of individuals committed to uncovering the disenfranchising aspects of the anti-hunger industrial complex. He makes clear distinctions between anti-poverty and anti-hunger advocates, noting that their allegiances are split in a neoliberal era of governance in which the state continues to cut funding from assistance programs, allowing corporations such as Walmart to proliferate their own branded approach to battling hunger.

His extensive experience lays the groundwork for his policy recommendations, while his presentation of numerous case studies suggests that more just and robust community food systems are possible. Fisher maintains that issues of inequality must be addressed systemically in order to ensure

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that efforts to confront hunger do not do more harm than good by examining factors such as empty calorie consumption, low wages, and poor working conditions. Fisher blends his accounts of work in the field with news reports, policy analysis, personal communications, and survey data in order to explore competing visions for the direction of the anti-hunger movement. The business-as-usual model of "feeding the need" with corporate support (pp. 58–59) is contrasted with more innovative approaches that highlight the agency of those in need.

Fisher begins his introduction, "Lost Opportunities and Collateral Damage," with an account of the impacts of neoliberal policies and globalization on his hometown, Youngstown, Ohio. Youngstown is squarely in what has been dubbed the "Rust Belt," indicating its aging industrial infrastructure and overall economic decline, but as Fisher notes, "…rust is not an emergency. Rust does not happen in one day, but over a long period of time" (p. 4). Youngstown has problems, but its problems are not new. They do not constitute an emergency situation necessitating stopgap mechanisms of assistance; rather they are entrenched and systemic, requiring a paradigm shift.

The existing paradigm is thoroughly discussed in the first three chapters. Chapter 1, "Occupy Hunger," discusses the social construction of hunger and contrasts this with the concepts of food security and the right to food. Chapter 2, "The Charity Trap," considers collateral damage of the emergency food system. Fisher highlights the differences between social movements and the nonprofit sector, noting that increasing professionalization, narrow mission focus, and the need to build coalitions both across the food industry and outside it diminish the ability of large anti-hunger groups to see the trees for the forest. It is with these alliances that daily Pyrrhic victories over hunger are realized.

Chapter 3, "The Politics of Corporate Giving," describes the scope of, rationale for, and limitations imposed by corporate philanthropy in the realm of anti-hunger. Fisher unapologetically names corporations that have compiled a series of gaffs in their attempts to redeem and rebrand themselves for consumers. He points out corporations that adopt philanthropic efforts see sizable returns on their investments through greater consumer appeal and greater economic resilience. In general, they institute policies of giving which give back to themselves through taxpayer-subsidized tax breaks and increasing consumer confidence in their brand. While claiming to support the communities of their employees and consumers through their philanthropic efforts, Fisher points out that they may also simultaneously work to systematically suppress wages and union organizing.

Chapter 4, "SNAP's Identity Crisis,"[1] and chapter 5, "Economic Democracy through Federal Food Programs," address the contested nature of federal food policies (SNAP, USDA commodity purchases, and school meals) and their implications for the health, nutrition, and well-being of those who are deemed worthy of assistance. Chapter 6, "Who's at the Table Shapes What's on the Agenda," discusses the relative absence of those who are poor from decision-making processes, as "all too often, the anti-hunger movement seeks to advocate *for* the poor instead of *with* them" (p. 209).

Although hunger is symptomatic of poverty, Fisher notes that many entities and individuals involved in the anti-hunger movement are unwilling or unable to address larger structural concerns. Their narrow focus leads them to a growth-oriented model in which the goal is to get bigger in order to supply ever-larger quantities of food to more and more people. Success is measured through how much food is delivered, emphasizing quantity over quality. Work to scale up the infrastructure of food banks leads to viewing the buildings themselves as stakeholders in the process. This means that they must be fully utilized in order to justify the ask, the donations which made the structure possible in the first place. Similar to the privatized prison system that constantly seeks more and more offenders within a supply-demand framework to justify building more prisons (Parenti, 2000), the worthiness of the structure is defined through channeling ever more food out to the deserving poor. In both instances, those claiming

[1] SNAP (Supplemental Nutrition Assistance Program) is the federal food-purchasing assistance program for low- and no-income people.

to defend the morality of society congratulate themselves and one another for having fought the good fight.

Despite Fisher observing a fractured food security system in the United States, he still maintains hope that collaboration is possible in the context of a more robust and inclusive federal food assistance program that prioritizes nutrition. He notes that those who work in anti-hunger and anti-poverty ultimately share a concern for people who are hungry. He views SNAP as a key area where significant progress can be made. His hope rests on the notion that nonprofits that have adopted a growth model will be willing to work for the greater good. We could hope that corporations and their shareholders will organize to act in the public good out of pure beneficence. Secondly, we could hope that measures that focus on outcomes versus outputs will be considered more thoroughly by the mainstream anti-hunger organizations, effectively reworking success in food provisioning from "feeding the need" to reducing the need. We could adopt a multicentric economy as Hornborg (2007) suggests, an idea similar to food stamps, the first iteration of food assistance in the U.S. Still, the question remains of what will ultimately inspire action, particularly in those who benefit the least from it? If the anti-hunger system of private charity has been in the making for decades and continues to define itself in relation to inappropriate measures of success, which marginalize smaller-scale entities as irrelevant or unimportant in truly confronting hunger on the scale necessary, then how can this change come about?

Fischer moves beyond an indictment of the contemporary collusion to suggest a series of steps to advance the interests of those on the margins of society. He points to the power of government programs to shift the dominant approach to food security and hunger within the U.S. He draws from a variety of case studies from within and outside the U.S. to demonstrate the myriad approaches that have been successful in alleviating hunger while confronting the underlying power asymmetries between those that have a need and those who provide assistance. Fisher discusses innovations from both within the anti-hunger movement (Chapter 7) and outside of it (Chapter 8) to show what has worked in the past. He builds towards his conclusion, touching on what he refers to as a "new vision for the Anti-Hunger Movement." He shares that he grew increasingly optimistic over the three years it took him to write *Big Hunger*. At the same time, he notes that the path forward is unclear and likely to be contested in the upcoming iteration of the farm bill.

Overall, *Big Hunger: The Unholy Alliance between Corporate America and Anti-Hunger Groups* lays out the argument for equity as the fundamental issue in food systems. Fisher reminds the reader that food is never just the material substance that staves off hunger. In this sense, a holistic conceptualization of food security requires considering the security of those throughout the food system, from the recipients of assistance, those who work for less than a living wage in the food sector and retail, and those who have wrested sustenance from the soil. If we take this seriously, then it is possible to move beyond the rhetoric that creates deserving subjects to consider the agency and desires of those who currently have needs. *Big Hunger* clearly articulates the interwoven nature of food's ability to connect, to touch all aspects of our lives. *Big Hunger* asks us all to move past Pyrrhic victories in fighting hunger, past objectifying those who need assistance, and past sanitized solutions that are supposedly apolitical. It reaffirms that food systems—from production to distribution to consumption—are always political. Finally, and most notably, Fisher provides ideas and possibilities for activism on multiple fronts to move toward food systems justice, as part of a larger project of social equity.

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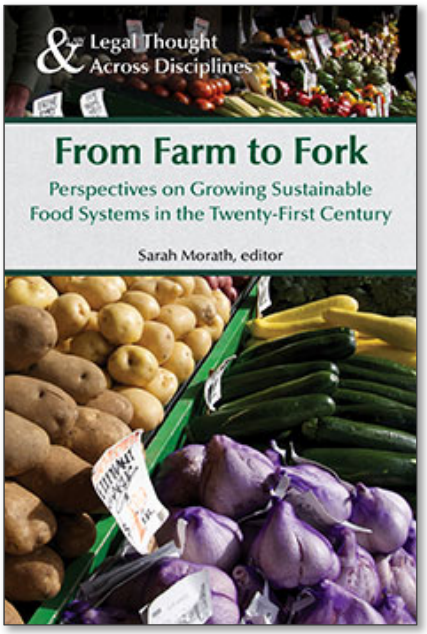
Presenting a 360-degree view of challenges in the U.S. food system, from farm to fork



Review by Carrie A. Scrufari *
Utility Intervention Unit, Division of Consumer Protection, New York Department of State,[1] and Vermont Law School

Review of *From Farm to Fork: Perspectives on Growing Sustainable Food Systems in the Twenty-First Century,* edited by Sarah Morath. (2016). Published by University of Akron Press, Ohio. Available as paperback and ebook; 312 pages. Publisher's website: http://www.uakron.edu/uapress/browse-books/book-details/index.dot?id=7bcff14d-52b9-4cdf-ad40-eac470eb8674

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From Farm to Fork is a compilation of various essays organized around three overarching topics: an overview of the food system with all its complications, views from within the food system, and the federal and local policies needed to move the U.S. to a more sustainable food system in the future. The thoughtful organization of the chapters around these three areas contributes to the book's readability and digestibility.

Another asset of the book lies in its multifaceted and comprehensive nature. Chapters address numerous aspects of the food system, including the funding mechanisms present in the farm bill, the struggles of securing stable and equitable land access, the role of the consumer within community supported agriculture (CSA) models, the plight of food system laborers who work under unfair conditions for poverty-level wages to feed the U.S. population, and the health and environmental

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[1] The views reflected herein are solely those of the author and do not constitute the opinion of the government.

consequences of ubiquitous pesticide dependence. The contributing authors also address and seek to define terms such as "social sustainability" (framed in one chapter as the answer to the question "How can we meet the needs of the present without diminishing opportunities for the future?" [p. 18]). Subsequent chapters seek to chart a path toward achieving the goal of social sustainability by proposing the creation of "the law of food, farming, and sustainability" (p. 125), suggesting structural changes to the current industrial food system, breaking our chemical addiction to pesticides, and implementing food policy audits to assess how we are starting to transform local food systems.

From Farm to Fork features well-known authors such as Marion Nestle (exploring how farm bill policy affects health outcomes), Susan Schneider (calling for a reconsideration of agricultural law and the development mechanisms to move us toward sustainable food polices), Jason Czarnezki (proposing a bridge from the mode of industrial agriculture to "new agriculture avenues" via direct marketing opportunities that also consider small-scale and organic farmers), and Maya Angelou (cleverly advocating for a 12-step approach to breaking our chemical addiction to pesticide use). The blend of multiple environmental and food systems scholars' voices makes *From Farm to Fork* an excellent book for use in any introductory level food, agricultural, or environmental law and policy course.

Although comprehensive in its analysis of food systems, *From Farm to Fork* lacks a chapter dedicated to the treatment of livestock in the United States. Any thorough investigation into our farming and food systems practices must include scrutinizing the way billions of animals are slaughtered for food in this country every year.[2] Yet any mention of animal welfare is fleeting or tangential to the other discussions at hand. *From Farm to Fork* could have benefited from a chapter devoted to the gaps in regulating agricultural animal welfare as well as proposals for reform. A discussion of social sustainability is incomplete without an adequate consideration of how the current industrialized modes of production in the concentrated animal feeding operation (CAFO) (Hibrar, 2010) system impact animal health, human health, and environmental health. The book also could have benefited from including a conclusion chapter to tie together all the featured themes and leave the reader with final thoughts for forward movement.

Despite these shortcomings, *From Farm to Fork* is a useful introductory text for anyone reading about food systems work for the first time. It details current research in the field from which even seasoned scholars could benefit and learn.

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[2] Red meat production in the U.S. totaled 49.3 billion pounds (22.3 billion kg), including beef production of 25.8 billion pounds (11.7 billion kg), hog slaughter of 112.1 million head, and sheep slaughter of 2.32 million head (USDA NASS, 2014a). In 2013, 8.52 billion broiler hens were slaughtered to produce 50.6 billion pounds (22.9 billion kg) of meat; turkey production totaled 7.28 billion pounds (3.3 billion kg); and egg production totaled 95.2 billion eggs (USDA NASS, 2014b).

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Food sovereignty: Reality vs. assumptions

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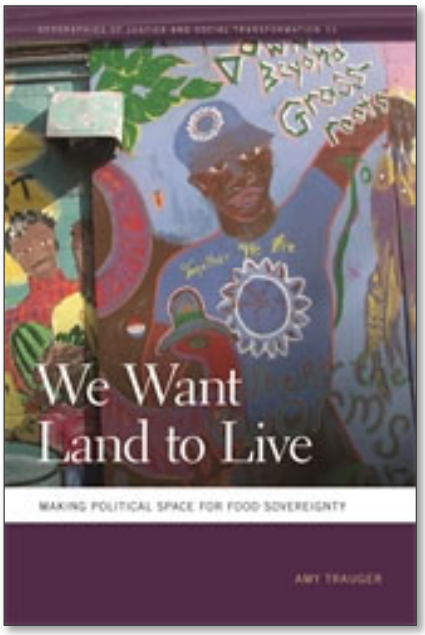

Review of *We Want Land to Live: Making Political Space for Food Sovereignty,* by Amy Trauger. (2017). Published by University of Georgia Press. Available as hardcover, paperback and ebook; 172 pages. Publisher's website: http://www.ugapress.org/index.php/books/we_want_land_to_live

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In *We Want Land to Live*, author Amy Trauger endeavors to draw attention to food sovereignty, its practices, and its political implications. Written during a time where the discussion of hunger and poverty in a global context is a top priority, *We Want Land to Live* presents a convincing argument for understanding how food sovereignty interacts with not only global political systems but international economic and social systems as well.

Trauger has an impressive background that includes experience as a feminist geographer with substantial experience in farming. In the introduction, Trauger presents a synopsis of her childhood as well as her current farming experience in Georgia. She details chronologically the personal experiences that have contributed to her interest in the episteme of food sovereignty, to which she dedicates an entire chapter. Through this window into Trauger's personal life, the reader is able to resonate with the passion that jumps from each

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page. Trauger's writing style is both open and scholarly, while providing a clear argument from a critical perspective about food sovereignty.

In *We Want Land to Live*, Trauger ventures to address a gap in the food sovereignty literature that addresses the presence of political implications. She presents a very compelling case to examine food sovereignty and its impact on "the transformation of meaning, primarily around land, labor, and exchange" (p. 30). The book leaves a memorable impression of all the stakeholders and major players involved in the food system and food security throughout the world. Utilizing the book as a possible platform to highlight those unique threats that emerge from food sovereignty, Trauger offers a sophisticated theoretical perspective about the role of food sovereignty "as a radical and collective struggle for alternative political spaces" (p. 12). Trauger's knowledge of the policies surrounding food sovereignty is evident and articulated in a detailed fashion within the text.

Using ethnographic methods to assemble data for her research, Trauger concentrates specifically on explaining the production of spaces by food sovereignty, the mobilization of power within these identified spaces, and the definition of food sovereignty. For example, in her chapter on urban agriculture, Trauger gives an illustration of the privatization of urban land and its correlation to food sovereignty. According to Trauger, these cases adequately reveal the necessity of an "alternative mode of governance" (p. 63). Trauger structures her argument to call for an ideological shift regarding food sovereignty through the case studies presented in the book.

Trauger claims further that capitalism fuels the presence of federalism and prevents the recognition of the rights of local communities. She implies that "reterritorializing of power" (p. 80) should be a direct result of the shift in governance from the alternative spaces being created by food sovereignty.

This book recognizes the relationship between the assumptions and reality surrounding food sovereignty. Individuals interested in different perspectives to food sovereignty and its implications will value this book. Readers can benefit from Trauger's theories and plausible strategies to approach the various spaces that are generated by food sovereignty. Her critical perspective encourages future research into food sovereignty and the spaces being created by it.