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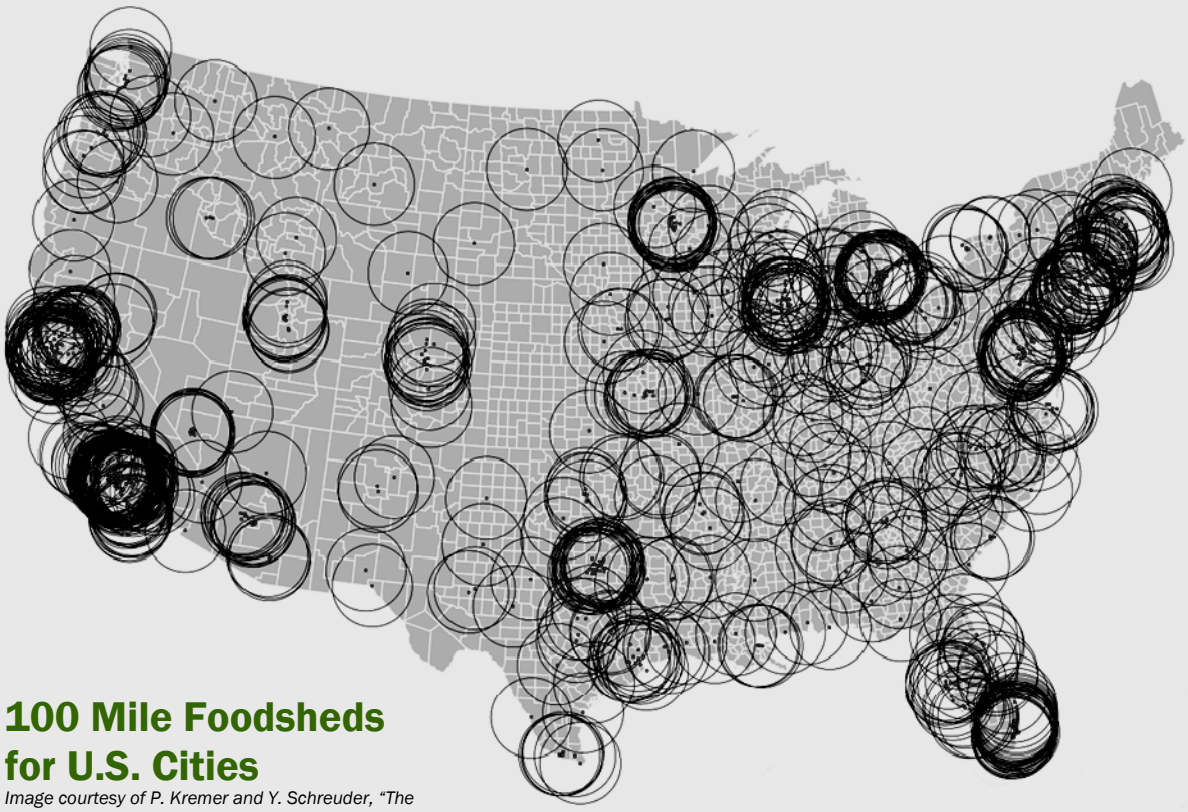
Open Call and
Food Systems Planning Papers



100 Mile Foodsheds for U.S. Cities

Image courtesy of P. Kremer and Y. Schreuder, "The Feasibility of Regional Food Systems in Metropolitan Areas: An Investigation of Philadelphia's Foodshed," in this issue.

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On the cover: Local foodsheds are delineated by 100 mile radii around U.S. cities with populations over 50,000. Image courtesy of Peleg Kremer and Yda Schreuder, from their paper in this issue entitled "The feasibility of regional food systems in metropolitan areas: An investigation of Philadelphia's foodshed."

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IN THIS ISSUE

DUNCAN HILCHEY

A smörgåsbord of fresh applied research papers

Published online 28 March 2012

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Sometimes you just have to improvise. We received such a strong response to our call for manuscripts on food system planning that we decided to squeeze a group of excellent additional papers on the topic into this winter issue. Starting out the issue, however, are a number of exceptional open-call papers. We begin with *Assessing the Growth Potential and Economic Impact of the U.S. Maple Syrup Industry*, by **Michael Farrell** and **Brian Chabot.** In honor of one of North America's unique seasonal foodways, this paper will remain open access (freely accessible even without a subscription) through April 2012. Click here to access it for FREE.

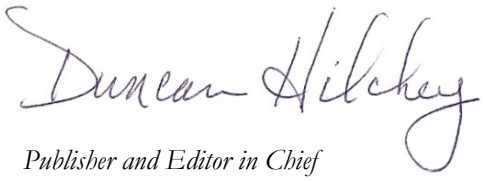
In *Kaiser Permanente's Farmers' Market Program: Description, Impact, and Lessons Learned,* **DeAnn Cromp, Allen Cheadle, Loel Solomon, Preston Maring, Elisa Wong,** and **Kathleen Reed** present the results of a large shoppers survey of the leading HMO's ground-breaking farmers' market program. **Nick McCann** and **Frank Montabon** review innovations in mid-scale beef value chains in *Strategies for Accessing Volume Markets in the Beef Industry: A Review of Three Case Studies.* **Leah Greden Mathews** presents a "portfolio" methodology for exploring the wide range of benefits farms provide to communities in *From the Ground Up: Assessing Consumer Preferences for Multifunctional Agriculture.* In *"Food Security" and "Food Sovereignty": What Frameworks Are Best Suited for Social Equity in Food Systems?* **Megan Carney** provides some clarity on the meaning and application of the oft-confused terms. **Thomas Steiger, Jeanette Eckert, Jay Gatrell, Neil Reid,** and **Paula Ross** provide a fresh and surprising look at farm succession in the Midwest in *Cultivating Narratives: Cultivating Successors.*

Our international contributions include papers from Brazil, Europe, and Canada. In *Is a Geographical Certification a Promising Production and Commercialization Strategy for Smallholder Sheep Farming in Ceará, Brazil?* **Sarah Schneider, Marianna Siegmund-Schultze, Evandro Holanda Júnior, Francisco Alves,** and **Anne Valle Zárate** studied the feasibility of using a geographic indication for a specialty dried mutton product. **Paul Swagemakers, M. Dolores Domínguez García, Xavier Simón Fernández,** and **Johannes Wiskerke** provide a case comparison of two European farms' agro-ecological practices in in *Unfolding Farm Practices: Working Toward Sustainable Food Production in the Netherlands and Spain.* Rounding out our international papers is the second installment of *Could Toronto Provide 10% of its Fresh Vegetable Requirements from Within its Own*

Boundaries? subtitled *Part II, Policy Supports and Program Design* by **Rod MacRae, Joe Nasr, James Kuhns, Lauren Baker, Russ Christianson, Martin Danyluk, Abra Snider, Eric Gallant, Penny Kaill-Vinish, Marc Michalak, Janet Oswald, Sima Patel,** and **Gerda Wekerle.**

The food system planning papers in this issue include **Peleg Kremer** and **Yda Schreuder's** *The Feasibility of Regional Food Systems in Metropolitan Areas: An Investigation of Philadelphia's Foodshed*, in which they provide an exhaustive look at three foodshed scenarios for the City of Brotherly Love. This issue's cover image comes from their paper. *In Welcoming Animals Back to the City: Navigating the Tensions of Urban Livestock Through Municipal Ordinances,* **William Butler** offers an analysis of municipal codes which regulate livestock production in 22 U.S. communities. **Alison Meadow** looks at local food accessibility (including local versus conventional food prices) in *Assessing Access to Local Food System Initiatives in Fairbanks, Alaska.* We offer two papers on agriculture greenhouse gas emissions and mitigation strategies for communities by **Tara Moreau, Jennie Moore,** and **Kent Mullinix** entitled (1) *Mitigating Agricultural Greenhouse Gas Emissions: A Review of Scientific Information for Food System Planning,* and (2) *Planning for Climate Action in British Columbia, Canada: Putting Agricultural Greenhouse Gas Mitigation on Local Government Agendas*.

Finally, our columnists look at challenges to food systems here and abroad. **Ken Meter** looks to "America's game" for inspiration on how we can increase farm numbers in the U.S., while **Rami Zurayk** looks at food insecurity as a basis for the Arab Spring.



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METRICS FROM THE FIELD
Blending insights from research with insights from practice
KEN METER

How do we grow new farmers?
Learning from another American pastime

Published online 28 March 2012

Citation: Meter, K. (2012). How do we grow new farmers? Learning from another American pastime. *Journal of Agriculture, Food Systems, and Community Development, 2*(2), 3–6. http://dx.doi.org/10.5304/jafscd.2012.022.015

Often in my travels as a consultant and speaker, I am asked, "How do we grow new farmers?"

Every time I hear this question, I draw a quick breath. This is truly a remarkable question to hear in America, which prides itself on "feeding the world." If the most productive agricultural engine on the planet does not know how to grow new farmers, who does?

To answer this question, one needs to go back 50 years. A 1962 report by the Committee for Economic Development, a Wall Street think tank, concluded that the problem with U.S. agriculture was that it employed too many people. These human resources could be better allocated, the CED argued, by moving people off the farm, to be replaced by larger equipment.

"[Our] adaptive approach utilizes positive government action to facilitate and promote the movement of labor and capital where they will be the most productive and earn the most income," the study said (CED, 1962; see also Ritchie, 1980). The mechanism for this forced migration of labor was simple: a conscious effort to keep commodity prices low (Meter, 1990). Another mechanism was providing public tax incentives for adopting new technology that replaced labor.

Ken Meter *is president of Crossroads Resource Center in Minneapolis, Minnesota. He has performed 78 local food-system assessments in 30 states and one Canadian province; this information has promoted effective action in partner communities. He served as coordinator of the review process for USDA Community Food Project grants, and has taught economics at the Harvard Kennedy School and the University of Minnesota. He is co-convener of the Community Economic Development Committee of the Community Food Security Coalition. A member of the American Evaluation Association's Systems Technical Interest Group, Meter also serves as an Associate of the Human Systems Dynamics Institute. He serves as a contributing advisor to* JAFSCD.

Indeed, from 1962 to 2011, farmers more than doubled productivity (USDA ERS, 2012a). Food consumption rose from USD107 billion (USD790 billion in 2011 dollars) to USD1.2 trillion (USDA ERS, 2012c). Yet net farm income fell. In 1962, all U.S. farmers combined earned USD46 billion (in 2011 dollars) of net cash income (total cash receipts from marketing farm products, less the production expenses required to produce them) (USDA ERS 2012b). By 2011, net cash farm income had fallen 9%, to USD42 billion (USDA ERS 2012b). Farmers had collected USD793 billion in government payments during that time, but they had paid USD1.2 trillion in interest on loans — which means that at least USD363 billion left the farm sector over that 50-year period[1] (Bureau of Economic Analysis, n.d.; USDA ERS, 2012b; see also Meter, 2011, p, 205). This is a classic case of public intervention magnifying market failure.

This occurred despite billions of dollars of subsidies provided by millions of immigrants who worked below minimum wage under conditions of grave physical risk, drawing upon skills they learned in impoverished settings, working more diligently and more effectively than many American-born children ever learn to work.

So, one answer to the question, "Why doesn't America know how to grow new farmers?" is that our public policy has been to remove the farm labor force under the guise of economic efficiency. As the CED had hoped, both labor and capital were extracted from the U.S. farm economy (CED, 1974). Scant attention was paid to the question of how we would generate new generations of farm owners. Funding for agriculture training programs was dismantled, even as farm income declined; essential training grounds for farm production and family values (such as 4-H, FFA, and high school agricultural courses) eroded in importance.

[1] This data is adjusted for inflation by taking nominal dollar charts and adjusting to 2011 dollars using the U.S. Federal Reserve Board Consumer Price Index.

America received the very policy outcomes it asked for. This was no "market-based solution." This was federal intervention designed to make some players in the market stronger than others.

If we can accomplish that policy goal, why couldn't the U.S. accomplish the goals of promoting healthy locally based food systems, and continuously training new generations of farmers?

As I consider a practical approach to growing new farmers, I often think of that essential American pastime, baseball. Almost every town in the U.S., large or small, has several baseball fields. Many sponsor highly competitive teams. Provision of these fields does not seem to accomplish much in building an economic advantage for the U.S., and it could even be argued that baseball games — especially afternoon contests in the big cities — actually take people away from contributing to the economy. Baseball is inherently seasonal. Yet we seem to know how to grow new baseball players. Despite *Moneyball,* we do this to promote vague and unmeasurable values, things like "teamwork," or "athletic talent," which many now believe should be squeezed out of the broader economy in favor of hard-nosed dollar counts.

Nearly every township board or city hall allocates money for baseball fields close to where young people grow up, so everyone will have a chance to learn the game. A few years ago, we even made it easier for girls to have the same access to baseball fields that boys have. People of all races join the game. Playing baseball has been viewed by some new immigrants as a way of showing one's interest in joining mainstream America.

It is hard to imagine how anyone actually learns baseball, however, since few learn the game through coursework. People are actually expected to learn by doing it, often by giving each other tips or watching a slightly better player's chops. Parents have been known to teach skills to their children. Even to this audacious display of self-organizing, however, there is a public policy response. A remarkable number of cities, towns, and park systems pay adult players a modest amount of

money to coach youngsters or to umpire Little League games. It is almost as if we were all assured access to a precious right.

Truly, we rely on the American competitive spirit to motivate youngsters to learn how to play well, and to credential themselves by winning baseball games. As these youngsters mature, they may try out to be placed on a team where they can play on smoother fields, with larger outfields and higher fences, and where more and more people can watch them play. I am told that parents can become quite impassioned by watching their children vie for places in these arenas, and that games can be chaotic at times. These Little League, Babe Ruth league, and local amateur playing fields are typically built using public funds. That is to say, public money is spent in ways that give Americans pleasure, as well as ways of building their own capacities in a self-organized way. Private investment by families dovetails with public investment by local municipalities.

Most startling to me is the term of art we use in America to describe this ubiquitous, seamless, multifaceted, inclusive, and values-based system of seasonal enterprises that ensures we have plenty of competitive baseball players who understand teamwork.

We call it a "farm system."

A few of the most highly motivated players go on to play in college, semipro, or minor league ball, where the competition is fiercer and the potential reward is greater. At this level, people are financially rewarded for their personal skills — yet many of these full-blooded Americans are more than happy to play these contests on a baseball field that was — gasp! — subsidized by public dollars.

A few of the lucky move on to multimillion-dollar contracts, where they can vie for attention on the cable networks, trying to steal viewers away from Iron Chef competitions. I don't condone these superstar salaries, since to my thinking farmers create more value, but they seem popular. Moreover, it should not be overlooked that millions of Americans pursue the baseball dream with absolutely no financial compensation.

Shockingly, nearly every major metropolitan area in the U.S. sports a professional stadium (or two) designed expressly for the game of baseball. The Minnesota Twins' beautiful new stadium, paid in large part by Hennepin County over the opposition of its residents, features a climate-controlled outdoor space where grass can be kept alive year-round, and a specially designed sandy soil so rain drains promptly. Yet many northern cities tell me their growing season is too short to allow for food to be grown inside city limits; the season is "too short," I am told.

Most startling to me is the term of art we use in America to describe this ubiquitous, seamless, multifaceted, inclusive, and values-based system of seasonal enterprises that ensures we have plenty of competitive baseball players who understand teamwork — this elegant and complex combination of public and private investment, working in complementary ways for a socially approved good.

We call it a "farm system."

It is almost as if we had learned from our 4-H clubs, our FFA chapters, and our multigenerational family farms how to build a system of baseball facilities and processes that ensure open access to all. Indeed, the patient, long-term planning that a farmer needs to raise a healthy dairy herd, or to effectively rotate pastures with crops to reduce weed pressure, or to pass a farm down to the children, would be essential in framing a long-term approach to the baseball question.

Perhaps we could now apply these same principles to the topic of growing new farmers. Yet to do so,

we might have to decide, as a society, that feeding all of our children fresh food is as important as making sure they all have access to baseball. 

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GLOBAL VIEWS OF LOCAL FOOD SYSTEMS

Reflections on the growing worldwide local food movement

RAMI ZURAYK

Bread, freedom, and social justice

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Anyone needing an indication of how much the Arab World has changed in the past year has only to tune in to one of the popular satellite TV music channels. There, young artist Ramy Essam's hit song "Bread, Freedom and Social Justice" is beamed several times a day to the four corners of the Arab world. The song was released last year, in the wake of the Egyptian uprising that brought down a regime that punished talk about freedom and social justice with imprisonment and torture. It takes its title from one of the most popular slogans chanted during the 2011 protests, which came after bread riots had shaken Egypt and many surrounding Arab countries in the wake of the 2008 food crisis. In that sense, the song adequately summarizes the main demands of the Arab people. Food security is at the top of that list.

The Arab region is the most food-insecure part of the world. It imports 50% of the calories it consumes (The World Bank, FAO and IFAD, 2006), and local food production is limited by serious ecological and structural conditions. Egypt is the largest single grain importer in the world (FAO, 2011), and other countries in what was historically known as the Fertile Crescent (parts of present day Iraq, southern Turkey, Lebanon, Syria, and Palestine) suffer from the same predicament. This is one of the main reasons why many researchers from around the world have sought to attribute the Arab uprisings to rising food prices (see for example Bar-Yam, 2012 and Harrigan, 2012). The food price spikes since 2008 have certainly served to mobilize public anger, but people have risen up for many different reasons. Among these are youth unemployment and rural poverty associated with the demise of local food systems. All these are important components of food security.

Rami Zurayk *is professor at the Faculty of Agricultural and Food Sciences at the American University of Beirut, Lebanon. He studied at the American University of Beirut and at Oxford University, UK. His research addresses issues at the nexus of food, landscapes, and livelihoods. He is an active member of Lebanese civil society and a founder of Slow Food Beirut. He can be contacted at ramizurayk@gmail.com.*

To the interested onlooker, the problem of food security in the Arab world appears to be inextricable: the region's ecological endowment is simply not sufficient to satisfy the needs of a population that has been experiencing the fastest growth rates worldwide and the most rapid urbanization (IFPRI, 2010). Moreover, crop productivity is low (except in Egypt) and the spread of technology is limited by rural illiteracy and poor standards of education. The natural conclusion is usually that the region must rely principally on global trade in order to satisfy the needs of its growing population. But markets are only open to those who can afford them. That is why mainstream institutions such as the International Food Policy Research Institute (IFPRI) (Breisinger et al., 2010) classifies oil-rich countries such as Qatar as food secure although Qatar produces no food, while the Arab countries of the Levant — where farming began 10,000 years ago — are considered to be food insecure because they do not produce sufficient oil rent to afford to import all the food they need.

A solution to the Arab food security riddle must definitely have a homegrown component, especially in those countries where great human civilizations were built on surplus created from agriculture.

The instability of the world food markets has clearly shown that reliance on trade for food security is a very risky enterprise, and that the globalized food regime does not believe in charity. A solution to the Arab food security riddle must definitely have a homegrown component, especially in those countries where great human civilizations were built on surplus created from agriculture. The Nile basin was the cradle of the Pharaohs, and Babylon rose from the rich Mesopotamian plains. Why are these regions unable to cater better to their own needs? Why can't they contribute more prominently to their own food security?

The answer to this conundrum lies first in a better understanding of the contemporary rural and farming history of the region, which, half a century ago, moved from the yoke of colonialism to the grasp of autocracies in a world system where strategic interest in oil reserves are the prime determinant of foreign policy. Since the mid–twentieth century, the region has had more than its share of invasions, occupations, and wars, and the need to keep a tight control over the region has led the dominant nations to embrace and foster local dictatorships. With generous military help, these totalitarian regimes developed competencies in oppression and repression, but not in farming and rural development. As a result, local food systems were quasi-annihilated and rural poverty became rampant. Today, while 43% of the Arab population still lives in rural areas, 70% of them are poor (Riadh, 2010). A small affluent class has taken hold of the resources of these nations, strengthened by its close association with the regimes to whom it acts as a financial intermediary. Investments in agriculture have been largely capitalistic in nature. Strengthened with state subsidies, investors have aimed at producing value-added goods for export rather than addressing the food and nutritional needs of the population. Meanwhile, this same class also doubled up as trade agents for multinational corporations flooding local markets with once cheap subsidized food from Northern surpluses. It is in this context that Arab food security needs to be perceived.

Fair access to land is a precondition to the growth and prosperity of a local food system that contributes to food security and sovereignty and alleviates rural poverty. Access to adequate land resources remains one of the most challenging hurdles facing Arab family farmers, who are the backbone of the local food systems. In many Arab countries, the endowment of fertile land is limited by natural conditions: a mixture of terrain and water availability. In Egypt, for instance, the farmland area per capita is just one twenty-fifth of a hectare (0.1 acre). Those in power hold much of this land according to the GINI index for land, a measure of the inequality in distribution (where 0 is perfect equality

and 100 is perfect inequality). In this region, the GINI index is among the highest worldwide. In Egypt it is 69, in Jordan it is 81, in Lebanon it is 69, in Morocco 62, in Tunisia 69, and in Algeria 65 (FAO, 2010). (It is unavailable for Yemen, Syria, Libya, Bahrain, and other Gulf countries.) Few countries in the world show higher land inequality figures as a group, except perhaps the U.S., where the GINI for land is 78. By comparison, Ireland is 44 and Sweden is 32 (FAO, 2010).

The Arab popular uprisings have proved that people can remove dictators from power. But a difficult question remains: Will the Arab people be able to change their social and economic realities, ameliorate the living conditions of the poor, improve food security, and achieve the social justice called for in Ramy's song?

Current indications are not very encouraging. Media reports indicate that public feeling on the Tunisian streets is that there has been no real change in the countryside, where the uprising began. This is despite the fact that the agriculture sector provides more than 12% of the Tunisian GDP and continues to attract foreign investments (Larbi & Chymes, 2009). Statistics also show that agricultural exports rose by 12% after the revolution (Shahin, 2011). However, none of these achievements was used to improve the livelihoods of small producers and of agricultural workers. They also did not lower unemployment, rife in the countryside.

The problem lies in great part in the economic model followed by Arab countries, which has not been seriously challenged by the uprisings. This model depends on economic growth based on the maximum exploitation of human and natural resources. Wealth continues to be concentrated in the hands of a small group of affluent people that influences national policy to protect its members' interests. For instance, the land rent "liberation" Law 96 of 1992, which forced more than a million Egyptian farmers off their land, has not been revoked — and there are no indications that it will be (Bush, 2010).

Many today feel that no regime change will truly take place if this system is not confronted. There are, however, some positive trends that lead us to cautious optimism. In Egypt, a popular movement has recently emerged in the countryside, where 18 million farmers live. It seeks to lobby for the inclusion of farmers' rights to land, water, and a decent living in the new constitution. Whether movements such as these will gain enough power to change the established order may be decisive in achieving bread, freedom, and social justice.

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Assessing the growth potential and economic impact of the U.S. maple syrup industry

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Abstract

This paper addresses the growth potential of the U.S. maple syrup industry. It outlines the number of potentially tappable maple trees and the economic impact of utilizing more of these trees for syrup production. U.S. producers currently tap 0.4% of all potentially tappable maple trees, with the highest percentage tapped in Vermont, at 2.94%. Two scenarios are analyzed for how production and consumption could grow together: (1) if each state tapped 2.94% of its available trees and consumed all of the syrup locally among its residents; and (2) the number of taps needed in each state to provide 2.6 ounces (76.9 ml) per person from "local" sources. Based on these analyses, states with the greatest potential to increase local production and consumption of pure maple syrup include Connecticut, Michigan, New York, Ohio, and Pennsylvania. Strategic marketing efforts are necessary to help maple producers take advantage of the growing demand for local, healthy, and organic food.

Keywords

economic impact, Forest Inventory & Analysis (FIA), local food, maple syrup, red maple, sugar maple

Introduction

Maple syrup was once a much larger component of the rural economy in both the U.S. and Canada. The United States produced a record equivalent of 6,613,000 gallons (25,032,928 liters) of maple syrup in 1860, with most of the syrup actually boiled down further to produce granulated maple sugar (U.S. Census Office, 1860). As seen in figure 1, maple production in the U.S. peaked in the 1800s, steadily declined throughout the twentieth century, and is experiencing a rebirth in the twenty-first century. Maple production was always a small

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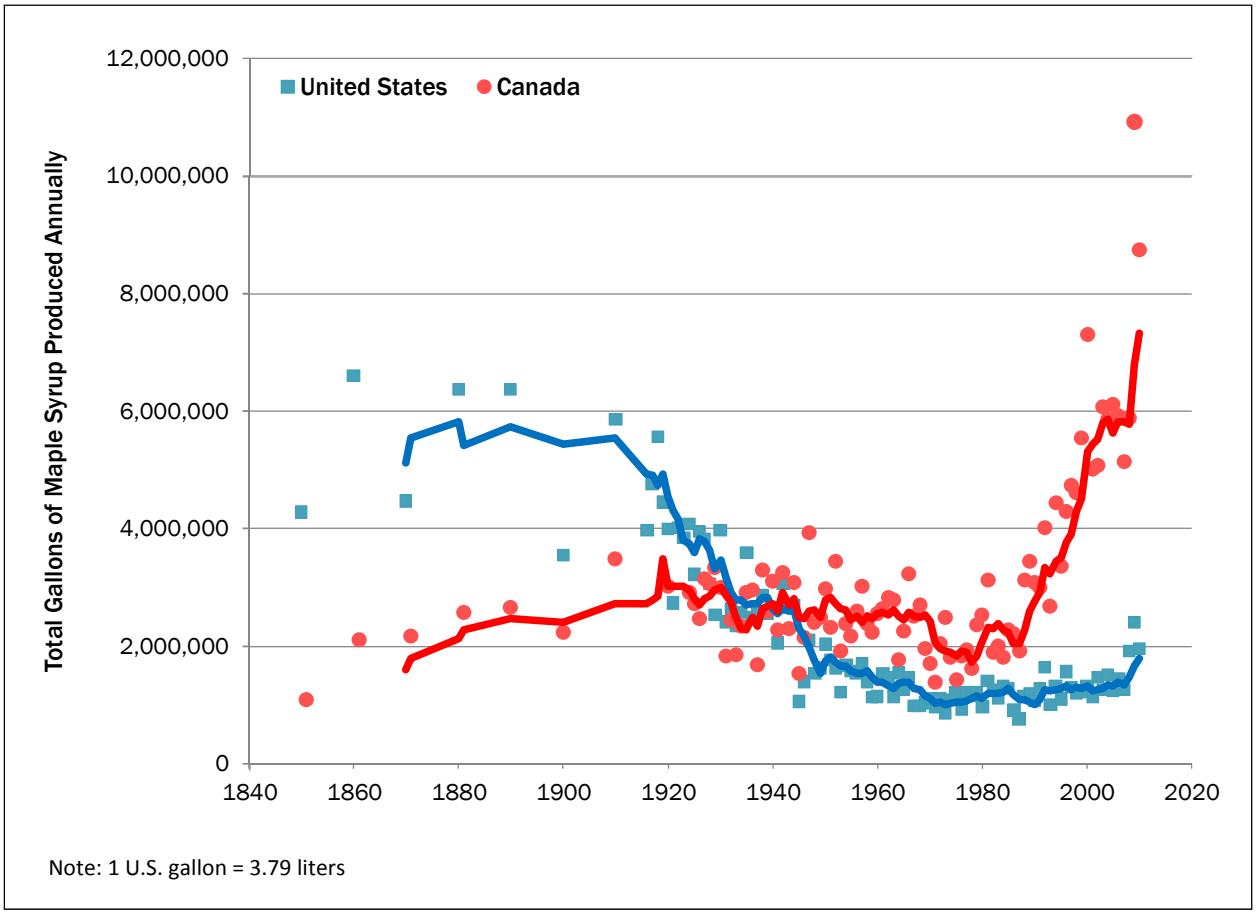
See the Cornell Maple Program website at http://maple.dnr.cornell.edu

Figure 1. Maple Syrup Production in the United States & Canada 1860–2010



Sources: Statistics Canada. (2011, Dec. 14). Table 001-0008 — Production and farm value of maple products, annual (table). CANSIM (database) . Retrieved from http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=0010008&pattern=maple&tabMode=dataTable&srchLan=-1&p1=1&p2=-1

U.S. Department of Agriculture, Economic Research Service. (2011, June 10). *Table 43—U.S. maple syrup production, imports, exports, and prices, by calendar year* [Excel spreadsheet]. Retrieved from http://www.ers.usda.gov/briefing/sugar/data/table43.xls

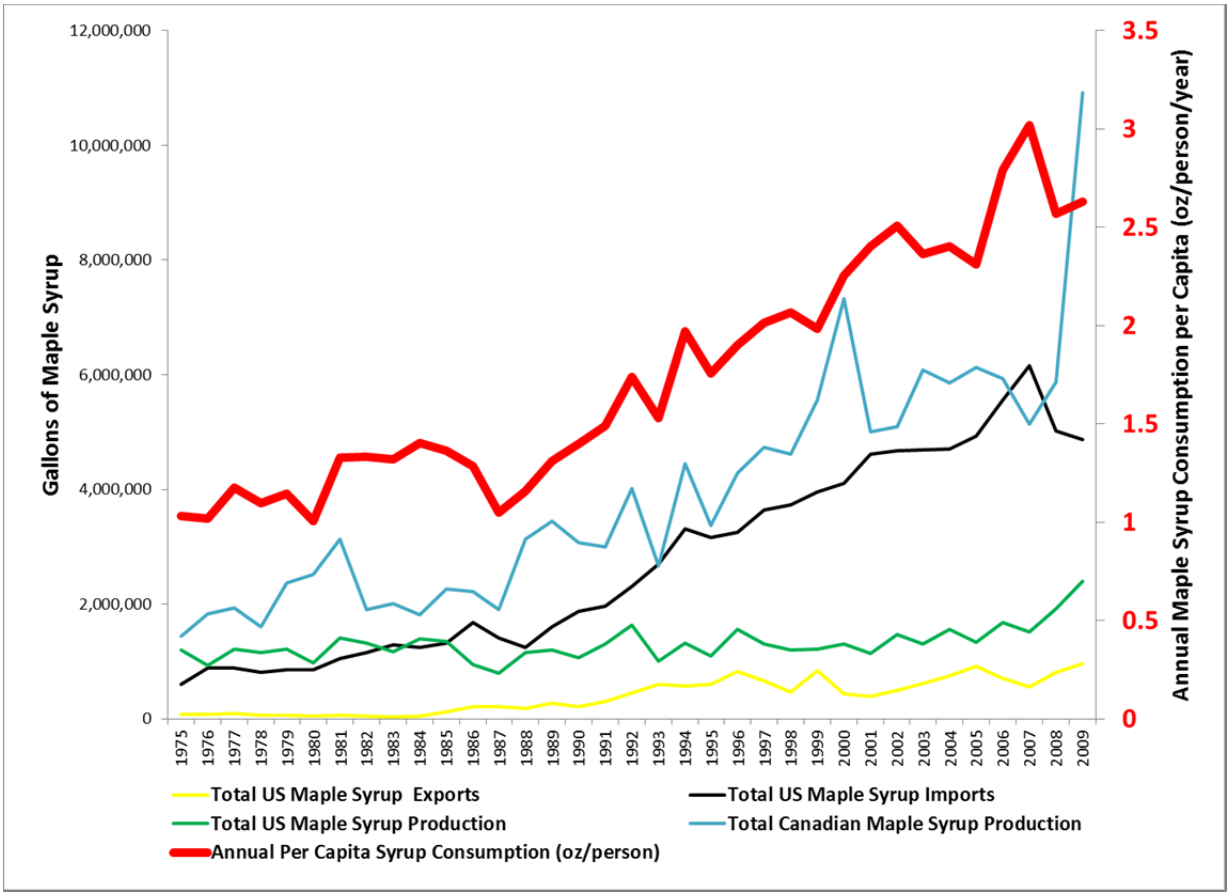
component of the agricultural sector in Canada, but spiked dramatically in Quebec in the early 1980s. Producers installed vacuum tubing systems and reverse osmosis units that allowed them to significantly expand their operations while saving time and using less fuel. Production in Canada leveled off in recent years due to implementation of a quota system in Quebec in 2005 aimed at stabilizing prices and reducing surplus inventory (Gagné, 2008). Once the inventory was exhausted in 2008, prices rose to record levels, the quota restrictions were eased, and production levels surged once again.

Maple syrup is a luxury item consumed around the world, yet the greatest market for syrup still lies within the United States. The U.S. currently imports nearly four times as much syrup from Canada as it produces (Agriculture and Agri-Food Canada, 2006), so there is a tremendous opportunity for U.S. producers to expand production and fill domestic markets with "local" syrup. Maple syrup production is growing rapidly in the U.S., as a shortage of syrup and corresponding price increases led many sugarmakers to expand production and others to get started in recent years (Dravis, 2008; Dravis, 2009). Some politicians even seized on the opportunity to spur rural economic

development through enhanced syrup production. Senator Charles Schumer (D-NY) introduced legislation in April 2008 that would provide grants and incentives to states in order to increase the number of trees being tapped on private lands (Churchill, 2008, Schwaner-Albright, 2009). This legislation was reintroduced in both the House and the Senate several times but has yet to pass in any form. Even without federal support, states including Connecticut, Maine, Michigan, New York, and Vermont have all moved forward with efforts to boost syrup production (Hoyum, 2010; Karkos, 2011; Litten, 2011; Wanamaker, 2009; Whitcomb, 2009).

Maple syrup consumption in the U.S. is only 2.6 oz. (76.9 ml)/person, yet this has grown tremendously over the past 35 years. Figure 2 tracks U.S. and Canadian syrup production, as well as U.S. imports and exports of maple syrup, from 1975 to 2009. Per capita consumption levels were determined by summing the amount of syrup produced by U.S. sugarmakers and the amount of syrup imported from Canada, subtracting the amount of syrup exported from the U.S., and then dividing by the population in a given year.

Figure 2. Maple Syrup Production, Imports and Exports in the United States and Canada, and Per Capita Annual Maple Syrup Consumption in the U.S. 1975–2009.



Sources: Statistics Canada. (2011, Dec. 14). Table 001-0008 — Production and farm value of maple products, annual (table). CANSIM (database) . Retrieved from http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=0010008&pattern=maple&tabMode=dataTable&srchLan=-1&p1=1&p2=-1

U.S. Department of Agriculture, Economic Research Service. (2011, June 10). *Table 43—U.S. maple syrup production, imports, exports, and prices, by calendar year* [Excel spreadsheet]. Retrieved from http://www.ers.usda.gov/briefing/sugar/data/table43.xls

U.S. Census Bureau. (2011, Dec. 21). *Population estimates: State totals: Vintage 2011.* Retrieved from http://www.census.gov/popest/data/state/totals/2011/index.html

Per capita consumption of maple syrup in the U.S. has grown by 155% over the past 35 years, rising from 1.03 oz. (30.5 ml)/person in 1975 to 2.63 oz. (77.8 ml)/person in 2009. While the boost in U.S. consumption has been made possible by large increases in Canadian production, future levels of syrup production and consumption might not follow the same trends. Questions remain about where the additional syrup will be produced and consumed and the impact of future development on prices and profitability.

Methods

In order to determine the tapping potential in the U.S., analyses were performed using the latest U.S. Forest Service Forest Inventory & Analysis (FIA) data (Bechtold & Patterson, 2005) from 24 states that contain a significant number of sugar (*Acer saccharum*) and/or red maples *(Acer rubrum*). The number of potential taps was estimated by summing all of the sugar and red maple trees greater than 10" (25.4 cm) diameter at breast height (dbh) and applying conservative tapping guidelines of one tap for a 10"–17" (25.4– 43.2 cm) tree and 2 taps for trees 18" (45.7 cm) and greater. The FIA data are classified by ownership category (private, U.S. Forest Service, other federal land, and state and local government). They are also divided between the tappable (nonreserved) and nontappable (reserved) trees, as the reserved forestlands where timber production is legally prohibited are also likely to have restrictions on tapping.

To determine the percentage of potential taps that are actually utilized for syrup production, these figures were compared with the number of taps reported for each state in the 2010 National Agricultural Statistics Service (USDA NASS) Maple Syrup Crop Report. NASS only tracks maple syrup production for 10 states. Thus, although 14 additional states have a substantial number of maple trees, we lack any information on their number of taps and corresponding utilization rates. Syrup production levels in these states are currently so low that it is not feasible for NASS to gather these data.

Given the strong growth in the local food sector and the niche that maple syrup occupies as the local, minimally processed sugar alternative for the eastern U.S., analyses were performed to determine the market potential for maple syrup production and consumption on a "local" basis. For these analyses, local syrup is defined as being produced and consumed within the same state. Based on local production for local consumption, two scenarios are posed for how the maple industry could expand:

1. If each state tapped the same percentage of its trees that Vermont does and all of the syrup was consumed locally by the residents of the state, how much syrup must each person in that state consume on an annual basis?

2. Given that the average American consumes 2.6 oz. (76.9 ml) of pure maple syrup annually, what percentage of the maple trees in each state would need to be tapped in order to fill the existing demand for syrup in a state from its own trees?

The final component of this paper is determining the economic impact for each of these two scenarios. For each state, average annual syrup production was estimated based on the average yield per tap in 2007–2009 for that state. For the states that do not have any production data, the lowest figure of all states, 22 oz. (651 ml)/tap for Pennsylvania, was assumed for the average production. A dollar figure was estimated by multiplying the possible production figures for each state by the average price that producers received in that state from retail, wholesale, and bulk syrup sales over the period 2007–2009. For states that do not have any data available, the average figure of USD37.10 per gallon for the entire U.S. was used.

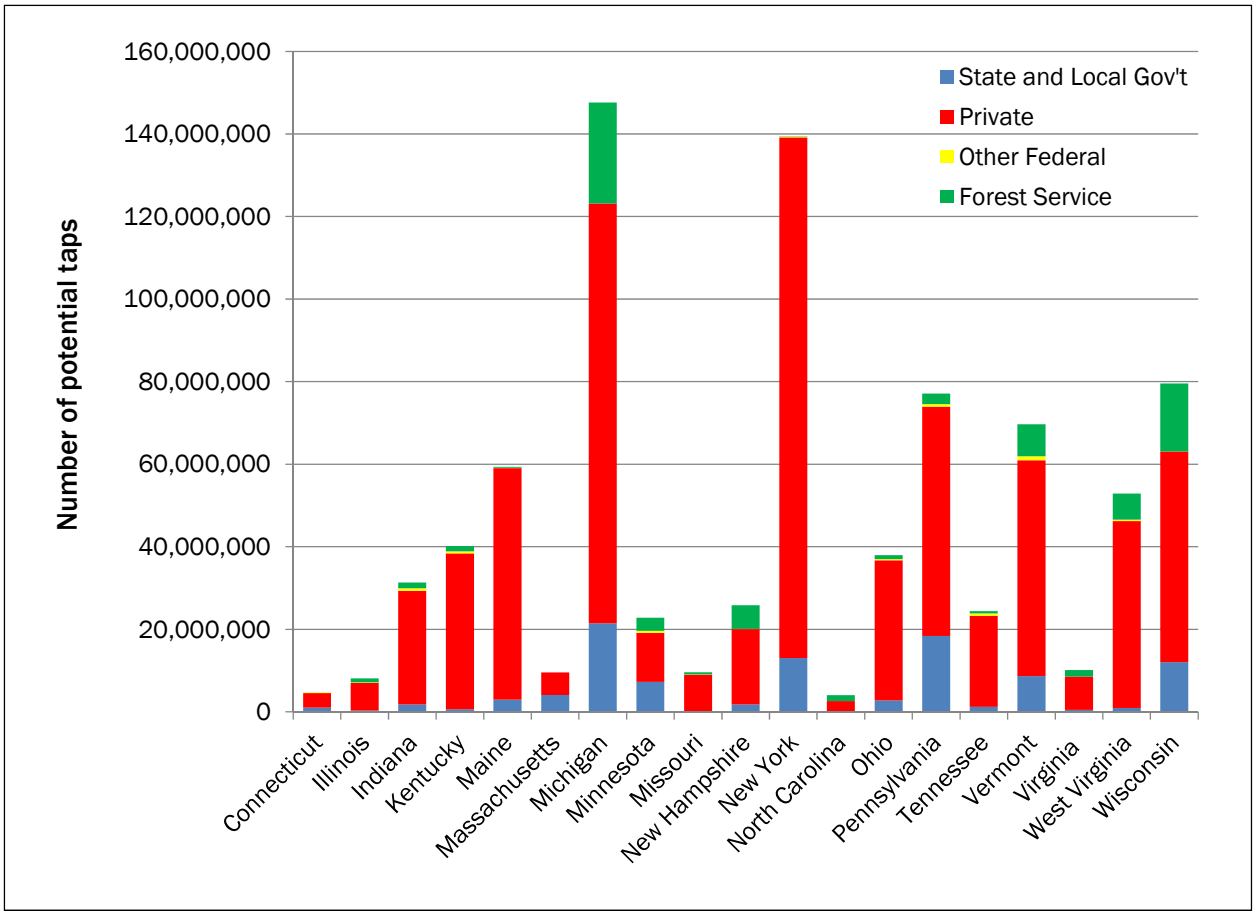
Results and Discussion

As an agricultural crop, maple syrup production is unique since it is produced from large trees that are at least 30–40 years old. If a farmer or landowner would like to start producing syrup, he or she would either have to plant trees and wait a long time or find an established grove of maples that are

already suitable for tapping. Thus, the immediate potential for syrup production is based on the existing resource of large maple trees. While sugar maples are the preferred species for tapping due to the high sugar concentration in their sap, red maples are also suitable for syrup production, but usually exhibit slightly lower sap sugar production than sugar maples (Chapeskie, Wilmot, Chabot, & Perkins, 2006). The number of potential sugar maple taps is displayed in figure 3, while the number of potential red maple taps can be seen in figure 4. Figure 5 presents the total number of combined sugar and red maple taps for 24 states.

Michigan contains the greatest number of potential sugar maple taps, whereas Pennsylvania leads in red maples. When considering sugar and red maples combined, New York has the most potentially tappable trees of any state. The more southern and western states tend to have more red maple than sugar maple potential taps, though there are exceptions to this rule. For instance, Connecticut, Maine, Massachusetts, and Pennsylvania all have significantly more red maples than sugar maples, whereas Illinois, Indiana and Kentucky all have more sugar than red maple potential taps. Although Vermont dominates in syrup production, it ranks fifth in the number of potential sugar maple taps and seventh in the combined total number of sugar and red maple potential taps. Producers in Vermont make up for this apparent shortfall by tapping a much larger percentage of their trees than any other state.

Figure 3. Number of Potential Sugar Maple Taps for 19 States by Ownership Status, 2011



Source: U.S. Department of Agriculture, Forest Service. (2010)..

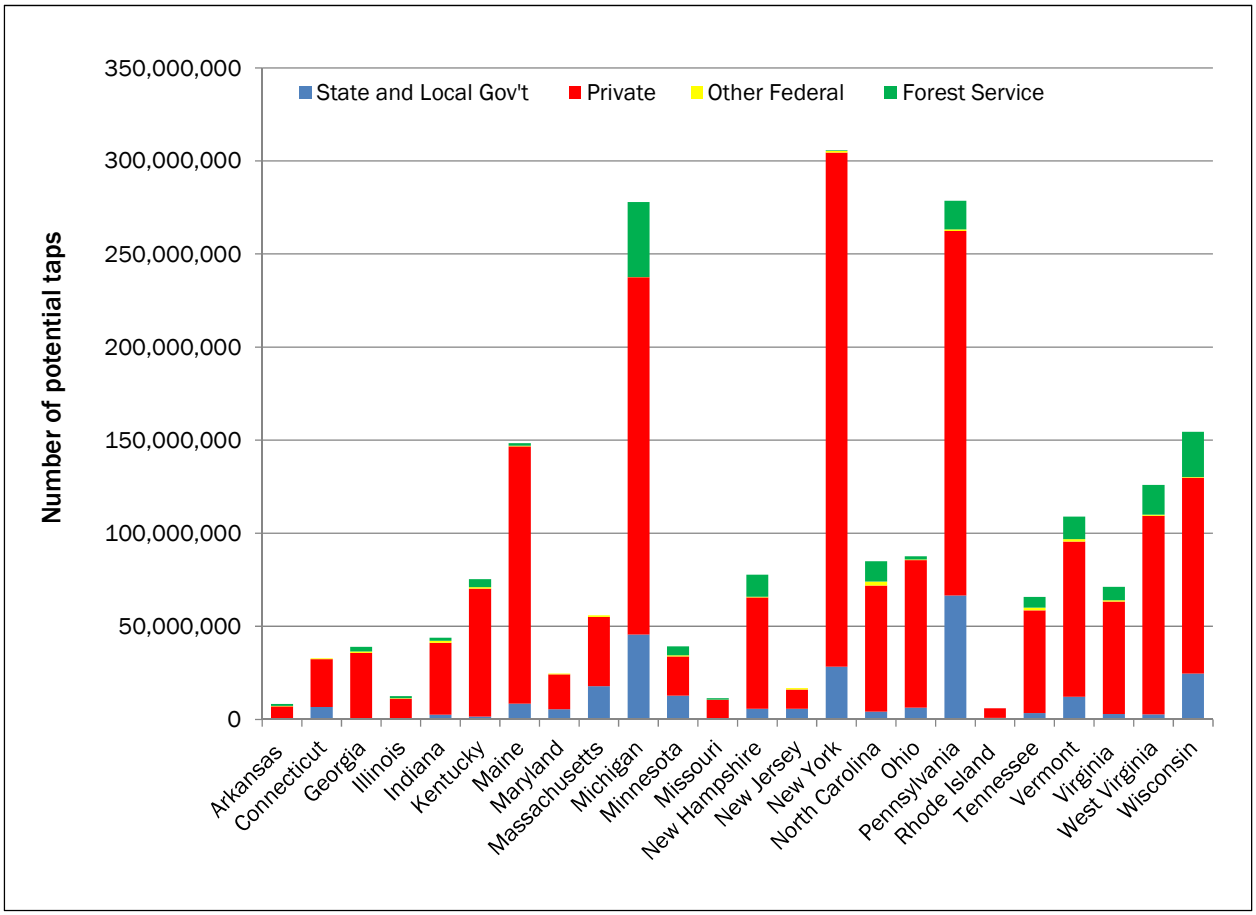
It is important to realize that the figures presented here overestimate the realistic tapping potential for several reasons. In order to economically tap maples, the trees must be located close enough to an access road and the density of trees must be high enough to justify installing a tubing or road system to collect the sap. While the FIA data includes all sugar and red maple trees growing on nonreserved forestland (land that is not restricted from management), many of these trees are growing in locations that are not suitable for tapping. Some of them are in stands that have a low density of maples, are too far from an access road, or are otherwise inaccessible due to topographic constraints. Further research is in process to obtain a more realistic estimate of the tapping potential for several states based on these considerations.

Finally, it is important to note that the FIA program only deals with forestland, and therefore does not account for a significant percentage of the trees that are actually tapped. Maples growing in yards, parks, and along roads are favored by producers who collect with buckets due to the easy access and large volumes of sweet sap they generate. In order to quantify these potential taps, much more detailed inventory data must be collected and analyzed through urban and community forestry research initiatives.

Utilization of the Maple Resource for Syrup Production

Significant differences exist in the utilization of the maple resource for syrup production, as seen in figure 6. Vermont clearly dominates the industry

Figure 4. Number of Potential Red Maple Taps for 24 States by Ownership Status, 2011



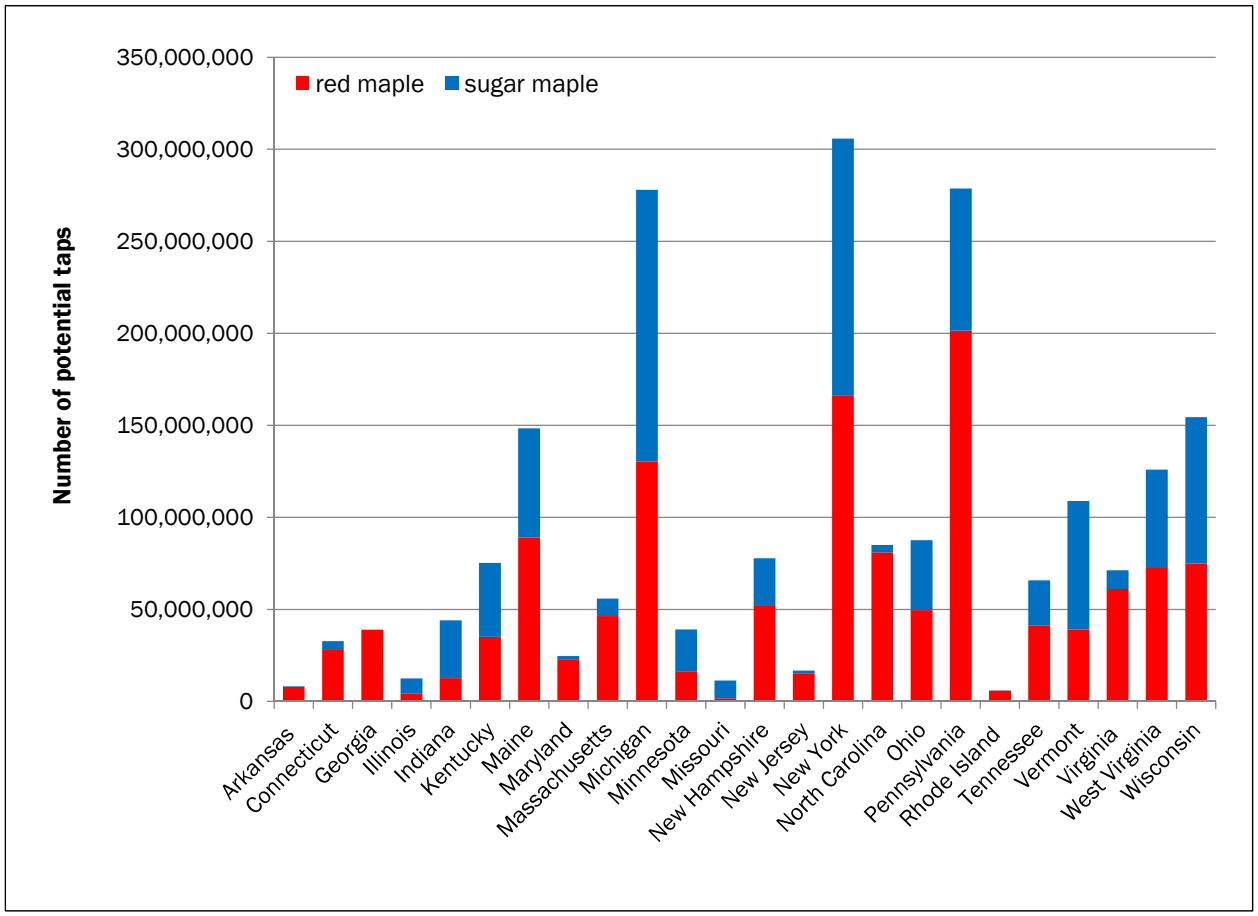
Source: U.S. Department of Agriculture, Forest Service. (2010).

due to its relatively high utilization rate of 2.94%, whereas states such as Michigan (0.15%), New York (0.45%), and Pennsylvania (0.17%) have tremendous potential for expansion. Although these three states have the largest maple resource, they tap a much lower percentage of their trees than Vermont does.

The discrepancies in utilization rates can largely be explained by cultural traditions (Hinrichs, 1998). When there are strong cultural norms to produce maple syrup in a certain area, farmers and landowners are more likely to do so. However, even when there is a robust maple resource, if nobody is already producing syrup, then it is much less likely that landowners start production. Thus, even though Michigan contains the most tappable sugar maples of any state, the logging industry has dominated the landscape and only 0.15% of the maples are used for syrup production. Similarly, West Virginia has more tappable maple trees than Vermont, yet the culture for syrup production does not exist in most of the state. Even though Vermont ranks seventh in the number of potential taps, it ranks first in syrup production due in large part to the strong cultural traditions and superior branding and marketing of its product over the last century.

Among the more southerly states, such as Kentucky and Tennessee, even though maples grow abundantly, the climate is not thought to be as suitable for commercial syrup production. The climate may play a critical role in explaining why

Figure 5. Total Number of Potential Sugar and Red Maple Taps for 24 States in the United States, 2011

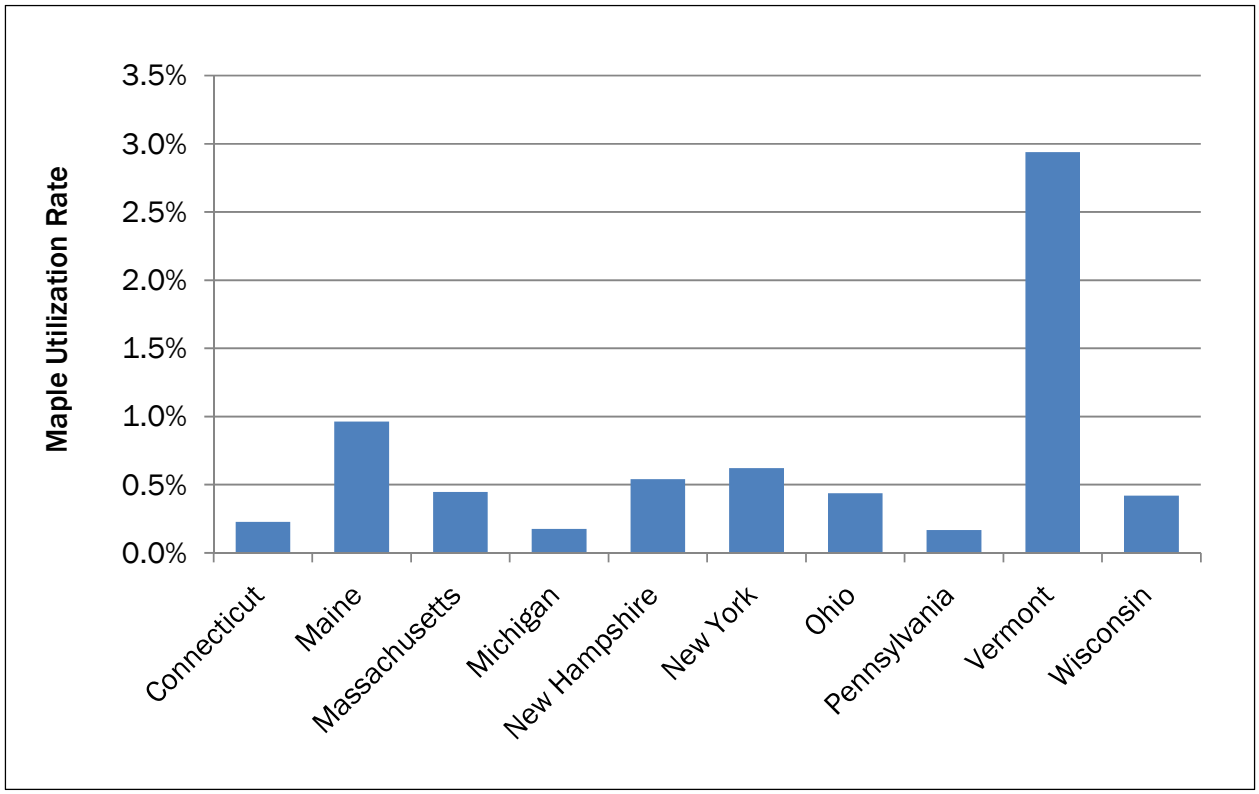


Source: U.S. Department of Agriculture, Forest Service. (2010).

more syrup is not currently produced in these states and what the potential for increasing production is. Sugaring used to be more commonplace in the mid-Atlantic region during the 1800s (U.S. Census, 1860), but that tradition has been lost over time. In these states, the limited number of freezing nights and the spells of very warm weather can cause tapholes to "dry up" prematurely, especially when using buckets or gravity-based tubing to collect the sap. However, with new technologies and techniques, such as high-vacuum tubing, check-valve spout adapters, and replacement of droplines and spouts every year, there may be opportunities to achieve economic returns from syrup production even when the weather is not favorable. More research is needed to determine the potential yields in warmer climates using modern sap-collection technologies. This could provide immediate economic development in these states, while providing a preview for what the Northeast can expect in a future climate that is predicted to be similar to the mid-Atlantic region (Skinner, DeGaetano, & Chabot, 2010).

Finally, it should be noted that the NASS estimates are based on voluntary reporting of producers. Many sugarmakers are opposed to a government agency knowing about their activities and therefore do not provide NASS with accurate (or any) information on their production levels. Thus, even though NASS provides the most comprehensive database on syrup production in the U.S., using these figures likely underestimates the actual production in many states. Furthermore, since NASS only tracks syrup production in 10 states, there is no data on the limited amount of sugaring that takes place in the other states.

Figure 6. Utilization of the Maple Resource for Syrup Production, 2011



Note: Results based on NASS Maple Syrup Crop Report (2010) and U.S. Foresty Service FIA data (2010) on the number of tappable sugar and red maple trees.

Economic Impact of Increased Syrup Production: Two Scenarios for Local Consumption

This section presents the results of two scenarios for increasing the production of maple syrup through local consumption within the state in which it is produced. The first scenario examines what could happen if each state tapped the same percentage of its trees as Vermont does, while the second scenario estimates the number of taps needed to provide each resident with 2.6 oz. (76.9 ml) of locally produced syrup.

Scenario 1: What if Each State Tapped the Same Percentage of Its Trees as Vermont

The first scenario provides a theoretical upper limit for what is possible to achieve in each state. Although no other state will likely ever tap the same percentage of its trees as Vermont does, this analysis presents the economic impact and per capita consumption levels necessary to consume all of the syrup locally if it did.

There are interesting observations when examining the per capita consumption necessary to sell all of the syrup produced in a state among the residents of that state. While most states have low "necessary" consumption levels, below 3 oz./person, the residents of Vermont and Maine would need to consume significantly more syrup, at 180.9 oz. (5,349.9 ml) per person and 26.6 oz. (786.7 ml) per person, respectively, in order to utilize all of the syrup they produce themselves. These extremely high values result from the combination of extensive syrup production and relatively low populations. While it is likely that many producers of maple syrup consume at least 180 ounces themselves in a given year, it would take enormous marketing efforts and a tremendous reduction in prices to encourage all citizens to consume this much pure maple syrup annually.

Given this reality, Vermont and Maine have not limited their markets to the residents of their own state, but strategically looked elsewhere to sell most of their syrup. Vermont made wise decisions throughout the twentieth century in branding itself as *the maple state* in order to export this high-value crop throughout the U.S. and now to the world. Similarly, Canada purposefully built a worldwide image *as the maple syrup nation* and now exports over 80% of its production (Agriculture and Agri-Food Canada, 2006). It's commonly known within the maple industry that the vast majority of syrup production in Maine is carried out by Canadian citizens on former paper company land along the Quebec border. Since this region has few people to sell to locally, nearly all of the syrup is sold in bulk to the major packaging and distribution companies in the U.S. and Canada.

Although exports will continue to be important for agricultural commodities, the local food sector is currently experiencing rapid growth. It is now even being embraced by Walmart, which plans to source a larger percentage of the produce sold in its stores from farmers located in that state (Clifford, 2010). In order to examine the potential for local syrup consumption on a statewide basis, table 1 presents two figures:

1. The per capita syrup consumption necessary to consume all of the syrup currently produced in a state locally, and

2. The syrup consumption levels necessary if a state tapped the same percentage of its trees as Vermont does.

There are states such as Illinois, Missouri, and New Jersey that have high populations and relatively few tappable maple trees. Sugarmakers in these states do not produce enough syrup to be counted by NASS, but if they tapped 2.94% of their trees (as Vermont does), the average person would only have to consume less than 2 oz. (59 ml) annually to exhaust the supply. Therefore, these states could aggressively grow their maple industries and market exclusively through local outlets without trying to compete in the greater marketplace. As evidence, researchers in Illinois have examined the economic feasibility of expanding syrup production in their state and found promising results (Buchheit, Carver, Zaczek, Crum, Mangun, Williard, & Preece, 2004). States with high populations and a slightly greater number of tappable trees, such as Indiana, Kentucky, Massachusetts, Ohio, Tennessee, and

Table 1. The Economic Impact of Increasing Syrup Production Levels to those Achieved in Vermont (all prices in USD)

	Population (2010 Census Data)	Number of Potential Taps[1]	Number of Actual Taps[2]	Number of Taps When Achieving Vermont's Utilization Rate[3]	Syrup Production Efficiency (oz/tap)[4]	Local per-Capita Consumption at current utilization rates (oz./person)	Local per-capita consumption at Vermont utilization rates (oz./person)	Average Price per Gallon[5]	Current Value of Syrup Production	Potential Value of Syrup Production at Vermont's Utilization Rates	Economic Impact of Increasing Syrup Production to Vermont's Level
Arkansas	2,915,918	8,293,520	—	243,745	22.4	0.0	1.9	$37.80	—	$1,612,373	$1,612,373
Connecticut	3,574,097	32,702,898	75,000	961,132	23.7	0.5	6.4	$59.23	$823,343	$10,551,221	$9,727,878
Georgia	9,687,653	38,954,859	—	1,144,876	22.4	0.0	2.6	$37.80	—	$7,573,354	$7,573,354
Illinois	12,830,632	12,527,570	—	368,183	22.4	0.0	0.6	$37.80	—	$2,435,530	$2,435,530
Indiana	6,483,802	43,971,137	—	1,292,303	22.4	0.0	4.5	$37.80	—	$8,548,587	$8,548,587
Kentucky	4,339,367	75,286,754	—	2,212,663	22.4	0.0	11.4	$37.80	—	$14,636,768	$14,636,768
Maine	1,328,361	148,404,616	1,430,000	4,361,583	27.9	30.0	91.5	$33.27	$10,354,694	$31,582,419	$21,227,726
Maryland	5,773,552	24,643,818	—	724,277	22.4	0.0	2.8	$37.80	—	$4,791,093	$4,791,093
Massachusetts	6,547,629	55,928,669	250,000	1,643,733	24.6	0.9	6.2	$48.73	$2,339,200	$15,380,080	$13,040,880
Michigan	9,883,640	277,960,651	490,000	8,169,211	29.1	1.4	24.1	$42.53	$4,737,930	$78,990,094	$74,252,164
Minnesota	5,303,925	39,181,626	—	1,151,541	22.4	0.0	4.9	$37.80	—	$7,617,440	$7,617,440
Missouri	5,988,927	11,322,763	—	332,774	22.4	0.0	1.2	$37.80	—	$2,201,299	$2,201,299
New Hampshire	1,316,470	77,720,574	420,000	2,284,193	29.5	9.4	51.2	$50.40	$4,882,752	$26,555,112	$21,672,360
New Jersey	8,791,894	16,806,386	—	493,936	22.4	0.0	1.3	$37.80	—	$3,267,390	$3,267,390
New York	19,378,102	305,685,731	1,903,000	8,984,045	26.9	2.6	12.5	$38.83	$15,543,598	$73,381,184	$57,837,585
North Carolina	9,535,483	84,977,529	—	2,497,473	22.4	0.0	5.9	$37.80	—	$16,520,786	$16,520,786
Ohio	11,536,504	87,616,491	385,000	2,575,032	29.7	1.0	6.6	$39.07	$3,484,421	$23,305,184	$19,820,763
Pennsylvania	12,702,379	278,622,099	465,000	8,188,650	22.4	0.8	14.4	$36.00	$2,929,500	$51,588,498	$48,658,998
Rhode Island	1,052,567	6,019,295	—	176,906	22.4	0.0	3.8	$37.80	—	$1,170,233	$1,170,233
Tennessee	6,346,105	65,814,848	—	1,934,286	22.4	0.0	6.8	$37.80	—	$12,795,301	$12,795,301
Vermont	625,741	108,881,278	3,200,000	3,200,000	35.4	180.9	180.9	$34.57	$30,566,151	$30,566,151	—
Virginia	8,001,024	71,216,930	—	2,093,052	22.4	0.0	5.9	$37.80	—	$13,845,539	$13,845,539
West Virginia	1,852,994	125,961,220	—	3,701,976	22.4	0.0	44.8	$37.80	—	$24,488,573	$24,488,573
Wisconsin	5,686,986	154,493,465	650,000	4,540,533	30.8	3.5	24.6	$37.17	$5,806,053	$40,557,811	$34,751,758
United States	308,745,538	2,152,994,723	9,268,000	63,276,105	24.7	0.7	5.1	$39.54	$81,467,642	$503,962,019	$422,494,377

[1] These are calculated only for nonreserved forestlands, i.e., those that are NOT legally prohibited from timber harvesting or management.
[2] Based on USDA NASS 2010 Maple Syrup Crop Report.
[3] These figures are calculated by multiplying the number of potential taps by 2.94%, the utilization rate achieved in Vermont.
[4] Based on the average production per tap for each state for 2007–2009 as seen in the 2010 NASS Maple Syrup Crop Report.
[5] Based on the average price received for all retail, wholesale, and bulk syrup sales for each state for 2007–2009 as seen in the 2010 NASS Maple Syrup Crop Report.

Virginia could also expand production aggressively. The per capita consumption levels necessary in these states range from 4.5 oz. (133.1 ml) to 6.6 oz. (195.2 ml) per person, which are certainly achievable levels, especially if any efforts are put into marketing local syrup to each state's citizens and businesses.

There are other states that have large populations and a much greater resource of tappable maple trees, such as Michigan, New York, Pennsylvania, and Wisconsin. If these states were to expand to the same levels as Vermont, the consumption levels needed to sell all the syrup locally would be much higher, between 14 oz. (414 ml) and 25 oz. (739 ml) per person. Since it would be more difficult to sell all of the additional syrup locally, producers in these states would have to sell some of their syrup in barrels to large packaging companies. Bulk prices are strongly tied to global supply and demand, which is out of the control of individual producers. Therefore these states may not be able to expand as aggressively if global demand does not keep pace with supply, and prices fall to unprofitable levels.

Finally, states such as Vermont and Maine already produce much more syrup than can realistically be consumed locally. The majority of their syrup is already sold in bulk to large bottling companies, whose success is highly dependent on the national and global markets for maple syrup. Whereas the local food movement will help some of these producers sell their syrup to nearby residents and visitors, the dominant outlets for most of the syrup produced will continue to be elsewhere. Thus, expansion in these states will likely be curtailed if production outpaces consumption and bulk syrup prices fall.

Under the hypothetical scenario in which each state taps the same percentage of its trees as Vermont currently does, the U.S. maple industry could grow from approximately USD81 million to over USD500 million annually. It is important to realize that only 24% of total U.S. residents live in the 11 major maple producing states, while 52% live in the 25 states that contain a significant number of sugar and red maple trees. Thus, roughly half of U.S. citizens will not have access to local syrup and must purchase it from other states or Canada. At current production levels, if U.S. residents only consumed maple syrup produced within the U.S., the average per capita consumption would be 0.7 oz. (20.7 ml), much less than the current figure of 2.6 oz. (76.9 ml). If the U.S. were to develop its maple industry in every state the way Vermont has, did not import any syrup from Canada nor export any throughout the world, the average consumption would have to increase to 5.1 oz. (150.8 ml) per person. Given that this figure is less than the per capita consumption in Quebec, it is not an unreasonable proposition. However, as previously stated, it is highly unlikely that any state could achieve the same levels of production as Vermont, let alone every state. Furthermore, barring any unforeseen and extraordinary political tensions or drastic fluctuations in the exchange rate with Canada, the U.S. will continue to import the majority of its syrup from Quebec. Thus, although the U.S. will likely increase its production and consumption of pure maple syrup, it will probably never achieve the levels as conjectured in table 1.

Scenario 2: What if Each State Produced All the Syrup its Residents Consume Locally

Whereas scenario 1 examines the increased consumption necessary for each state to tap the same percentage of its trees that Vermont does, scenario 2 assumes that per capita consumption levels will stay the same, yet all of the syrup will come from local sources. This scenario provides a more realistic target for many states to achieve. It calculates the number of taps necessary, the corresponding utilization rate, and economic impact for each state to provide 2.6 oz. (76.9 ml) of maple syrup to each of its residents (see table 2). The same assumptions on production per tap and price per gallon of syrup are used for this analysis.

Vermont and Maine would only need 45,996 and 123,962 taps, respectively, to supply all of their citizens with 2.6 oz. (76.9 ml) of syrup. Since there are many large producers and such low populations in these states, most of the syrup in Vermont and Maine is sold in bulk to large bottling companies

and shipped out of state. Thus, the average price per gallon received by producers is the lowest in Vermont and Maine, at USD34.57 and USD33.27, respectively. New Hampshire, New York, and Wisconsin are the only other states that currently have more taps than needed to provide their residents with 2.6 oz. (76.9 ml) of syrup each year.

On the opposite end of the spectrum, there are states with large populations and a limited maple resource that would have a difficult time trying to provide each of their residents with 2.6 oz. (76.9 ml) of syrup. The necessary utilization rates in New Jersey and Missouri at 6.1% and Illinois at 11.9% are beyond the levels that could reasonably be expected to be achieved. Thus these states must continue to rely on imported syrup to meet consumer demand. Individual producers in these states would have a difficult time just supplying their own customer base with syrup and therefore would have to purchase bulk syrup from other states in order to meet local market demand. This strategy is already practiced throughout the maple industry, creating better synergy between the large sugarmakers who are focused on production and the smaller sugarmakers who concentrate on the marketing of finished products.

There are several states that could easily develop their maple industries further by supplying the local markets for pure maple products. Connecticut, Massachusetts, Michigan, Ohio, and Pennsylvania all have existing maple industries and the infrastructure in place to spur additional development. With existing utilization rates ranging between 0.15% and 0.45%, these states would only need to tap at most 1.2% of their trees to supply 2.6 oz. (76. 9 ml) of local syrup to their residents. Particularly desirable places for expansion are states such as Connecticut that have an affluent population with a strong desire to purchase local food. Expanding production in these regions is one of the best ways to assure profitability for producers. As evidence, producers in Connecticut sell most of their syrup retail and therefore command the highest average price of any state at USD59.23/gallon.

New York has the greatest number of potential taps, the largest population of any maple-producing state, and an extensive educational infrastructure already in place to enhance development. The industry has been growing in recent years and is poised for further expansion. Its utilization rate of 0.62% just barely allows the state to supply all residents with 2.6 oz. (76.9 ml) of syrup. However, previous studies have found that most of the syrup consumed in New York is purchased at grocery stores and comes from out of state (for example, see Chamberlin, 2008). New York is also a net importer of bulk maple syrup, as more bulk syrup is bought in and repackaged by individual producers than is sold out of state (Farrell & Stedman, 2009). Thus, per capita consumption in New York is already well above 2.6 oz. (76.9 ml) per person, but much more research is needed to determine the actual figure. New York state government officials have recognized the opportunity to increase maple production and have made several investments to help expand the industry, including creating a Maple Task Force in 2009 to explore the ways in which the state can assist in developing the maple industry (Wanamaker, 2009).

Generally speaking, most states would only have to tap a small percentage of their trees in order to supply their residents with local maple syrup. Eight states would have rates below 1% and another 8 states would have rates between 1% and 2%. Although these are feasible goals, it will be more difficult to establish maple production in regions that do not currently have a significant maple industry. For instance, although states such as Kentucky, Virginia, and West Virginia have a robust maple resource and some syrup producers already exist, the educational and cultural infra-structure simply does not exist to adequately develop the maple industry at this time. Since the climate is also much warmer in these states than in the traditional producing regions, there will be skeptics who believe that syrup production is only supposed to occur in northern states. Much more research is necessary to determine what yields one could expect utilizing various sap collection

Table 2. Economic Impact of Producing All of the Maple Syrup Consumed in a State Locally (all prices in USD)

	Population (2010 Census Data)	Number of Potential Taps	Number of Actual Taps	Number of Taps Necessary To Provide 2.6 oz/ Resident of Each State[1]	Current Utilization Rate[2]	Utilization Rate Necessary to provide 2.6 oz/resident of each state[3]	Syrup Production Efficiency (oz/tap)	Average Price per Gallon	Current Value of Syrup Production	Potential Value of Syrup Production to Supply 2.6 oz for Each State Resident	Economic Impact of Supplying 2.6 oz/Resident for Each State
Arkansas	2,915,918	8,293,520	—	338,455	—	4.08%	22.4	$37.80	—	$2,238,878	$2,238,878
Connecticut	3,574,097	32,702,898	75,000	391,720	0.23%	1.20	23.7	$59.23	$823,343	$4,300,272	$3,476,928
Georgia	9,687,653	38,954,859	—	1,124,460	—	2.89	22.4	$37.80	—	$7,438,301	$7,438,301
Illinois	12,830,632	12,527,570	—	1,489,270	—	11.89	22.4	$37.80	—	$9,851,520	$9,851,520
Indiana	6,483,802	43,971,137	—	752,584	—	1.71	22.4	$37.80	—	$4,978,344	$4,978,344
Kentucky	4,339,367	75,286,754	—	503,677	—	0.67	22.4	$37.80	—	$3,331,820	$3,331,820
Maine	1,328,361	148,404,616	1,430,000	123,962	0.96%	0.08	27.9	$33.27	$10,354,694	$897,612	$(9,457,081)
Maryland	5,773,552	24,643,818	—	670,144	—	2.72	22.4	$37.80	—	$4,433,005	$4,433,005
Massachusetts	6,547,629	55,928,669	250,000	692,702	0.45%	1.24	24.6	$48.73	$2,339,200	$6,481,471	$4,142,271
Michigan	9,883,640	277,960,651	490,000	883,115	0.18%	0.32	29.1	$42.53	$4,737,930	$8,539,053	$3,801,123
Minnesota	5,303,925	39,181,626	—	615,634	—	1.57	22.4	$37.80	—	$4,072,420	$4,072,420
Missouri	5,988,927	11,322,763	—	695,143	—	6.14	22.4	$37.80	—	$4,598,373	$4,598,373
New Hampshire	1,316,470	77,720,574	420,000	115,928	0.54%	0.15	29.5	$50.40	$4,882,752	$1,347,736	$(3,535,016)
New Jersey	8,791,894	16,806,386	—	1,020,488	—	6.07	22.4	$37.80	—	$6,750,526	$6,750,526
New York	19,378,102	305,685,731	1,903,000	1,871,400	0.62%	0.61	26.9	$38.83	$15,543,598	$15,285,487	$(258,111)
North Carolina	9,535,483	84,977,529	—	1,106,797	—	1.30	22.4	$37.80	—	$7,321,463	$7,321,463
Ohio	11,536,504	87,616,491	385,000	1,011,519	0.44%	1.15	29.7	$39.07	$3,484,421	$9,154,697	$5,670,276
Pennsylvania	12,702,379	278,622,099	465,000	1,474,383	0.17%	0.53	22.4	$36.00	$2,929,500	$9,288,615	$6,359,115
Rhode Island	1,052,567	6,019,295	—	122,173	—	2.03	22.4	$37.80	—	$808,174	$808,174
Tennessee	6,346,105	65,814,848	—	736,601	—	1.12	22.4	$37.80	—	$4,872,619	$4,872,619
Vermont	625,741	108,881,278	3,200,000	45,996	2.94%	0.04	35.4	$34.57	$30,566,151	$439,355	$(30,126,796)
Virginia	8,001,024	71,216,930	—	928,690	—	1.30	22.4	$37.80	—	$6,143,286	$6,143,286
West Virginia	1,852,994	125,961,220	—	215,080	—	0.17	22.4	$37.80	—	$1,422,752	$1,422,752
Wisconsin	5,686,986	154,493,465	650,000	480,653	0.42%	0.31	30.8	$37.17	$5,806,053	$4,293,378	$(1,512,675)
United States	308,745,538	2,152,994,723	9,268,000	32,460,105	0.43%	1.52	24.7	$39.54	$81,467,642	$247,981,361	$166,513,719

[1] This is determined by first multiplying the population by 2.3 (oz) to determine the total syrup consumption and then dividing this figure by the average production per tap for that state.
[2] These figures are determined by dviding the number of taps reported for each state in the 2010 NASS Maple Syrup Crop Report by the number of potential taps based on the FIA data.
[3] These figures are determined by dividing the column “Number of Taps Needed to Supply 2.3 oz per Resident” by the column “Number of Potential Taps.”

technologies along the southern and western edges of red and sugar maples' ranges. If some producers adopt the latest technologies and are able to achieve economic yields of at least 32 oz. (946 ml) of syrup per tap, these success stories could entice others to get started.

As a nation, the U.S. only taps 0.39% of all sugar and red maples growing in the eastern half of the country. In order to supply the average citizen with 2.6 oz. (76.9 ml) of "locally produced" U.S. syrup, it would have to add roughly 23 million taps, thereby increasing the utilization rate to 1.52%. The economic impact of doing so would be USD167 million, increasing the size of the maple industry from USD81 million to USD 248 million. However, to facilitate this growth, the U.S. would have to either stop importing syrup from Canada and/or increase average syrup consumption. It is highly unlikely that Americans will stop buying Canadian syrup, especially if it is relatively inexpensive and readily available in grocery stores. Thus, in order to increase consumption of locally produced maple syrup, U.S. producers should invest in strategic marketing campaigns that capitalize on the increasing interest in local, healthy food.

Limitations and Drawbacks of These Analyses

It is important to understand the limitations of these analyses and why they are both unrealistic scenarios. For the first question, it is highly unlikely that any state will build its maple industry to the same status that Vermont has. Maple production is strongly tied to cultural heritage and Vermont has made a dedicated effort over the last century to build its reputation and brand itself as "the place for maple" in the U.S. So while Vermont presents a upper limit for what is possible to achieve in other states, it is highly unlikely that any other state will ever tap the same percentage of its trees as Vermont does.

It is also impractical to assume that the maple syrup produced within a state's borders is the only maple syrup residents of that state will consume. Since most people buy their food at grocery stores and it is difficult for small, local producers to gain access to these markets, many residents will continue to buy imported syrup. Thus, the average syrup consumption in each state must be higher than the national average of 2.6 oz. (76.9 ml) per person in order to account for the additional syrup coming from out of state. On the other hand, not all the syrup that sugarmakers produce is sold to residents of their state. Many producers have extensive mail-order businesses, sell directly to tourists, or sell to restaurants and gift shops that cater to out-of-state tourists. Furthermore, the commercial-grade syrup that is produced at the end of the season is almost always sold to large bottling and distribution companies in Vermont and New Hampshire. Since a portion of the syrup produced in any state would be sold and consumed elsewhere, the per capita consumption among residents of that state could be lowered. Without knowing the magnitude of these variables, it is not possible to know the effect on necessary per capita consumption levels.

Furthermore, having a target consumption level of only 2.6 oz. (76.9 ml) per person is likely to underestimate the actual syrup consumption levels in states that produce maple syrup. Many producers are happy to share their products with friends, family members, and neighbors at a reduced price or free of charge, so naturally these people consume more syrup than they otherwise would. Even for people with no relation to a sugarmaker, there is still a more readily accessible supply of pure maple. The prevalence of maple products being sold through sugarhouses, roadside stands, farmers' markets, community supported agriculture operations (CSAs), producer-operated pancake houses, and other venues for local food tends to increase the average per capita consumption of pure maple in regions where it is produced.

In fact, historical research by the U.S. Forest Service found that only 1.9% of households outside the maple-producing region had purchased pure maple syrup over a 12-month time frame versus 11.2% of households within maple producing states (Sendak, 1978). Therefore, the 2.6 oz. (76.9 ml) per person average consumption likely presents a minimum level that each producing state could easily achieve

by supplying syrup from its own trees. Perhaps a more realistic estimate of syrup consumption in maple-producing states is 6 oz. (177 ml) per person, the level currently achieved in Quebec (Agriculture and Agri-Food Canada, 2006). However, since many residents will continue to purchase syrup from grocery stores that has been imported from outside the state or country, a 2.6 oz. (76.9 ml) per capita consumption of maple syrup produced within a state's borders may be a realistic target for many states.

It is also important to consider the impact of yield per tap in conducting these analyses. The volume of syrup produced varies greatly from year to year, depending primarily upon the weather patterns and sap collection technologies that are used. New vacuum tubing systems can result in yields as high as 0.5 gallons of syrup per tap (64 oz. or 1,893 ml), whereas traditional bucket systems may only yield 0.1 gallons per tap (12.8 oz. or 379 ml). It is possible that average yields per tap could increase as more producers adapt the latest technologies with vacuum tubing. If this were to happen, either fewer taps would be needed to produce the same amount of syrup, or consumption would have to rise in order to keep pace with the additional syrup output.

Finally, the economic impact figures presented here only account for the farm-gate syrup sales of individual producers. They do not include the economic activities of bottling companies who purchase bulk syrup, package it into retail-size containers, and market it throughout the U.S. and beyond. Nor do they factor in the economic impacts of building sugarhouses and manufacturing and selling all the equipment necessary to produce maple syrup. Given all the additional economic activity that is involved with maple production, the economic impact figures provided in these tables grossly underestimate the true impact of expanding the maple industry. Determining the full economic impact of syrup production would require significant additional research and is outside the scope of this paper.

Conclusion: Marketing Must Keep up with Production

The fate of the global economy, coupled with the marketing efforts of the maple industry, will have a strong influence on the overall production and consumption of pure maple syrup. Production has spiked in recent years and is likely to continue to grow, so the maple industry will have to be more aggressive in its marketing and promotion efforts in order to keep demand in line with supply and prices stable. Per capita consumption of pure maple syrup in the U.S. is currently very low, so there is tremendous room for expansion, especially in the growing niche markets for local and healthy foods. The average American consumes about 2.6 ounces (76.9 ml) of syrup in one pancake breakfast, so clearly there is room for growth. One of the keys will be educating consumers about the differences between pure maple syrup and its artificial competitors and convincing them that pure maple syrup is worth the extra cost.

Maple syrup is produced commercially only in the eastern U.S. and Canada, yet there is a growing worldwide demand for pure maple products, especially once people are exposed to them. Marketing efforts have been extremely successful in other countries, as Canadian exports to Japan rose by 252% between 2000 and 2005 once the Federation of Maple Producers in Quebec initiated a marketing campaign there (Agriculture and Agri-Food Canada, 2006). Markets have also been growing steadily in western Europe, as Canadian exports to Denmark and Switzerland each grew by more than 100% over the same time period. Even in the U.S., where most people should already know about pure maple syrup, marketing efforts often lead to dramatic increases in sales. For instance, the New York State Maple Producers Association initiated Maple Weekend, a statewide event where sugarmakers open their doors during the last two weekends in March every year. This event has grown steadily since it began in the 1990s and now accounts for over USD750,000 in sales among the over 100 participating producers during a four-day period (H. Thomas, personal communication, January 21, 2011). Vermont, Maine, Pennsylvania, and others have since adopted similar

campaigns for their states. Despite these successes, only a small fraction of maple producers in the U.S. currently participate in this type of event.

If the maple industry continues to expand and supply outpaces demand, it should not be viewed as an overproduction problem, but rather an undermarketing problem. There is overwhelming evidence that investments in marketing pay off in terms of increased consumption of pure maple products. Per capita consumption has nearly tripled in the U.S. over the past 35 years, yet it is still quite low at less than 3 oz. (89 ml) per person, so more efforts should be put into marketing pure maple syrup as the local, healthy sugar in the regions where it is produced. Moreover, since maple syrup is only produced in eastern North America and yet has a growing worldwide demand, there is a tremendous opportunity to supply this high-value crop to international markets. It is up to the entire maple industry to work together — as they have in Quebec (Gagné, 2008), New York, Vermont, and elsewhere — to move the industry forward in a positive direction. In particular, further consumer research is necessary to determine the current and potential demand for maple syrup on a state-level basis throughout the U.S. Increasing both production *and* marketing efforts will provide more people locally and throughout the world with pure maple products while maintaining profitable prices for producers.

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Kaiser Permanente's Farmers' Market Program: Description, impact, and lessons learned

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Abstract

Farmers' markets are an innovative strategy to potentially increase healthy nutrition environments. Kaiser Permanente (KP), the largest private, nonprofit healthcare system in the country, has been hosting farmers' markets on its medical campuses since 2003 and now has markets in nearly 40 KP locations in four states: California, Hawaii, Oregon, and Maryland. This paper describes the KP farmers' market program and summarizes the results of a patron survey conducted in 2010 among 2,435 market patrons. The majority of patrons are KP physicians and staff, and a quarter of patrons are KP members and community residents. The markets appear to have an impact on what people are eating: 74% of all patrons reported eating more fruits and vegetables as a result of coming to the market. The KP experience may be generalizable to other healthcare organizations and to other large employers.

Keywords

farmers' markets, healthy food access, hospitals, obesity prevention

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Introduction

In the face of rising levels of obesity and poor nutrition that contribute to the major causes of chronic diseases in the United States, farmers'

markets are recommended as an innovative strategy to increase healthy nutrition environments (Kettel Khan, Sobush, Keener, Goodman, Lowry, Kakietek, & Zaro, 2009; Institute of Medicine, 2005). Hosting farmers' markets at hospitals and other healthcare institutions is a novel approach receiving increasing interest and attention. Hospital-based farmers' markets provide an access point to health resources for patrons: besides produce and other fresh foods expected at a market, the hospital may provide healthy recipes, cooking demonstrations, general wellness pamphlets, and other health-promotion materials. For patients and community members, these markets can also foster positive social norms, reinforcing the role of food in creating health. There is a strong call to action for healthcare communities to serve as leaders toward public health advances in the obesity epidemic, by creating healthier food systems — through organizational policy, changes in the workplace food environment, and health promotion (Harvie, Mikkelsen, & Shak, 2009). For physicians and hospital employees, markets can complement employee wellness programs, which are effective at improving various health outcomes and work productivity when evidence-based (American Hospital Association, 2010; Baicker, Cutler, & Song, 2010).

Furthermore, healthcare-based farmers' markets may provide increased access to healthy foods in communities disproportionately lacking nutritious choices. Healthcare organizations are located in a variety of communities, including "food desert" neighborhoods where there is a dearth of retailers offering healthy and affordable foods to their low-income residents. There is a strong public health rationale and supporting research to facilitate the ability of low-income community members to participate in successful farmers' markets as patrons, particularly through government food assistance programs. Electronic Benefits Transfer (EBT) food stamps can now be used by participants in the federal Supplemental Nutritional Assistance Program (SNAP) to buy healthy foods at farmers' markets, and there are guidelines for markets to attract SNAP customers (Briggs, Fisher, Lott, Miller, & Tressman, 2010; W.K. Kellogg Foundation, 2009). There is evidence that markets have a positive impact on fruit and vegetable consumption for seniors and for Women, Infants, and Children (WIC) program participants through subsidies under the Farmers' Market Nutrition Program (McCormack, Laska, Larson, & Story, 2010). Markets located at healthcare facilities in underresourced areas may also offer convenience to captive customer bases of thousands of healthcare workers, increasing the potential for economic viability. In particular, there are opportunities for generating cross-subsidies for markets located in low-income areas, where relatively well-paid physicians and hospital employees may generate sufficient sales that low-income residents alone may not be able to provide to keep that market going (Fisher, 1999).

Recognizing the potential for farmers' markets to generate these multiple benefits, Kaiser Permanente (KP), the largest nonprofit healthcare system in the country, hosts farmers' markets and farm stands on several KP medical campuses.[1] KP conducted a survey of its farmers' market patrons in 2010 to evaluate the impact of the market on patrons, identify key factors related to market sustainability, and inform strategies to support their long-term success. This paper describes key results from the survey of market patrons, with an emphasis on benefits to healthy eating, and presents lessons learned from the evaluation.

There have been few studies that assess the impact of farmers' markets on food behavior in the general population. McCormack et al.'s review article (2010) identified 12 studies with nutrition-related outcomes, all evaluations of the SNAP Farmers' Market Nutrition Programs: seven focused on the impact for WIC participants and five focused on the influence for seniors. Six out of seven studies that measured fruit and vegetable consumption found an improvement in diet associated with accessibility to the farmers' market, particularly for vegetables; the other studies identified some positive benefits around beliefs and

[1] Note: In this paper, the term "farmers' markets" (FM) or "markets" refers to both farmers' markets and farm stands.

intentions related to healthy eating and farmers' markets. The review authors found that few studies were well designed and many lacked standard dietary assessment measures, prompting a national call for further evaluation of the impact of farmers' markets on dietary behavior among various populations and settings.

Program Description

The Kaiser Permanente (KP) farmers' market, started in 2003 by KP physician Preston Maring at the Oakland (California) Medical Center, was one of the first hospital-based markets in the country. By 2010, KP was hosting 37 markets, mostly in regions where it operates its own hospitals: 20 in Northern California, 11 in Southern California, three in Hawaii, two in Oregon, and one in Maryland. The markets align with the organization's social mission to promote the well-being of its members and the communities it serves by increasing access to healthy and fresh food to its staff, members, and local community residents. Farmers' markets are a strategy within KP's comprehensive Healthy Eating/Active Living Initiative (Cheadle, Schwartz, Rauzon, Beery, Gee, & Solomon, 2010) and a component of KP's Environmental Stewardship program, which supports sustainable food systems and reducing the distance from farm to fork. Various factors influenced which KP medical centers established markets, including access to an implementation guide (Kaiser Permanente, 2006), technical assistance and other organization-wide resources, and interest and support from local medical center employee "champions."

KP-hosted farmers' markets vary in structure and size, including average number of patrons and vendors. In August 2010, the majority of KP markets consisted of 8 to 14 vendors, with the smallest farm stands hosting one vendor and the largest market hosting about 30 vendors. Two of its markets, including the first one in Oakland, feature all organic produce. At many locations, the number of vendors fluctuates seasonally based on availability of produce. The sites also vary in the variety of vendor products available: produce, baked goods, prepared foods, and other items (such as flowers). There are several types of market management structures, each placing KP in a different role. As of August 2010, approximately 27 markets were managed by a farmers' market association or independent market operator responsible for coordinating most operational logistics; five were operated in a collaboration between KP and a local community organization; and five were operated directly by KP. Each market site has a KP "farmers' market champion" who serves as the key KP point of contact supporting market activities. Champions come from a wide range of departments, including health education, employee wellness, food and nutrition services, community benefit, and public affairs. Depending on the market management structure of the site, the day-to-day market operations and vendor communications are handled by a market manager from the market association, an independent operator or vendor, or a KP staff member (Kaiser Permanente, 2006).

Most markets are held one time per week on a weekday for four hours, though some take place every other week. About two-thirds of the markets operate year round, while the remaining third are seasonal, open only during spring, summer, and early fall.

Methods

In summer 2010, KP partnered with the Group Health Center for Community Health and Evaluation (CCHE) to conduct a cross-site survey of market patrons. The goals of the patron survey were to: (1) determine the influence of the markets on patrons' eating behaviors, and (2) understand patron preferences for products and services that reinforce healthy eating. The survey was undertaken not as a formal research study, but rather as an evaluation designed to provide KP with measures of the program's impact and to inform efforts to improve the program. The 2010 patron survey was conducted across all 37 KP-hosted farmers' markets and farm stands during the peak summer season, in August and September.

Each KP farmers' market champion coordinated survey implementation at his or her facility, with

the assistance of market association representatives, market managers, and volunteers. Kaiser Permanente and CCHE conducted multiple webinar trainings and provided guidelines for those who conducted the survey at each market site. Training and materials were designed to increase patron participation in the survey, encourage accurate and complete responses, and standardize procedures across sites.

Each site that had a currently operating farmers' market or farm stand in August 2010 was invited to participate in the survey. The goal was to receive at least 50 patron responses at each site. Patrons were sampled while shopping at the market and asked to complete a survey questionnaire. Sites were encouraged to collect surveys on one market day in order to avoid having the same patron surveyed more than once.

The survey instrument was developed by adapting questions from other farmers' market surveys, and creating other items based on input from market stakeholders. A draft instrument was reviewed by KP market champions, members of an external market association, and evaluation advisors in KP's national offices. The questionnaire was pilot tested at the KP Oakland market by the KP farmers' market coordinator and the market manager as a way to finalize items, improve formatting, and inform the survey implementation procedures. The final questionnaire included 10 close-ended items (3 demographic) and one open-ended question, and was expected to take patrons less than five minutes to complete. The instrument was translated into Spanish and Chinese, to minimize some language barriers to participation in the survey.

The instrument includes questions designed to assess:

- Who comes to the markets,
- Patron shopping frequency,
- The impact of the markets on patrons' consumption of fruits and vegetables,
- Patron preferences for goods and services associated with healthy living offered at the markets,
- Influence of the markets on patron attitudes towards KP, and
- Patron opinions for market improvements to inform market decision-makers.

Because this survey was part of a program evaluation and not a research study, participants did not sign a formal consent form to participate. Patrons were given the option of filling out the questionnaire themselves or having the KP survey volunteer read the questions verbatim and record their verbal responses. Each KP market provided respondents with an incentive, such as seed packets, or entry into a drawing for market goods or a market gift certificate.

Each KP market was asked to standardize some procedures and use specific items in order to evaluate cross-site measures, but there was no explicit protocol for approaching patrons or guidelines on the number of additional surveys to collect once the target quota was reached. Each KP market location sent patron survey questionnaires in the mail to CCHE in Seattle, Washington, where the data were entered and analyzed. Surveys missing more than half of possible responses were excluded from the analysis. Open-ended comments were analyzed to identify key themes that emerged about patrons' opinions of the markets. Chi-square tests were used to test for significant differences between market-use frequency categories (e.g., comparing patrons who shopped weekly at the market to those who shopped less often).

Results

A total of 2,435 patron survey responses were received from the 37 Kaiser Permanente sites that hosted farmers' markets in summer 2010, with a range of 11 to 148 completed questionnaires from each. The number of responses received at each site often correlated with the size of the market or farm stand, with larger markets gaining more responses, but it also varied with contextual factors that interfered with survey implementation plans

Table 1. Kaiser Permanente Farmers' Market Survey: Respondent Characteristics by Frequency of Market Use[a]

Variable	*Weekly*	*<Weekly[b]*	*Overall*
Number of respondents	1,199	1,211	2,410
Patron Category			
Kaiser Permanente (KP) physician or staff	69%	32%	50%
KP member	14%	48%	31%
Live and/or work in neighborhood	14%	11%	12%
Other	3%	9%	6%
Schedule appointments around market			
Yes	46%	29%	33%
No	20%	42%	36%
Did not respond to question	34%	29%	30%
Age			
17–24	3%	5%	4%
25–34	15%	15%	15%
35–44	21%	17%	19%
45–65	52%	41%	46%
65+	9%	22%	15%
Sex			
Male	19%	23%	21%
Female	81%	77%	79%
Race/Ethnicity			
African American	11%	11%	11%
Latino/Hispanic	18%	16%	17%
Asian American	21%	17%	19%
Pacific Islander/Native Hawaiian	5%	4%	5%
White, Euro-American	38%	46%	42%
Mixed race	1%	2%	1%
Other	5%	5%	5%

[a] All differences shown between weekly and <weekly shoppers were statistically significant (p <.05, chi-square test).
[b] <Weekly = Less than weekly category includes responses "monthly" (18% of respondents), "a few times per year" (16%), and "first time at the market" (16%).

(e.g., inclement weather, change in KP farmers' market champion during the survey period). Some sites administered the survey on more than one day to increase the number of responses, if the target number of 50 was not achieved.

Patron Demographics

Table 1 shows respondent characteristics overall and by frequency of market use. Overall, half of respondents were KP staff or physicians, 31% were KP members, and 12% lived or worked in the neighborhood.[2] The proportion of KP staff was even higher among regular (weekly) shoppers: 69% were physicians or staff, compared with 14% who were KP members and 14% who lived or worked in the neighborhood. Among KP members, 33% (257) purposely scheduled their medical appointments on market days. Market patrons overall

[2] Note: If multiple patron categories were checked, respondents were assigned to KP staff if they checked that category, KP members if they did not check KP staff, and neighborhood if they checked neither KP staff or KP member categories.

tended to be older (61% greater than 45 years) and female (79%) than the general population, and roughly the same age and gender mix was found among weekly shoppers. The largest race/ethnicity category was White (42%), but there were significant numbers of patrons who were African American (11%), Latino (17%), and Asian American (19%). This racial/ethnic distribution was also found among weekly shoppers.

Impact on Fruit and Vegetable Consumption

Table 2 shows results for the two "impact" variables — amount and variety of fruits and vegetables consumed — as well as a question about how market patrons viewed KP's motives for offering the markets. The results are shown by frequency of market use and exclude those who were first-time visitors. For both of the questions regarding fruit and vegetable (F&V) consumption there is a clear dose-response relationship, with more regular users consuming greater quantity and variety of F&Vs. For example, 48% of weekly market users reported consuming "a lot" more F&Vs as a result of coming to the market, compared to a 25% response from those patrons who came a few times per year.

Eighty-six percent of respondents either agreed (41%) or strongly agreed (45%) that KP is looking after their health by operating the markets. This percentage was similar across all categories of shopping frequency.

Discussion

This paper describes the KP farmers' market program and summarizes the results of a patron survey conducted in 2010 among 2,435 market patrons. The survey results show that the majority of patrons, particularly regular weekly shoppers, are KP physician and staff. However, the markets do attract a substantial number of KP members and community residents: over a quarter of regular weekly shoppers were members or residents.

The markets have an impact on what people are eating. Seventy-four percent of all patrons reported

Table 2. Kaiser Permanente (KP) Farmers' Market Survey: Change in Fruit and Vegetable Consumption, Perception of KP, by Frequency of Market Use[a]

Variable	*Weekly*	*Monthly*	*<Monthly[b]*	*Overall*
Number of respondents	1,199	455	378	2,032
Eating more fruits and vegetables				
No change	19%	30%	42%	26%
A little more	33%	39%	33%	34%
A lot more	48%	30%	25%	40%
Eating more variety of fruits and vegetables				
None	24%	33%	41%	29%
A few more	48%	48%	46%	48%
Many more	28%	19%	13%	23%
KP is looking after their health by operating farmers' markets				
Strongly disagree	7%	5%	4%	6%
Disagree	1%	2%	2%	1%
Neither agree nor disagree	5%	7%	12%	7%
Agree	38%	44%	46%	41%
Strongly agree	49%	41%	36%	45%

[a] All differences shown across the market use categories were statistically significant ($p<.05$, chi-square test).
[b] <Monthly = a few times per year; analysis excludes first-time market visitors .

eating more fruits and vegetables as a result of coming to the market, with 40% reporting that they are eating "a lot" more. Seventy-one percent of patrons reported eating a greater variety of fruits and vegetables, another meaningful nutritional outcome (Kettel Khan, Sobush, Keener, Goodman, Lowry, Kakietek, & Zaro, 2009; U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2010). Given the limited literature on the impact of farmers' markets on diet in the general population and among communities most difficult to reach, it is hoped these results and lessons learned from the KP experience may inform efforts elsewhere.

The survey results suggest a few areas for improvement and ways that farmers' markets may be spread more broadly using the KP model. There are implications for healthcare organizations that host farmers' markets to create more linkages to surrounding communities in order to increase the reach of benefits from shopping at the market to broader populations. At KP, these additional efforts have included markets hosted by community partners in additional locations, support for efforts to bring healthier food to corner stores, and investments that were established to attract new, healthy food retailers and build the infrastructure to support them, such as California FreshWorks (California FreshWorks, 2011).

The results also indicate that convenience may be an important factor in promoting market attendance. The vast majority of market patrons are KP physicians, staff, members, volunteers, or patient visitors to the medical campus. Among KP members, one-third of respondents said they scheduled their clinic appointments on market days. And, the fact that the hospital staff members compose a large majority of the regular shoppers suggests that the convenience of the on-site markets provides healthcare workers a means to fit farmers' market shopping into their highly structured workday. The value of convenience combined with the apparent impact of markets on F&V consumption suggests that other large employers may wish to consider farmers' markets as an innovative component to a workplace wellness program. Comprehensive workplace interventions offer the potential to reach a large number of people and have been proven to make a significant impact on employee health outcomes; lessons learned from the KP farmers' market experience build on understanding the effectiveness around weight maintenance or reduction interventions (Archer, Batan, Buchanan, Soler, Ramsey, Kirchhofer, & Reyes, 2011; Baicker et al., 2010).

There were a number of limitations to our study. While attempts were made to standardize data collection, this was not a research study, and therefore the sampling and administration of the survey varied across sites. Almost all data were only collected on a single market day, during the busiest season of the year. The validity of our convenience measure is uncertain given a high percentage of missing responses (30% of patrons did not provide a response). We assessed impact using only self-reported measures of increased consumption, rather than more valid and detailed dietary inventories. Finally, our design did not include a comparison group or assess changes over time.

Despite these limitations, the results indicate that the KP-supported markets are reaching a significant number of KP staff, members, and community residents, and positively influencing their choices around healthy eating. The KP experience may be generalizable to other healthcare organizations and other large employers. With the current need to find effective strategies to address obesity, healthcare- and workplace-based farmers' markets warrant further research and evaluation on their impact and reach across diverse populations.

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Strategies for accessing volume markets in the beef industry: A review of three cooperative business models

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Abstract

Given the increasing consolidation in the U.S. meat industry, smaller and specialty producers often have difficulty breaking into the market in profitable volumes. This paper examines three cooperative models for specialty beef producers. We offer a realistic examination of the potential for success of each model. Based on this, we identify the key attributes for a new model and offer guidance for future research efforts.

Keywords

beef producers, small-scale producers, specialty producers, market models

Introduction

In the U.S., consolidation in the meat industry has increased at a rapid pace. The number of major slaughter plants has declined rapidly. In 1997, the top four firms accounted for 40.6% of poultry slaughter and processing (Ollinger, Nguyen, Blayney, Chambers, & Nelson, 2005). In 2004[1] the top four firms accounted for approximately 64% of hog processing, and 80% of steer & heifer processing (U.S. Department of Agriculture, 2005). Today, the beef processing industry is classified by the Department of Justice (DOJ) as highly concentrated.[2] This high concentration is further exemplified by a 2008 DOJ lawsuit to block the acquisition of National Beef Packing by JBS SA on antitrust grounds (Zippay, 2008).

With this consolidation of the meat processing industry, there has also been a strong move toward the practice of supply chains which are defined by Barkema, Drabenstott, and Novack as "tightly

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[1] Note that these were most recent years for which we could find USDA data.

[2] The DOJ defines "highly concentrated" as having a Herfendahl Hirschman Index (HHI) of higher than 1,800 (U.S. Department of Justice, 2009). The HHI is calculated by squaring the market share of competing firms and then summing the resulting numbers. According to a 2008 study by the Agricultural and Applied Economics Association, the beef industry has an HHI of 1,826 when looking at federally inspected slaughter data (Anderson & Hudson, 2008).

orchestrated production, processing, and marketing arrangements stretching from genetics to grocery" (2001, p. 36). The first meat industry to incorporate supply chain methods was poultry, which led to a surge in its share of the meat market with its market share gains coming from beef. Following the poultry industry's lead, the pork industry also began to incorporate supply chain strategies into its processes (Barkema et al., 2001). The beef industry, with its longer supply chain and traditionally more independent producers, has lagged behind both the pork and poultry industries in its supply chain integration.

Consolidation and coordination of the meat supply chain has in many ways been beneficial to the meat industry. However, small producers have not always benefited from these changes. The food industry has seen consolidation, integration, and coordination in the pursuit of economies of scale and scope, and lower transaction costs. Increased processor consolidation and the resulting market power effects have caused distributional income losses to all food producers (Sexton, 2000).

One option for small beef producers in response to the drive for consolidation and coordination is to form cooperatives to achieve effective scale and market power. In this paper we present three cooperative models, with the goal of creating a new model for small producers seeking to access volume markets. We also examine the attributes of each model.

Methodology

The case studies include three beef cooperatives that have pursued very different strategies that allow small beef producers to access volume beef markets. Of these three cooperatives, two are currently successful and one is no longer in business. Comments by Dick Bradbury, founding member of Country Natural Beef, and Mike Lorentz, owner of Lorentz Meats, are used to illustrate some of the concepts discussed.

The following attributes are used to analyze each case study. We define them here, use them during the discussion of each case study, and then review them in the discussion section to glean how the attributes form successful models.

Marketing Management Expertise: The ability of smaller producers to access volume markets clearly depends on the marketing expertise of the producers. This factor is of such importance that the Leopold Center at Iowa State University has created a specific stream of research, the Marketing and Food Systems Initiative (Leopold Center, n.d.), to investigate this issue.

Value System Coordination: In any supply chain, the ability of the supply chain partners to communicate and coordinate with each other is critical to superior chain performance. This has been specifically studied in the food industry (Stank, Crum, & Arango, 1999). In general, chain coordination and how to achieve it have been popular topics in research. For just a few examples of this research, see Cousins, Handfield, Lawson, and Petersen (2006) and Holweg and Pil (2008). Weaver (2008) specifically argues that "collaboration across enterprises" is a key for successful value networks.

Scale: Maintaining the proper scale is a challenge for the smaller producer, as it must produce enough to interest buyers, but must to balance this against having enough capital (Born, 2001).

Valued-Added Traits: One way for small producers to differentiate themselves in a commodity market is to offer value-added traits such as organic production. (See Lau, Beverly, Kelley, & Hanagriff (2007) for a discussion.) Some producers and cooperatives strive to create a "story" for consumers based on value-added traits. Dimra and Skuras (2003) discussed how "cues" such as certification and geographic association signal characteristics and properties of the product. Franks (2003) discusses the idea of "telling the organic story" to consumers. The literature thus clearly indicates that offering value-added traits may drive consumer interest.

Production System: The signal used to start production is a key differentiator in production system design. The usual classifications for these signals

are "push" and "pull." The former refers to a system that produces based on a forecast and ends up pushing inventory down the chain. The latter system produces when a customer order is received (Krajewski & Ritzman, 2002). Weaver (2008) argues that "push innovation" is being supplanted by "pull innovation," and uses the food industry as an illustration. He also notes the importance of collaboration to pull innovation and that pull innovation has been specifically used in the case of organic foods. This implies that of the attributes described, the more of them in place, the greater the chance for success.

Relationship with the End Customer: The final attribute considered is the cooperative's relationship with the end customer. The discussion of the attributes of production system and value system coordination indicates that the cooperative needs to have a good understanding of its customer base. Nitschke and O'Keefe (1997) specifically mention the importance of "establishing and maintaining direct relationships with key customers" in their study of Australian grain farmers. This was seen as a way to provide market signals back to the producers. Our literature review indicated that there has been relatively little research interest in the issue of agriculture cooperatives' efforts with regard to customer relationships, despite the rather voluminous research literature on relationship marketing and customer relationship management (see Das (2009) and Kim and Kim (2009) respectively for extensive literature reviews of these concepts).

From Commodity to Integrated Value System: U.S. Premium Beef Ltd.

U.S. Premium Beef Ltd. (USPB) is a closed, member-owned cooperative and is "designed to operate in the highly competitive, and fragmented, global agribusiness industry" (Katz & Boland, 2000, p. 711). A closed, member-owned cooperative is defined by van Bekkum (2001) as a cooperative in which new entry is subject to the purchase of member rights. This is opposed to an open or collective cooperative structure, where entry is free. USPB was formed in 1996 as a reaction to two major difficulties in the beef market for cattle producers. First, the integrated poultry industry began to gain market share in the meat industry, mainly at the expense of beef. Additionally, there were large influxes of foreign beef into the U.S. domestic market, which was causing downward pressure on pricing.

One major problem identified by the cooperative founders was that, depending on market circumstances, each stage in the value system was put under stress, while another member in the value system was reaping the benefits. For example, when beef prices increased, feedlot owners benefited because they were marketing finished animals (Katz & Boland, 2000). On the other hand, as beef prices decreased, the slaughter plants reaped the benefits, as producers were forced to sell at low prices.

The term "value system" comes from Michael Porter's value chain concept, where inputs pass through stages in a firm's production process to create a new value-added product. The value system is defined by Porter as an interconnected system of value chains (Porter 1985). For the beef industry, the value system would include the seed stock, cow calf, back-grounding (a system where weaned calves are grazed before being sent to the feedlot), feedlot, slaughter, processing, and retail segments.

Taking its cue from the pork and poultry industries, USPB sought to develop a system that increased coordination and communication throughout the value system. Unlike the pork and poultry industries, it wanted to create a system where risks and rewards were shared more equitably at each stage. This process was accomplished through several actions. First, it incorporated each stage of the cattle production process into the cooperative. Therefore, each stage of the value system was included in the membership. Producers are required to buy a share for each head of cattle they have in the system. Shares for one member can range from 100 to 100,000 (Katz & Boland, 2000). However, regardless of the number of shares, there is only one vote per member in the cooperative. Feedlot owners with 100,000 head of

cattle in the program do not have more voting power than a small cow calf producer with 100 head in the program.

Acquiring processing facilities is a major part of USPB's strategy for sharing risk and reward more equitably through the value system. USPB management knew that building a large slaughter and processing plant would not be viable, due to high fixed costs and investment. Instead, they chose to partner with a large slaughterhouse owned by Farmland National, which was a producer-cooperative–owned enterprise (a cooperative owned by actual cattle producers). This was attractive because it meant that the Farmland system was already familiar with dealing with cooperatives. As part of its partnership, USPB required an equity ownership interest in Farmland in order to maintain control over its ideas and to protect its shareholders. This was attractive to Farmland as they were operating with excess capacity. At the start, USPB had the ability to make annual delivery commitments of 835,000 head of cattle for processing (Katz & Boland, 2000).

Processors often grade cattle carcasses on a grid to quantify carcass quality. The grid is determined by USPB management.[3] Producers are able to earn "grid premiums" if their carcasses achieve characteristics considered higher quality. One advantage that USPB has been able to incorporate through its structures is providing feedback on carcass quality to producers. In a nonvertically integrated system, producers are often not informed of the shortcomings of their cattle. In an effort to market higher quality beef, USPB has been able to inform producers why their cattle are not able to receive grid premiums. This has helped producers better understand the needs of the market and adopt management practices to better deliver those products — and in the process to collect grid premiums.

USPB is an example of successfully integrating a value system that is more complicated (i.e., that has more stages and less consolidation of producers) than both the poultry and pork industries. USPB was able to attain significant scale and shows how smaller producers can partner with larger feedlot and slaughter systems to create a value chain that allows them increased control and participation in the value system.

The key attributes for this model are a mix of proper scale and system coordination. These are exemplified by USPB deciding to partner with Farmland National and incorporating each stage of the cattle production process into the cooperative. To a lesser extent, it focused on value-added traits like U.S.-raised, and there was little push to develop direct relationships or contact with consumers.

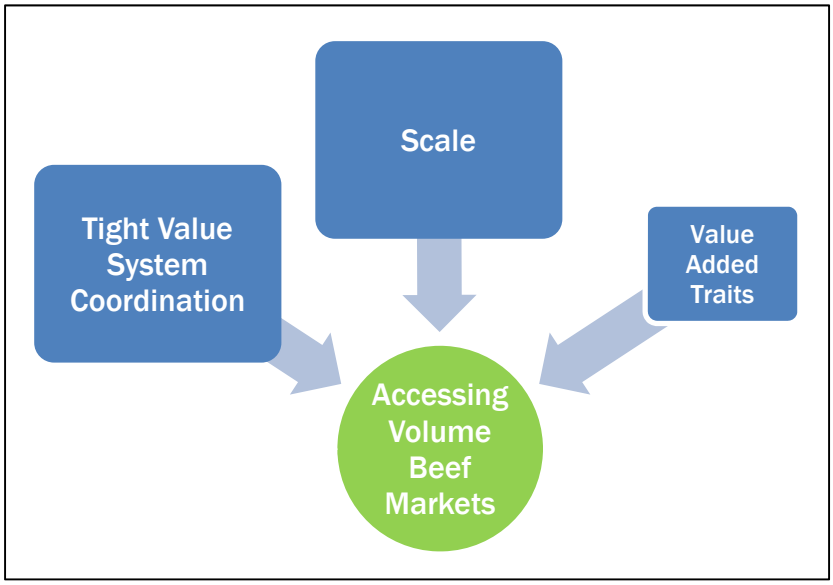
We should note that USPB converted to a limited liability company (LLC) in 2004. There are two share classes. "A" shares "carry delivery rights and obligations like USPB shares did under the cooperative structure" (USPB, 2011a, para. 10) and "B" shares are for investors and have no delivery rights. The "A" shares thus look much like the previous cooperative structure. In fact, USPB describes itself as producer-owned (USPB, 2011b).

In 2008, USPB paid record cash distributions (USPB, 2009). This is in contrast to Farmland National's continued struggle with beef packing industry overcapacity and struggles to attain profitability (Anderson & Hudson, 2008). Moody's downgraded Farmland National's credit rating in 2008 due to processing industry losses in 2007 and 2008. This performance comparison is further highlighted by USPB's blocked attempt to sell Farmland National to JBS Swift & Co. in 2008 (Wilke & Etter, 2008).

Figure 1 illustrates USPB's pursuit of value system coordination and scale to successfully provide access to volume markets for small producers. Notice that pull production systems and end consumer relationships are not included in this illustration. Additionally, value-added traits are included only to a lesser degree.

[3] For a description of the grading process, see the USPB website: http://www.uspremiumbeef.com/FAQ.aspx

Figure 1. U.S. Premium Beef Model



Challenges of Scale: Tallgrass Prairie Producers Co-op

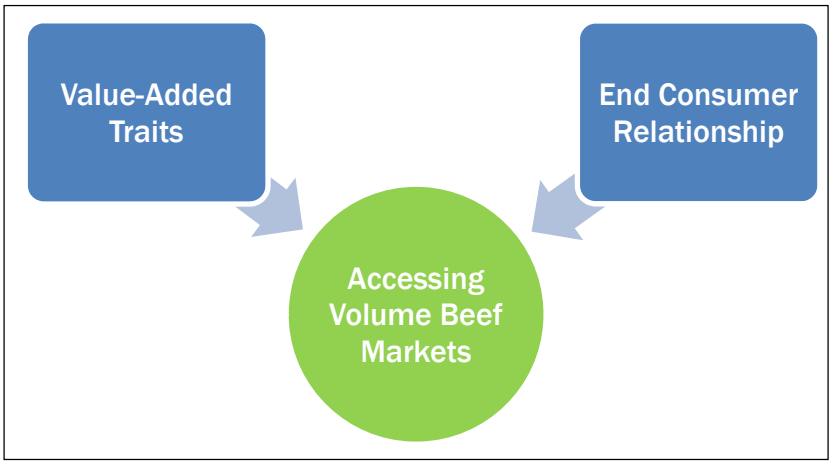
Many studies show that consumers are hypothetically willing to pay premium prices for value-added traits (McCluskey, Wahl, Li, & Wandschneider, 2005), but clearly there is a difference between hypothetical willingness to pay and actually paying. The Tallgrass Prairie Producers Co-op (Tallgrass) was started in 1995 and continued until it was liquidated in 2000 due to unprofitability (Wilson, 2001). The cooperative was originally formed to produce beef that was raised with sustainable values such as the conservation of natural resources, humane treatment of animals, no use of farm chemicals, and low use of fossil fuels.

However, the cooperative was never able to reach profitability and only survived based on the substantial subsidization provided by cooperative members' free labor. According to Wilson's analysis of Tallgrass, the fundamentals of developing a successful meat business based on social values were professional management of the business, sufficient volume to reach the break-even point, cost-effective operations, and realistic product pricing. These four aspects also had to be coupled with "a critical mass of supply and capital" (Wilson, 2001, p. 4). In order to reach the break-even point, Tallgrass desperately needed a distributor or retailer that could buy in volume. However, due to the seasonal nature of its grass finishing process, there was no way to guarantee a steady supply of beef through the winter. The issue of supply was compounded by its marketing campaign, which especially emphasized its special attributes of sustainability, low fossil fuel usage, humane treatment, no on-farm chemicals, and health benefits. These value-added traits were realized through their grass finishing process, which most consumers did not understand. For capital, the cooperative initially took a "do-it-yourself" approach to avoid debt. However, in the end, it did not have the capital needed to hire the skilled meat-industry professionals who could have identified and helped it capitalize on early market opportunities (Wilson, 2001).

Overall, Tallgrass was never able to develop the steady product flows and volume to make such investment in its business feasible. Barriers, or as Wilson stated, the "Catch-22," in its business were the competing problems at each stage of its value chain (2001). First, in actual production they could only produce finished beef during the spring, summer, and fall months because of their grass finishing process. Tallgrass co-operators also overestimated consumers' understanding of their process, social values, and willingness to pay a premium for these attributes. Wilson explains that reaching needed production volumes would have been a disaster because they could never have fulfilled such demand (2001). Second, finding a processing facility to process the beef at the costs needed to be profitable was also impossible. Large processing facilities need sufficient volume or are unwilling to deal with smaller producers. Furthermore, sufficient volume is needed to build distributor business. In the end, Tallgrass found itself with a low-volume, high-transaction-cost produc-

tion and distribution process that left them unable to provide consistent supply throughout the year. Tallgrass created a business that needed volume to survive but was never able to properly balance scale and marketing management expertise with value-added traits and end consumer relationship attributes to actually attain the volume it needed.

Figure 2. Tallgrass Prairie Producers Cooperative Model



Tallgrass relied heavily on the attribute of value-added traits for its model. It also emphasized the attribute of end-customer relationship. However, it did not expend enough energy to determine the correct the scale attribute, which led to problems with the attribute of value system coordination. This is depicted in figure 2. This ultimately led to the cooperative's failure.

From Commodity to *Shinrai:* Country Natural Beef

First started in 1987 in response to low beef prices, Country Natural Beef (CNB) is a successful cooperative that has developed what Dan Campbell, editor of the USDA publication *Rural Cooperatives,* calls the "third way" of cooperative management (Campbell, 2006). One of the first things to note about the CNB cooperative is that it has almost no overhead and there are no equity positions for members. Capital requirements are raised from revenue derived from cattle sales. The cooperative owns no processing plants or feedlots, has no headquarters, and hires no employees. Management functions are taken care of by "internal partners" who hire their own people to perform the functions that require expertise (Stevenson, 2009). The costs of these functions are paid to the individual rancher or "internal partner," but these individuals are not on the official cooperative payroll. Feedlot functions are managed by cooperative members, but also are not owned by the cooperative itself. Illustrative of CNB's success is its growth from an organization slaughtering 3,000 head of beef per year in 1990, to an organization that slaughters 47,000 head of beef today (Bradbury, 2009).

This model is different from USPB. One model for cooperatives looking to return more dollars to producers is to pursue greater vertical integration. USPB is a prime example of this; it looked for controlling interests in processing facilities upstream in the value system in order to capture more of the food dollar. What CNB did was counterintuitive to classic cooperative expansion. One general problem in agricultural industries is the increasing level of capital needed to be competitive. This is exhibited by USPB's need to gain a majority stake in Farmland National. CNB has been able to avoid this due to its limited capital structure as it builds resiliency into the system. Activity in cattle commodity markets usually means that beef producers are vulnerable to volatile market prices that change weekly. A typical grain-fed beef takes 18–20 months to get to slaughter weight. When a producer calves, he or she has no idea what price will be received when the animal is at market weight. As the logistics manager for CNB said, "We're in the beef business, not the cattle business" (Stevenson, 2009). A cattle business is only looking to deliver cattle and is not connected to the feedlot, processing facilities, distributors, retailers, or consumers. Being in the beef business means *partnering* with each stage on the value system to create situations with mutual reward or *shinrai.* CNB's first major customer, a

Japanese beef company, introduced the co-operators to the concept of *shinrai,* which is the Japanese concept of mutual reward and mutual gain. CNB cultivates these relationships and also maintains direct contact with customers at retail establishments. Each CNB member is required to visit retail establishments three times a year to build relationships with both consumers and ground-level employees of retailers. An example of cultivating close relationships is highlighted in the following story regarding CNB's relationship to its processor, AB Foods, as related by Dick Bradbury (2009), a founding member of CNB:

> Several years back, our processor got into trouble and was forced to shut down for a few days until things could be smoothed over. During this time, they had a large order for the U.S. Army coming up. With the plant down and the timing of the order, AB [Foods] wasn't able to fill the order in time. We told AB they could use our beef that they had on hand at the lower price they needed in order to fill the order. They couldn't believe it. We worked it out with them that our cattle would be the first ones processed after they came back online. They filled their order and our customers didn't experience so much as a hiccup.

For CNB, AB Foods' innovative expertise helped to manage carcass utilization, an extremely important aspect of beef marketing. It also gave CNB the ability to track point of origin through its processes. The willingness to sell excess CNB product through its commodity channels has made AB Foods a tightly knit and noninterchangeable partner with CNB.

This partnership also goes into CNB's supply forecasting. It communicates with both its secondary processor (Fulton Meats) and its major retail partners. This communication allows its value chain to match supply with demand. Because demand is forecasted 18 months out, ranchers with CNB don't produce calves that don't have buyers. This, in essence, establishes a system that comes close to pull production for CNB. It is not producing as much beef as possible and selling it on the spot market. It is adding intentionality to its production based on its own and its partner's expectations of demand. As Dick Bradbury says, "Every animal I produce is already sold" (2009). It should be noted that achieving true pull production in beef may be difficult given the difference between end customer lead time and production lead time.

This more pull-like method of production represents a departure from other commodity beef production and processing models. CNB is concentrating both on maintaining sufficient scale and maintaining involvement in every stage of the value-added process, which allows it to eliminate waste from overproduction. Additionally, CNB has been able to combine low capital expenditure with profitability. Low overhead means that difficult economic conditions and lowered demand for CNB products can lead to adjusted production targets. CNB is able to cut down on production and is not required to maintain fixed production targets or face losses. Cuts are determined by the cooperative, but farms can move beef through other channels when CNB demand decreases. The *shinrai* philosophy can be tested when the cooperative loses customers. However, the low-capital nature of the cooperative allows it the flexibility to survive difficult periods.

Though CNB uses sustainable production methods, it is not certified organic. CNB beef carcasses have attributes that include grass-fed, with only short times on the feedlot (short fed), antibiotic free, and humanely raised. Though its story clearly includes environmentally friendly concepts, it has not overemphasized this attribute of its model.

While these methods have worked well for CNB, they do come with disadvantages, risks, and assumptions. First, one of CNB's major customers, accounting for 60% of sales, is Whole Foods Market (Campbell, 2006). The relationship with Whole Foods Market has grown from a handshake agreement to formal contracts. There is significant overlap in CNB's business model (story) and Whole Foods Market's customer base (Stevenson,

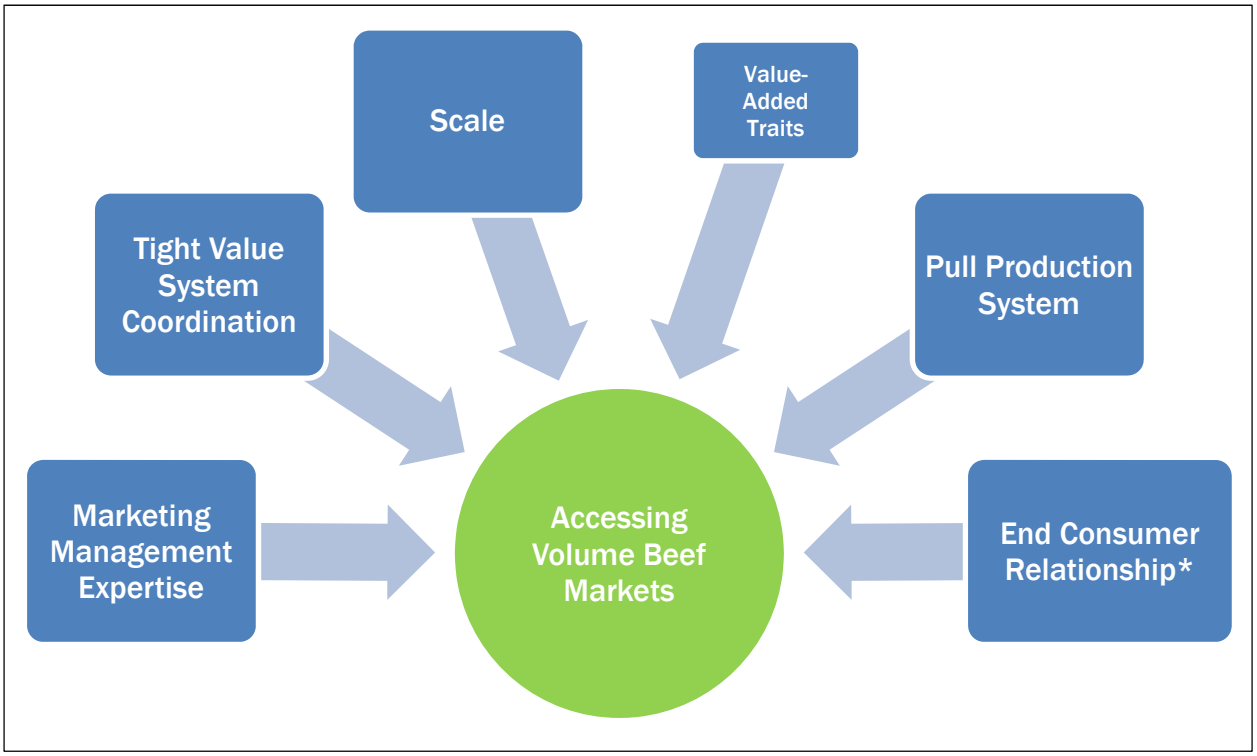
2009). However, with one customer taking 60% of the production, there is a risk to CNB that Whole Foods business would have a disproportionately negative effect on CNB business. This actually happened when Whole Foods changed from a regional to a centralized buying structure. This hurt the regional relationships that had already been cultivated and maintained over a long period of time. CNB production was set up to deliver beef to Whole Foods operations west of the Rocky Mountains. At the time of the changeover, Whole Foods had been growing rapidly and was looking for beef suppliers that would be able to deliver product to their locations nationally. Eventually, the relationship was repaired, but this does highlight risks associated with dependence on one large customer.

Furthermore, Whole Foods is able to connect CNB with consumers who are willing to pay more for direct contact with producers, environmental stewardship, social values, and antibiotic- and hormone-free production methods. There are a limited number of retailers similar to Whole Foods in the market. It might not be possible for every producer to connect with a retail and distribution system that has access to such markets. Additionally, pull systems of production require high amounts of coordination with customers and processors. CNB must pay for its managing members' and their employees' time to cultivate these relationships. This has proved profitable for CNB because of its access to premium markets. It might not be profitable for organizations without access to premium markets to take on increased transaction costs.

CNB's model includes achieving the proper scale, not just size for the sake of size. It uses a pull system of production that is facilitated by good value system coordination. This coordination is likely one outcome of the customer relationships that CNB has established. It has an innovative way of ensuring the attribute of marketing management expertise. Finally, its value-added traits are not more than what the market is willing to buy.

Figure 3 represents the relative balance that CNB has struck in accessing volume markets for their

Figure 3. Country Natural Beef Model



small producers. We have placed an asterisk next to end-customer relationship as a way to highlight the fact that a significant portion of their sales comes from one customer, making CNB very dependent on that customer.

Discussion: Toward a New Model

These three case studies were chosen because of the different model each represented. Organizations using similar models might achieve different results than the firms presented here. However, the three case studies do give an indication as to the key attributes to consider when evaluating a cooperative model for smaller producers to access volume markets: marketing management expertise; value system coordination; scale; value-added attributes; production system design; and end-customer relationship. Table 1 is a summary of the three case studies. For each, the authors offer an admittedly subjective rating on each attribute. It is consumer relationships that are vital in success. However, as tempting as a formula for beef marketing success might be, it is more important to recognize the highly dynamic nature of these attributes. Depending on the scale, different levels of value-added traits, expertise, relationships across the value system, or direct consumer contact will be needed. For example, as consumer contact increases, more marketing opportunities are possible with less scale due the more direct connections between consumer and producer. The discussion below will note where such interactions are particularly important.

Both USPB and CNB represent, to date, successful cooperative enterprises that have been able to connect small producers to volume markets. Yet USPB slaughters slightly more than eight times the beef that CNB does. As Dick Bradbury from CNB has stated, "We aren't even a drop in the bucket of the beef market" (2009). On the other hand, Tallgrass was never able to reach the scale needed to access volume markets and attain profitability. Scale, it seems, at least to a certain point, is important. A small producer might be able to sell 100–200 head of beef directly to consumers. However, as the number of beef marketed increases, small producers often have insufficient scale to hire a marketing manager full time, yet cannot market enough beef part time to enter into volume markets. Scale must thus be considered a "Catch-22" attribute.

Marketing management expertise is clearly an important attribute for beef producers looking to market their products into retail markets. As Mike Lorentz said, "Don't be naïve enough to think that you can part-time people out of a fulltime job. These people wake up in the morning and all they think about is selling more meat" (2009). Tallgrass's negative experience in niche markets is partially due to its failure to hire the required expertise. Market opportunities that "do-it-your-

Table 1. Summary of Case Studies of Cooperative Business Models for Beef Marketing

Attribute	U.S. Premium Beef	Tallgrass Prairie Producers Co-op	Country Natural Beef
Marketing Management Expertise	Professional, full-time management	Not significant	Internal partners hire expertise as needed
Value System Coordination	Emphasis on communication between value chain stages	Poor due to seasonal production	Shared Risk and Rewards
Scale	Sufficient to secure processing capacity	Unable to maintain proper scale	Proper, in part due to pull production
Value-Added Traits	Lower priority	Primary attribute	Appropriate to what market will bear
Production System	Push system	Push system	Pull system
End-Customer Relationship	Not emphasized	Significant attribute	Customer visits required

self" ranchers may have missed could have been caught by more experienced professionals. In contrast, USPB and CNB both hired the necessary expertise. USPB has an official management team, while individual ranchers with CNB either use their own expertise or hire expertise on a contract basis.

The case studies make clear that the issue of scale and expertise are linked. Consider the rule of thumb regarding scale from an industry presentation by Mike Lorentz of Lorentz Meats. When considering hiring a beef marketing expert, he suggests that it will take *at least* 1,000 head of beef to enter into volume retail and distribution markets (Lorentz, 2009). The reasoning behind this statement is that accessing volume markets takes at least one full-time marketing and sales employee. In order to pay a skilled full-time employee, a roughly 1,000-beef minimum is necessary. For direct marketing at low volumes, an additional employee is not needed. Between 200 beef and 1,000 beef is a no man's land that requires more marketing labor than one person can give, but also does not generate enough profit to justify hiring.

Value-added traits such as U.S. raised, humanely raised, antibiotic-free, GMO-free, and grass-fed are all important for accessing premium prices and volume markets. The natural meat and poultry market saw a 77% growth in market share between 2002 and 2003, and was a significant part of the organic food industry (Organic Trade Association, 2004). McEachern and Schröder (2004) found that a significant proportion of respondents to their survey (76%) would prefer to buy fresh meat products with social values–based labeling. Thus, there is a market for food and fiber products that convey a message of value-added traits (range-fed, humanely raised, etc.) to consumers that go beyond organic standards.

Value-added traits can help small producers and cooperatives succeed, but they cannot make a beef business. These attributes have helped CNB to be successful. However, the experience with CNB can be contrasted with USPB, which does not seek to compete in the beef market based on sustainable values and attributes, yet still has helped small beef producers be successful in volume markets. The experience of Tallgrass indicates that even though social values and health aspects might be important, there is a limit on what consumers are willing to pay for these aspects. Tallgrass received recognition in sustainable agriculture circles from people who wanted to believe that its environmental stewardship, social values, and health benefits were ushering in a new age for small agricultural producers. However, its lack of profitability shows that while markets based on value-added traits might be growing, they still must balance other factors in their business. The key to the value-added traits attribute is thus selecting a level of value-added traits that will sell in sufficient quantity and price to maintain profitability. The three cases studied here show three different approaches with regard to this attribute.

Coordination across the value system is also important. However, there are several different methods to achieving these goals. There are, as CNB has shown, *shinrai* methods of mutual risk and reward that require less capital outlay, but more regular maintenance of the relationship. Across each stage of the value chain, CNB maintains close relationships with companies that have similar goals and business strategies. On the other hand, USPB decided that it would invest downstream in processing capacity in its attempt to more tightly orchestrate its supply chains. A major focus of its business is greater coordination of production, not supply chain relationships. CNB appears to focus on the "soft side" issues, while USPB appears more focused on the technical side.

CNB has also been able to successfully partner across its value chain to better match its production to demand, thus eliminating waste. It has created a pull system that is unique. Most organizations, USPB included, are still tied to facilities that require a certain level of utilization and are required to push product out into the market, creating overproduction during times of limited demand. Vertical integration has helped to manage this better, but large processing facilities still must process sufficient product to reap economies of scale. In many ways, USPB doesn't have a lot of

flexibility in its production numbers because of the driving need to keep consolidated production facilities operating. These cases point out how system coordination and system of production are linked. Simply put, greater coordination allows the opportunity to take advantage of the benefits of pull production systems.

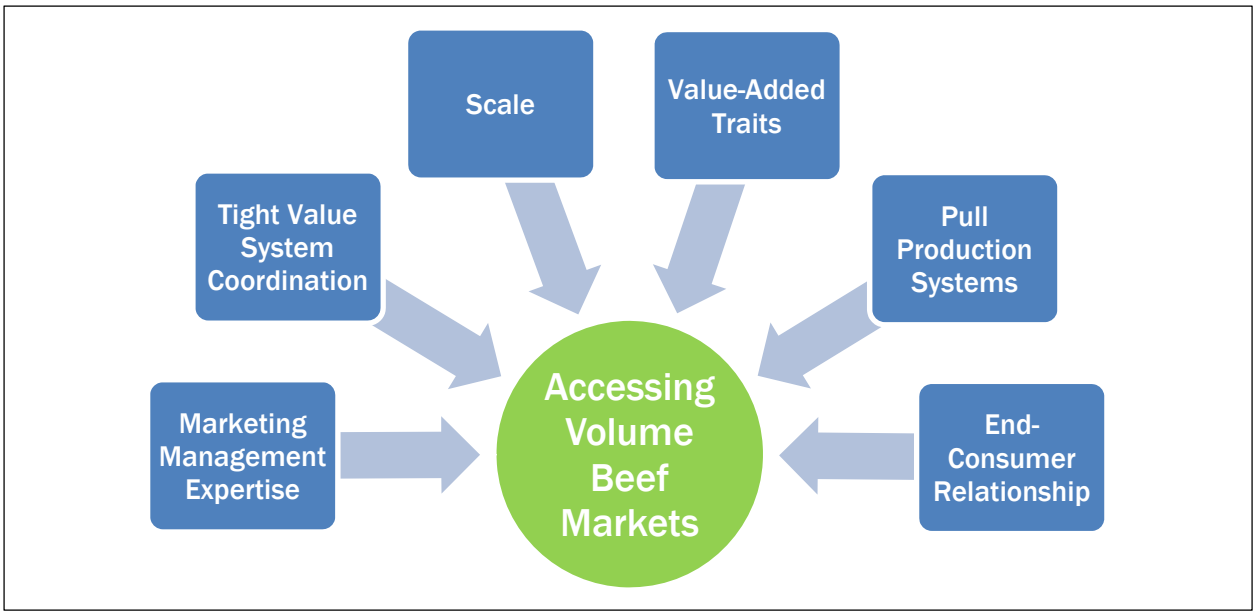
The final attribute considered is relationships with end consumers. This can also be an important factor or a difficult burden when coordinating across the value system. Tallgrass, for example, was only able to market its beef to high-transaction-cost, small and independent retailers. Although it had high degrees of direct contact with consumers, these high transaction costs were a barrier to profitability. On the other hand, CNB employs farmer visits to retail establishments and restaurants that serve its beef, which has been a key to promoting customer loyalty, connection with the farmer or rancher, and overall success. USPB does not have a direct relationship with the end consumer, but has sufficient scale to compete effectively in commodity beef sectors. The case studies all point to the idea that strong relationships with end customers facilitate system coordination and pull production systems.

Conclusion

The ability of small producers working alone to develop and access volume markets is limited. Direct marketing of products is not feasible in high-volume environments, as it is difficult for one small producer to manage both marketing and production aspects at sufficient volumes to be useful for an increasingly consolidated retail sector. Because of this, cooperative enterprise has long been an option for small beef producers to access volume markets and increase market power. Cooperatives that represent small producers must balance several factors to be successful selling into retail markets, as represented in figure 4.

The aforementioned qualities must be considered by small beef producers. It is also important to note that these qualities are dynamic parts of the whole business. Stronger relationships with end consumers might negate the need for different value-added traits or going to a larger scale. The degree to which each cooperative fulfills these factors is often a moving target based on the particular situation of a business. It would be beneficial for small beef producers to learn from the experiences of Tallgrass, Country Natural Beef, and U.S. Premium Beef, and also understand that there

Figure 4. A New Model for Small Producers



is no one way to beef marketing success. Finding the sweet spot for each factor is more an art than a science.

This research has synthesized three case studies and outlined some of the factors of success in beef marketing. Based on this, future research on small producer success in volume markets should include the following.

1. Additional factors responsible for small producer success in volume markets.

2. Research that highlights success factors in volume beef marketing using empirical methods.

3. Research that highlights how pull methods of agricultural production can be better incorporated into volume beef-marketing schemes.

4. Research that further investigates how different factors responsible for small producer success in volume beef markets interact with each other.

Research that extends the current paper along these lines is likely to give important practical guidance to small producers. 

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From the ground up: Assessing consumer preferences for multifunctional agriculture

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Abstract

Farmland provides more than just food and fiber; it also provides environmental benefits, scenic amenities, a link to our shared cultural heritage, and other benefits. While there is a vibrant literature on the multifunctionality of European agricultural landscapes, few studies examine the multifunctionality of those in the United States. This research provides a detailed, ground-up assessment of the multiple benefits that farmland provides to four counties in western North Carolina. Results outline the numerous benefits provided by rural landscapes and point to the value of a portfolio approach for documenting, monitoring, and financing the benefits of agriculture. The study introduces a replicable method that can be used by communities across the nation to investigate the multiple functions of their agricultural landscapes. Widespread and regular use of the method will lead to an improved understanding of the multifunctionality of U.S. agriculture and provide opportunities for effective monitoring and assessment of policies designed to protect these benefits.

Keywords

community assessment, farmland benefits, geographic information systems (GIS), multifunctionality of agriculture (MFA)

Introduction

Farmland provides food, fiber, scenic amenities, environmental and ecological services, and other benefits such as cultural heritage and recreation (Bergstrom, Dillman, & Stoll, 1985; Buckley, van Rensburg, & Hynes, 2009; Daugstad, Rønningen, & Skar, 2006; Drake, 1992; Gardner, 1977; Hall, McVittie, & Moran, 2004; Hellerstein, 2002; Kline & Wichelns, 1996; McClead, Woirhye, Kruse, & Menkhaus, 1998; Randall, 2002). Because agricultural lands provide many functions, it is often said that there is a multifunctionality of agriculture (MFA). Markets can provide signals to guide the

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production of some of agriculture's functions (food, fiber), but many of the farm's jointly produced amenities (scenic amenities, cultural heritage, environmental services) are nonmarket goods for which consumers (neighbors, other residents of the community, and visitors) cannot directly express their preferences through normal market channels. As a result, the total value of farmland to communities fails to be accounted for in everyday market transactions.

There is a substantial literature that reports on the willingness of individuals to pay to protect farmland (summarized by Bergstrom and Ready, 2009), which indicates the significant value that farmland provides to individuals and communities. While high levels of public preference for farmland protection are important indicators of general interest in agricultural lands (and perhaps agriculture in general), knowing *what* people value about agricultural lands is even more helpful for planners and policy-makers. Knowing whether people value land for its productive aspects (food, fiber) and/or nonproductive characteristics (visual amenities, cultural heritage) is key to understanding community preferences for MFA. This knowledge can help local decision-makers, policy-makers, and land trusts in at least three ways: to improve understanding of local resources that can assist with rural economic development and sustainability initiatives (Garrod, Wornell, & Youell, 2006); to design effective funding mechanisms for farmland protection efforts by targeting stakeholders who receive farmland benefits; and to know where monies will be most effectively invested to correct for market failure and maximize community benefits.

However, we often lack community-based information about the types of benefits that agriculture provides to local areas. Building on surveys of local residents and visitors, in this study we provide a detailed, ground-up assessment of what people perceive as the multiple benefits that farmland provides in four counties in western North Carolina. Results reinforce the demand for multifunctional rural landscapes and point to the value of a portfolio approach for documenting, monitoring, and financing the benefits of agriculture. We developed a replicable method that can be used by communities across the nation to investigate people's understanding and appreciation of the multiple functions of their agricultural landscapes. Widspread and regular use of the method could lead to an improved understanding of the multifunctionality of U.S. agriculture and also provide opportunities for effective monitoring and assessment of policies designed to protect these benefits.

The remainder of the paper is organized as follows: after an introduction to the MFA and review of the MFA literature, the study region is described. The subsequent sections provide an overview of the Farmland Values Project (FVP) and its results. The final sections discuss the results and present implications for other regions and future researchers.

The Multifunctionality of Agriculture (MFA)

It is widely recognized that agriculture provides benefits other than food and fiber (Bromley & Hodge, 1990; Duke & Aull-Hyde, 2002; Kuminoff, 2009; Lynch & Duke, 2007; Lynch & Musser 2001; McConnell, 1989; Nickerson & Hellerstein, 2003). These benefits vary by space and place and can include ecological services such as habitat provision, nutrient cycling, water regulation (flood control), and pollination; landscape services such as scenic quality; food security; recreation; and cultural heritage. Because it provides multiple functions, agriculture has thus come to be referred to as multifunctional. This multifunctionality plays a role in policy settings. The Organization for Economic Cooperation and Development (OECD) agriculture ministers have adopted the concept of multifunctionality as a policy principle, and so MFA is recognized and promoted by policy in the European Union (European Commission, 2004, p. 6; OECD, 2001). MFA has been a controversial element in international trade negotiations when countries act to protect these nonfood or -fiber amenities (Sakuyama, 2005; Swinbank, 2001). Generally speaking, the U.S. has resisted the protection of MFA in trade negotiations, although the U.S. Department of Agriculture clearly acknowledges MFA in its strategic plan that aims to preserve multiple functions of U.S. agriculture (USDA, 2008).

Hediger and Knickel (2009) provide a thorough summary of the relevance of agriculture's multifunctional benefits for economic welfare and sustainability considerations. Supply-side studies document agriculture's provision of environmental, cultural, scenic, and other services that are jointly produced with food and fiber. Most of these studies have been conducted in Western Europe (e.g., Boisvert, 2001; Lankoski & Ollikainen, 2001). While it is useful to know how these amenities are supplied by agriculture, it is especially beneficial to know the level of demand (i.e., consumer preferences) for the amenities for effective policy-making.

A majority of the research examining community preferences for MFA has been conducted in Europe. Hall, McVittie, and Moran (2004) provide an excellent review of early studies. They found that most preference studies explored public preferences for a particular rural amenity or set of key features rather than conducting a holistic evaluation of the full set of agricultural functions. Several more recent European studies have attempted to remedy this concern (Hyytiä & Kola, 2006; Lindemann-Matthies, Briegel, Schupbach, & Junge, 2010; Parra-López, Groot, Carmona-Torres, & Rossing, 2008; Sayadi, González-Roa, & Calatrava-Requena, 2009; Vera-Toscano, Gómez-Limón, Moyano Estrada, & Garrido Fernández, 2007).

Interestingly, little research exists that specifically focuses on the demand for MFA in the United States. Moon and Griffith (2010) use a national study to estimate a holistic valuation of the intangible amenities associated with U.S. agriculture. They asked respondents how much the intangible aspects of agriculture were worth to them and the amount of tax they would be willing to pay to retain them. They found that respondents were willing to pay an average of USD515 in annual taxes for the intangible functions of agriculture, which aggregates to USD105 billion annually, and conclude that valuation studies are needed that attach more specificity to the multifunctional attributes of agriculture. In a related study also conducted at the national level, Moon and Chang (2010) identified factors influencing public attitudes towards MFA. They found that appreciation of food self-sufficiency and ecosystem services are the most significant factors influencing public attitudes toward MFA.

Lenihan, Brasier, and Stedman (2009) sought to measure the perceptions of MFA among rural Pennsylvania residents. They conducted six focus groups in three counties selected for their differences in development pressure and agricultural type and found that the preferences for agriculture's positive characteristics varied among rural areas and social groups. They conclude that policies to promote MFA should be sensitive to local preferences and should provide opportunities for local input, thus underlining the importance of avoiding assumptions of national uniformity of preferences for MFA.

The literature on the demand for the MFA in the U.S. is limited. Our study addresses this gap by adding empirical evidence about community demand for MFA in western North Carolina, a region previously unstudied on this topic and whose agriculture is noted for providing multiple benefits to surrounding areas (Blue Ridge Forever, 2009). Hall, McVittie, and Moran (2004) recognize that some amenities, services, or products that we associate with rural areas require an active local agriculture (landscape, cultural heritage, local food) while others do not (rural character, biodiversity, soil conservation). Irwin, Nickerson, and Libby (2003) observe that policy-makers benefit from learning the relative importance of rural versus farmland amenities in order to improve the targeting of land protection schemes. The challenge for researchers interested in MFA is to be able to identify preferences for agricultural lands that are distinct from preferences for rural lands in general. In our study, we specifically asked participants to focus on the benefits of farmland as opposed to rural lands in general. In so doing, we introduce a novel, ground-up approach to the study of MFA that engages stakeholders in multiple ways to frame the multifunctionality of agricultural lands.

Setting

The Farmland Value Project (FVP) was conducted in four western North Carolina counties: Buncombe, Haywood, Henderson and Madison (see figure 1). These counties were selected because they fall in both the Asheville metropolitan statistical area and the Blue Ridge National Heritage Area, and their agriculture is known for providing multiple benefits to surrounding areas.

The study region contains a diverse but small-scale agriculture; average farm size is 75 acres (30 hectares) (USDA NASS, 2008). The region's agricultural lands are made up of approximately equal shares of cropland, woodland, and pasture (USDA NASS, 2008); due to the mountainous topography, many operations are composed of a combination of woodland with pasture and/or cropland. Historically, tobacco was a predominant crop, as evidenced by the large tobacco barns scattered throughout the region that provide tangible reminders of the area's agricultural heritage. The tobacco buy-out program led most tobacco farmers to seek alternate crops. Vegetable, dairy, and cow/calf operations currently predominate, although there are notable greenhouse operations in Haywood and Henderson counties and significant apple acreage in Henderson County (USDA NASS, 2008).

The four counties together demonstrate a range of urbanization levels. Buncombe County is the most urbanized of the four study counties, followed by Henderson, Haywood, and Madison (see table 1).

Figure 1. Farmland Values Project: The Four-County Study Region

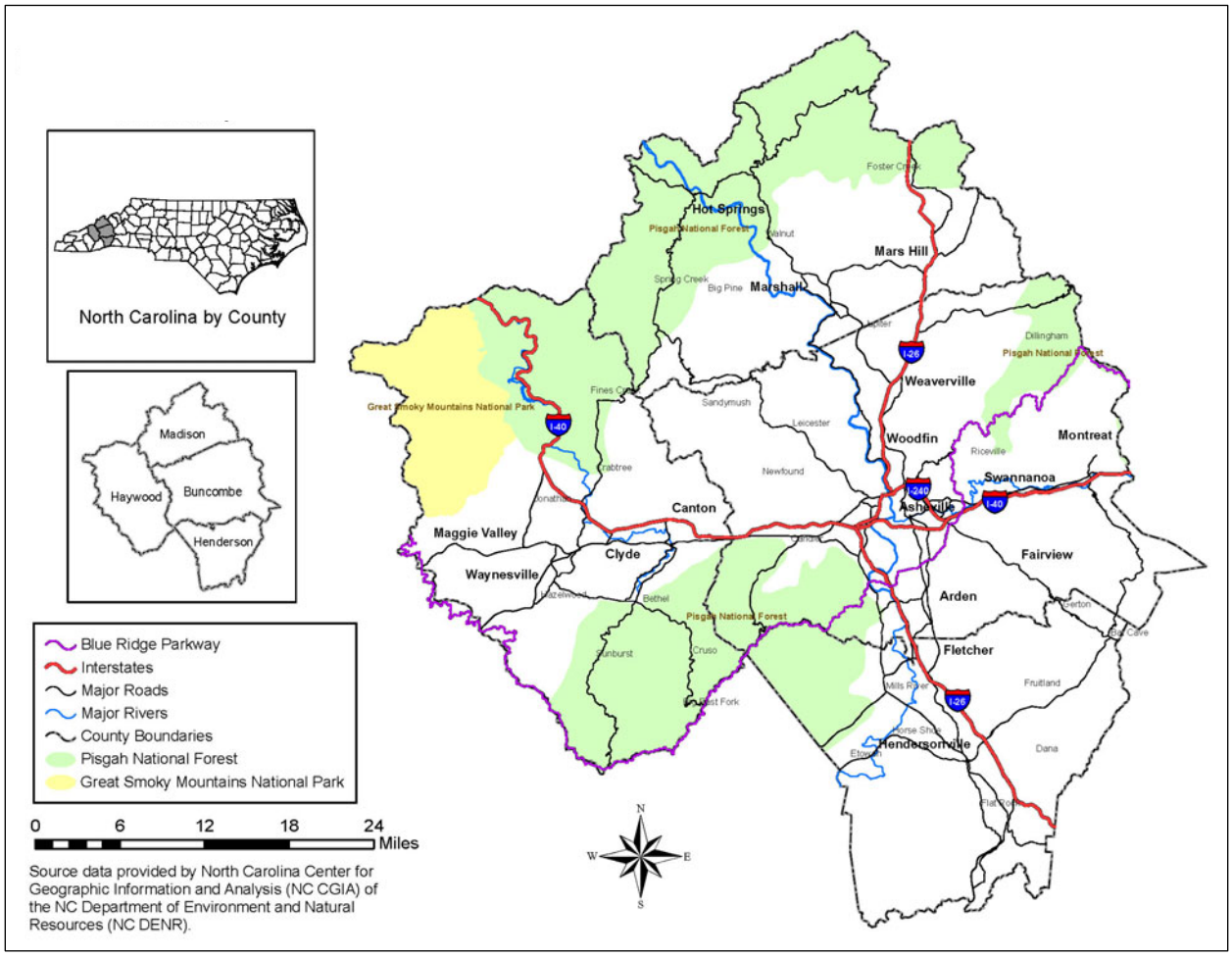

Table 1. Population and Farmland Statistics for Farmland Values Project Study Region

	Buncombe	Haywood	Henderson	Madison
2010 population[a]	238,318	59,036	106,740	20,764
2000 land area[b] (square miles)	655.99	553.66	374.00	449.42
2000 population density,[b] (persons per square mile)	314.5	97.5	238.4	43.7
Population growth, 2000–2010	15.5%	9.3%	19.7%	5.7%
Land in farms 2007[c] (acres)	72,087	56,212	37,947	66,734
Farmland loss,[c] 1997–2007	22.97%	19.65%	27.41%	28.49%

Source: [a] United States Census (U.S. Census Bureau, 2011), [b] U.S. Census Bureau County Quick Facts (U.S. Census Bureau, 2010), [c] USDA National Agricultural Statistics Service (USDA NASS, 2008).

Western North Carolina, especially the Asheville area, is popular with tourists and residents seeking natural and cultural amenities. Tourism is a significant economic driver in the region (Evans, Davé, Stoddard, & Ha, 2006; Starnes, 2005), and the scenic beauty of the region is frequently cited as an important factor in visitation and residential location decisions (Kask, Mathews, Stewart, & Rotegard, 2002; Mathews, Stewart, & Kask, 2003). As in other parts of the country, farmland loss has been significant in the study region. In this mountainous area, farmland is often the easiest land to convert to residential or other uses; as a result, farmland conversion rates generally trend with population growth rates. However, the region's relatively more rural counties (Haywood and Madison) still experience significant farmland loss despite slower population growth rates.

Despite the loss of farmland, there is an intense interest in local food in western North Carolina. The Appalachian Sustainable Agriculture Project (ASAP), a local nonprofit based in Asheville (Buncombe County), has championed an extremely effective local food campaign for the last 10 years. Research indicates that demand for local food greatly exceeds the supply; only about 2% of food consumed locally is produced in the region (Kirby, Jackson, & Perrett, 2007). In addition to raising awareness about the benefits of local food production for the economy and landscape of the region, and promoting farmers' markets, ASAP has also spearheaded efforts to incorporate local food into schools via its Farm to School and Chefs in Schools program. There are 22 tailgate markets in the study region, 38 CSAs (community supported agriculture operations) that are regularly fully subscribed, and local wholesale markets that facilitate the incorporation of local food into schools, hospitals, restaurants, and grocery stores (ASAP, 2010). Many people consider Asheville and the surrounding region a "local food hot spot." The Asheville Convention and Visitors Bureau even markets the city to the "foodie" crowd by referring to Asheville as *Foodtopia*, highlighting the active local food scene along with the city's many independent restaurants and microbreweries that feature local farm products (Buncombe County Tourism Development Authority, 2009).

Study Overview

Given the interest in local food, concern about farmland loss, and a desire to more fully understand the link between the area's natural resources and community preferences, the FVP was designed to inventory, analyze, and communicate the many different values that people have for farmland in the area. The purpose of the study, conducted 2005–2009, was to better understand the role that agricultural lands play in the hearts and minds of residents and visitors to the region by investigating the many benefits that agriculture provides and their valuation of them.

We utilized multiple methods to learn about the value that residents and visitors placed on farmland in the region. We used focus groups and interviews to gauge interest and identify themes that we then

used in designing a survey of resident and visitor preferences for farmland. We also developed a participatory geographic information system (PGIS) exercise that enabled residents to specify a particular place in the region that held value for them. The PGIS participants came to a computer lab and, after a brief introduction, used the Google Earth™ mapping service to pinpoint specific locations that they felt had significant scenic quality or cultural heritage characteristics. Participants were then asked to use their personal values to rate numerically and describe qualitatively the places they identified. In the end, the qualitative and quantitative data from the PGIS and survey were combined and used to enhance a land evaluation site assessment (LESA) model, a numeric rating system created by the USDA Natural Resources Conservation Service (NRCS) to evaluate a parcel's relative agricultural importance (Pease & Coughlin, 1996). The results of the LESA model demonstrate specific places in the region that hold significant value for residents that can be used to identify priority tracts for protection. Because the PGIS and enhanced LESA model have been described elsewhere (Mathews and Rex, 2011; Rex, Mathews and Lancaster, in press), the remainder of this paper will focus on the results and implications from the FVP focus groups and surveys.

Survey Design and Implementation

To begin learning about the values for farmland that people in our study region hold, we conducted 17 focus groups between May and July 2006. There were three focus groups in each of our four study counties: one each for farmers, nonfarming rural dwellers, and city dwellers. Additional focus groups brought together conservationists, developers, and Spanish-speaking farm workers. Altogether, 133 people participated in the focus groups. Major findings from the focus groups include:

- Widespread agreement that farmland provides significant contributions to western North Carolina communities.
- Strong support for farmland's ecological, scenic, and cultural contributions.
- Feelings of inability to stop the changes to the landscape that participants witness in their communities.
- Varying levels of importance of farm-level prosperity relative to other farmland characteristics. Farm prosperity was deemed more important by those more closely connected with agriculture.

Themes identified in the focus groups were used to finalize the design of the FVP survey; to provide continuity we also adopted some of the descriptions and phrases used by focus group participants in key survey questions. In the questionnaire we asked respondents about their impressions of farmland, the benefits and costs that it provides their community, their opinions about land use change and government action to protect farmland, and their willingness to pay to protect farmland in the region.

Because we surmised that both residents and visitors value the region's farmland, the FVP survey queried both groups. The resident survey was mailed to a random sample of 3,200 households in November 2007; a single-use, password-protected version of the questionnaire was available online for respondents who preferred to complete it via their home computer. Following Dillman, Smyth, and Christian (2009), a reminder postcard and follow-up mailing were sent to addresses that did not respond to the first mailing. The visitor survey was conducted at various local festivals, visitor centers, and popular tourist sites between September and November 2007; an invitation to complete the survey also appeared in the Asheville Convention and Visitor Bureau's visitor newsletter.

A total of 1,243 responses to the FVP survey were collected from 936 residents and 307 visitors. Our solicitation of visitors at festivals and other sites yielded both resident and nonresident respondents. We found the resident responses collected as part of this convenience sample were statistically significantly different from those collected from

Table 2. Demographic Characteristics of Survey Respondents

	Resident Respondents	Visitor Respondents
Average age	60 years	52 years
Gender (% female)	51% female	69% female
Full-time residents	89%	n/a
Years living in the county [visiting the region][a]	35 years	15 years
Education (% BA or higher)	53%	70%
Purchase local farm products regularly (once a week or more) [on this trip]	48.4%	55.7%

[a] Questions for visitors were reworded slightly from those asked of residents to ensure that their responses reflected their preferences for farmland in Western North Carolina (as opposed to farmland in their home region). Changes are noted in brackets.
n/a: Question was not asked of visitor respondents.

Table 3. Responses to the question, "When you think of farmland, what do you think of?"

	Resident	Visitor
n[a]	762	280
Pasture	88.8%	88.9%
Farm animals	87.3	87.5
Cropland	81.5	76.8
Farm buildings & equipment	79.9	84.3
Hay fields	79.1	73.2
Open space	77.4	78.6
Food	74.7	77.1
Orchards	63.6	70.4
Independent way of life	61.3	61.4
Woodland	58.8	48.9
Small-scale vegetable and flower gardens	58.1	50.0
Close-knit rural community	55.2	61.1
Soil	54.2	62.5
Family ties	53.7	63.2
Wildflowers	50.1	49.3
Traditional homes or buildings	44.5	50.4
Historic landmarks	26.2	26.4
Fiber, such as cotton or wool	14.0	25.0
Other	8.9	12.1
% no response	1.3	8.8

Note: The question responses are re-ordered so that responses are listed according to popularity.
[a] Because of item nonresponse, the sample size for each question varies slightly; thus *n* is reported in each table.

the random sample of residents. To simplify discussion, in this paper we report on the 1,079 responses collected from the random sample of residents (n=772) and visitors (n=307).

Results

Table 2 provides an overview of respondent demographics. Our sample had higher education levels than do typical residents of the region and, because we restricted our survey to adults, the average respondent was older than the region's average age. Most respondents were long-term residents (averaging 35 years) or visitors who had been returning to the area over a long period (averaging 15 years), indicating that our sample is very familiar with the region.

Identification of the Multiple Benefits of Farmland

We began the survey with a question designed to get respondents thinking about farmland in general. We asked, *When you think of farmland, what do you think of?* and found that the physical characteristics of farmland were most frequently selected from the categories provided. Pasture, farm animals, cropland, farm buildings and equipment, hay fields, open space, and food were all mentioned by at least 70% of all respondents (table 3). The less tangible features that may be conjured up when thinking of farmland — an independent way of life, close-knit rural communities, or family ties — were selected by at least half of all respondents.

When asked about the benefits of farmland, survey respondents indicated a clear understanding of the multiple benefits that farmland provides to their communities (table 4). The most frequently selected benefit for both resident and visitor respondents was locally produced food (identified by 92% of residents and 98% of visitors), which is consistent with the strong local food movement in the region. Other benefits recognized by at least 75% of both resident and visitor respondents include scenic beauty, jobs for farmers and others in agriculture, agricultural heritage, and open space. Thus a majority of survey respondents identify the local food, economic, aesthetic, heritage, and open space functions of agricultural lands.

Table 4. Responses to the question, "What benefits, if any, do you believe farmland brings to your county [to Western North Carolina]?"

	Resident	Visitor
n[a]	764	276
Locally produced food	92.3%	97.8%
Scenic beauty	80.6	89.5
Jobs for farmers and their suppliers, pickers, packers, and truck drivers	80.1	89.9
Agricultural heritage	79.8	89.9
Open space	74.9	76.4
Wildlife habitat	74.7	71.4
Soil conservation	60.7	72.5
Attractiveness to visitors	56.9	79.7
Opportunity to observe natural cycles	54.1	62.3
Biodiversity	41.2	67.8
Capacity to slow global climate change	40.7	56.9
Flood control	37.6	44.2
Other	8.5	9.1
None: I do not believe farmland benefits my county [Western North Carolina]	0.4	0.0
% no response	1.0	10.1

Note: The question responses are re-ordered so that responses are listed according to popularity.
[a] Because of item nonresponse, the sample size for each question varies slightly; thus *n* is reported in each table.

While the primary focus of our study was on the perceived benefits that farmland provides, we also asked respondents about their impression of the costs that farmland imposes on their county. The most frequent response for residents was *I do not believe farmland imposes costs on my county* (51.6%), and environmental damage was the cost most frequently noted by visitors (53.5%; table 5). Costs often associated with farmland in other parts of the country, such as dust and smells, were indicated by less than 10% of residents. This is likely because the topography of the region leads to relatively small-scale agricultural enterprises with very little row-crop cultivation and few livestock operations of significant size.

Table 5. Responses to the question, "What costs, if any, do you believe farmland brings to your county [to Western North Carolina]?"

	Resident	Visitor
n[a]	746	273
None: I do not believe farmland imposes costs on my county [Western North Carolina]	51.6%	43.6%
Environmental damage	42.5	53.5
Nutrient and/or pesticide runoff	36.9	47.6
Soil erosion	14.2	17.2
Wildlife habitat loss	12.2	18.7
Smells	9.4	11.0
Dust	6.2	10.3
Traffic congestion caused by slow-moving farm vehicles	5.9	7.0
Reduced flood control	5.0	5.9
Prevents profitable new development	3.2	4.4
Other	2.9	2.2
Biodiversity loss	2.5	11.7
Noise	2.1	4.0
Contribution to global warming	1.5	4.8
Other environmental damage	1.1	1.1
% no response	3.4	11.1

Note: The question responses are re-ordered so that responses are listed according to popularity.
[a] Because of item nonresponse, the sample size for each question varies slightly; thus *n* is reported in each table.

In addition to knowing respondents' perceived benefits and costs of farmland, we were also interested in learning how they feel farmland directly affects their lives. We thus asked them to identify whether and how farmland affects their lives. Once again, the most popular response was related to local food, while scenic beauty was the second most frequent response (table 6). Respondents' third choice — *I am happy just to know it is there* — suggests that the existence of farmland provides intangible psychological benefits to most respondents.

Table 6. Responses to the question, "How does farmland affect your quality of life?"

	Resident	Visitor
n[a]	761	273
Farmland allows me to buy local food	85.8%	90.8%
Farmland is attractive and makes the area more beautiful	84.5	80.6
I am happy just to know that it is there	82.0	76.6
Farmland provides recreation	56.2	68.5
Farmland provides a link to my agricultural heritage	51.0	53.1
Farmland helps me to learn about natural cycles	38.5	42.9
Farmland brings visitors to the area, which helps my county tax base	33.9	n/a
Farmland brings visitors to the area, which helps the business or industry I am in	28.4	n/a
Unproductive farmland prevents new economic development	5.7	8.4
Pollution and byproducts from farmlands pose threats to my health	4.3	7.7
Other	3.5	4.4
Farmland does not affect my quality of life	2.5	2.2
% no response	1.4	11.1

Note: The question responses are re-ordered so that responses are listed according to popularity.
[a] Because of item nonresponse, the sample size for each question varies slightly; thus *n* is reported in each table.
n/a: Question was not asked of visitor respondents.

When asked to rank statements about farmland in order of importance, residents and visitors again expressed similar, although not identical, views. The most important characteristic was local food provision, followed by farm income and scenic beauty (table 7). These responses corroborate the implicit ranking provided by responses to earlier questions.

To determine the consistency of responses, we asked respondents to identify which farmland characteristics were the most important to them in a series of questions designed to give them time to reflect on the characteristic. Specifically, this set of questions asked participants to rate each characteristic on a seven-point Likert scale based on whether the characteristic was important to them; some characteristics had positive connotations ("visual appeal") while others had negative connotations ("unpleasant smells"). A comparison of the average ratings (table 8) suggests that contribution to environmental quality is very important —

Table 7. Average Ranking of Statements Related to Important Farmland Characteristics
(1 = most important, 7 = least important)

	Resident	Visitor
n[a]	687	244
Farmland provides local food	2.2	1.9
Farmland provides income for farmers	2.5	2.5
Farmland provides scenic beauty	3.7	4.1
Farmland provides habitat for wildlife	4.0	4.0
Farmland contributes to our region's agricultural heritage	4.4	4.5
Farmland provides other natural services like biodiversity and pollination	4.6	4.1
Farmland provides flood control	5.3	5.1
% no response	11.0	20.5

Note: The question responses are re-ordered so that responses are listed according to their ranking.
[a] Because of item nonresponse, the sample size for each question varies slightly; thus *n* is reported in each table.

something that doesn't clearly show up in the responses to earlier questions. The remaining average score comparisons demonstrate similarities to responses to earlier questions underlining the importance of farmland for local food, visual appeal, and rural character.

Stated Willingness to Pay Farmland Protection

In the second section of the survey we used a contingent valuation question to ask respondents about their willingness to contribute to farmland protection in the study region. Contingent valuation is a nonmarket valuation method that asks respondents a hypothetical question regarding their willingness to pay for goods or services that are not typically exchanged in markets. Because the study region uses multiple methods to protect farmland (including land purchase and conservation easements), our question asked respondents generally about their willingness to make voluntary annual donations if they knew the money would be designated for protecting farmland in their county (or western North Carolina, if they were not residents). The question was designed using standard contingent valuation techniques, which include a realistic payment vehicle (a voluntary donation), a range of randomized bids (USD25, USD50, USD100, USD200, USD250, USD500, USD1,000), and a dichotomous choice (yes/no) format. Over half of resident respondents (54.3%) and two-thirds of visitor respondents (66.7%) indicated that they were willing to make some contribution to protect farmland in their community (table 9). Using standard regression methods, average annual willingness to pay was estimated at USD184.64 for residents and USD195.41 for visitors, yielding a combined sample estimate of USD184.79. Significant factors influencing willingness to pay included resident status, income, education level, the dollar amount presented in the question, and whether the respondent indicated a willingness to pay more for local food (Mathews, 2009). Most of those willing to make a voluntary donation indicated they would prefer that a local nonprofit organization manage the funds (80% of resident sample, 75.7% of visitor sample) rather than a local, state, or federal government entity.

Given the interest in local food in the region, we also asked respondents if they would be willing to pay more for their food if the increase in price

Table 8. Importance of Various Farmland Characteristics (1= not important, 7 = very important; average score reported)[a]

	Resident	Visitor
Contribution to environmental quality	6.3	6.3
Availability of local farm products	6.2	6.4
Visual appeal	6.0	5.9
Rural character	5.8	5.8
Pleasant smells/aroma	5.2	5.0
Impacts on water quality	4.8	5.2
Impacts on air quality	3.8	4.5
Unpleasant smells	3.1	3.5

Note: The question responses are re-ordered so that responses are listed according to their ranking.
[a] Sample size and % no response vary by item. Complete results can be viewed at http://www2.unca.edu/farmlandvalues/pdfs/survey_results.pdf

Table 9. Willingness to Pay for Farmland Protection and Preferred Fund Management (all currency in USD)

	Resident	Visitor
n[a]	732	263
Respondents willing to make a contribution > $0	54.3%	66.9%
% no response	1.9	13.0
n[a]	280	103
Estimated average annual voluntary contribution for farmland protection	$184.64	$195.41
Prefer to have funds managed by local nonprofit organization	80%	75.7%
% no response	4.9	1.9

[a] Because of item nonresponse, the sample size for each question varies slightly; thus *n* is reported for each question.

Table 10. Willingness to Pay More for Food and Reasons for Not Doing So

	Resident	Visitor
n[a]	745	256
Respondents willing to pay more for food if the increase went to protect farmland in their county [WNC]	63.9%	87.9%
% no response	3.5	16.6
Reasons for not indicating a willingness to pay more for food		
n[a]	265	32
I do not want to pay any more for my food	53.2%	43.8%
I should not have to pay to preserve farmland	37.4	12.5
I do not have sufficient income to pay more for my food	32.8	9.4
I do not believe farmland will be preserved, regardless of my payment	29.1	15.6
I would prefer to make a voluntary contribution on my local taxes rather than food prices to fund farmland protection	16.2	12.5
I do not have enough information to decide right now	7.9	6.3
I do not believe preserving farmland will benefit me	3.8	0.0
Other	3.8	12.5
I do not think that the amount of farmland acreage will decrease, so I do not think we need to preserve it	1.1	0.0
Farmland in Western North Carolina is not that important to me	0.8	0.0
% no response	5.6	0.0

Note: The question responses are re-ordered so that responses are listed according to popularity.
[a] Because of item nonresponse, the sample size for each question varies slightly; thus *n* is reported for each question.

went directly to protect farmland in their county [or western North Carolina]. Not surprisingly, a majority of both residents (63.9%) and visitors (87.9%) indicated they would be willing to do so (table 10).[1] We did not ask specifically about how much more they would be willing to pay for their food, but did ask for an explanation from those who replied *No*. The analysis of *No* responses provides some interesting insight into our sample. As one might expect, most of those who did not wish to support a food price increase to protect farmland indicated that they did not want to pay more for their food (53.2% of residents, 43.8% visitors). However, the second most popular response for residents, selected by over one-third of the resident respondents who said they were not willing to pay more for their food to protect farmland, indicated *I should not have to pay to protect farmland* (37.4% or 99 resident responses). This suggests that a small but significant portion of our sample (13%) does not feel responsibility for footing the bill for farmland protection.

Concerns about Farmland Conversion

The above results indicating a willingness to pay for farmland protection are consistent with the concerns delineated by respondents in the final section of our survey. Respondents were asked to indicate their level of agreement with a series of statements including *I believe the community needs to do more to protect farmland* (54% and 46.1% indicate they strongly agree (SA)) and *I am concerned about the likelihood that farmland will be developed* (62.2% SA resident; 58.4% SA visitor; table 11). The concern about farmland loss is not surprising from a sample where one-third believe that *our region should supply*

[1] A survey of visitors to downtown Asheville conducted in 2010 confirms this result: 81% of residents and 85% of visitors polled indicated they would be willing to pay more for their food if the price increase went directly to protect farmland in western North Carolina (Riddle, 2011).

its own basic food needs locally, including the energy and material inputs needed to produce the food (36.8% SA resident; 36.2% SA visitor). Most respondents believe that *private decisions often impact others in the community* (56.0% SA resident; 67.2% SA visitor). However, there was less support for the belief that *more government action is needed* (17.6% SA resident; 14.5% SA visitor).

Discussion and Implications

Participants in the FVP recognize and articulate the multiple functions of agriculture. A majority of respondents identify local food provisioning, economic, aesthetic, heritage, and open space functions of agricultural lands in four western North Carolina counties. Many of the most popular benefits (local food, aesthetic, heritage) require an active agriculture in the region to be sustained. Recognition of these characteristics, along with stated concern about loss of farmland and willingness to pay to protect farmland by both residents and visitors, suggest a commitment to MFA and a desire to

Table 11. Opinions about Farmland and Land Use Issues (1 = Strongly Disagree, 7 = Strongly Agree)

		Resident	Visitor
"I am concerned about the likelihood that farmland in my county [in western North Carolina] will be developed for nonfarm use."	% Strongly agree (7 on Likert scale)	62.2%	58.4%
	Average score	6.2	6.3
	Median score	7	7
	n	754	257
	% no response	2.3%	16.3%
"I believe the community needs to do more to protect farmland."	% Strongly agree (7 on Likert scale)	54.0%	46.1%
	Average score	6.1	6.1
	Median score	7	7
	n	756	256
	% no response	2.1%	16.6%
"I believe that our region [western North Carolina] should supply its own basic food needs locally, including the energy and material inputs needed to produce the food."	% Strongly agree (7 on Likert scale)	36.8%	36.2%
	Average Score	5.6	5.8
	Median Score	6	6
	n	748	257
	% no response	3.1%	16.3%
"What do you think about the impacts of private land use decisions in your community?"	% Private decisions *often* impact others in the community (7 on Likert scale)[a]	56.0%	67.2%
	Average score	6.3	6.5
	Median score	7	7
	n	747	256
	% no response	3.2%	16.6%
"What do you think about the level of local government involvement in land use in your county [in western North Carolina]?"	% More government action is needed (7 on Likert scale)[b]	17.6%	14.5%
	Average score	4.3	4.8
	Median score	4	5
	n	738	256
	% no response	4.4	16.6

[a] The statement corresponding to (1) on the Likert scale was: Private decisions *never* impact others in the community. [b] The statement corresponding to (1) on the Likert scale was: Less government action is needed.

see it maintained. Most residents responding to our survey had not participated in a forum, public meeting, or survey related to land use in the community in the year prior to our survey (88%), which suggested that we captured the preferences of citizens with an interest in farmland who were not active in land use issues.

Policy Implications

Because farmers are not typically compensated for the benefits agriculture provides to the surrounding region, such as scenic amenities and contributions to cultural heritage, agriculture represents a potential source of market failure. Hediger and Lehmann note that "multifunctionality could provide an efficiency-based argument for government support to agriculture" (2003; p. 1127). This study documented that people throughout the region believe that farmland provides them benefits. If future studies demonstrate widespread concurrence with these results, public financing to protect farmland could be justified. Buncombe County already uses its general fund to support land conservation (including farmland); since 2001 more than USD5.5 million has been designated to assist land protection efforts yielding over 3,800 protected acres (1,538 hectares) (Buncombe Land Conservation Advisory Board, 2010; D. Truempy, personal communication, May 9, 2011). Counties could consider means to provide farmers with compensation for the ways that their citizens value and feel that they benefit from farmland.

As it is not likely that local government budgets yield sufficient funds to compensate all farmers for all benefits they provide to their communities, county government officials could consider a competitive fund that would offer compensation in the form of additional tax credits or payments to farmers who meet specific criteria similar to the Natural Resource Conservation Service's (NRCS) Environmental Quality Incentives Program (EQIP) and Wildlife Habitat Incentives Program (WHIP). For example, the significant interest in local food expressed by respondents in the region suggests a community priority for efforts that focus on the most productive agricultural lands in order to protect food production capabilities. Study results also suggest that the role of farmland in providing scenic quality and cultural heritage amenities should receive expanded recognition. When farmland is developed, the community loses these important amenities. Impact fees could be imposed on development to compensate the community for the loss of these assets.

Visitor Preferences for MFA

It is significant for four reasons that visitors recognize the benefits of the region's multifunctional agriculture. First, it reinforces the fact that our local food and agriculture system is not a closed system. Most food system advocates recognize that local systems rely on imports of things like seed, livestock, fuel, and equipment from other areas for production to take place; systems typically export food and fiber products. This research supports the idea that local agricultural systems also provide nonfood exports in the form of tourism benefits. Because these exports are not priced like most agricultural products, farmers are not financially benefiting from the aesthetic and other benefits provided to visitors.

Second, the fact that visitors to a region can experience a familiarity with the landscape and its elements without living there suggests the area is offering desired and appreciated tourism experiences. This is significant because unlike the Amish region of Pennsylvania or Napa Valley of California, there is no coordinated marketing plan for agricultural tourism in western North Carolina. This suggests opportunities for individual farms and tourism development authorities to expand their efforts to attract visitors seeking this type of experience.

Third, because the study documents that tourists value the region's farmland and derive significant benefits from it, visitors to the region should be included as potential sources of revenue for farmland protection. Specific ideas for doing so are included in the following section.

Fourth, because visitors express preferences similar to those of residents, efforts to protect what is important to residents will have benefits for visitors and vice versa. In other words, agricultural

land protection could serve to promote tourism development (or maintenance) for the region. Thus local tourism development authorities should be solicited as partners in local farmland protection to maintain the region's investment in tourism. In the study region, Buncombe and Haywood counties have tourism development authorities that generate revenue from a hotel occupancy tax; in addition to marketing the region's tourist amenities, these funds also contribute to projects that generate additional room nights such as parks, music venues, and museums (Shrestha, 2010). Since farmland attracts tourists, land protection could also be included in the list of eligible spending categories.

Financing Farmland Protection

As mentioned earlier, tailgate markets and CSA enterprises are popular in western North Carolina; local food's ranking as the most frequently cited benefit of farmland in this study supports their value to respondents. The fact that respondents both indicate they think private decisions impact others and state a desire for more government action on farmland protection issues suggests a collective action framework. However, participants in this study report they do not want government to be in charge of a farmland protection fund financed by their donations. The recognition of MFA by both residents and visitors thus suggests the need for additional tools for capturing the value that farmers provide for the many nonfood benefits that are simultaneously produced with agriculture.

To capture a greater amount of both visitor and resident dollars to protect farmland, a program could be created that asks restaurant operators to invite diners to round-up their total or add a donation to their bill that would go to a local nonprofit farmland protection fund. Given that over 120 restaurants in the region actively support the local food movement (ASAP, 2010), it might not be difficult for such a program to gain momentum in the region.

Another tool could target those who particularly value the scenic quality amenities associated with farmland by providing a mechanism to compensate farmers for the scenic beauty their land and agricultural practices provide. While there are likely thousands of parcels that could qualify as "scenic" in this region, to make the program manageable the program could target lands within the Blue Ridge Parkway viewshed and other designated scenic byways popular with tourists, or those within the viewsheds of homes whose real estate listings mention scenic views. After placing brochures in hotel rooms or at rental car counters, visitors could be asked at check-out if they would be willing to make a donation to protect the scenic beauty of the region by protecting farmland, and businesses could be asked to match their customers' contributions. Since respondents clearly indicated a preference for nonprofit coordination of donated funds, a local nonprofit could be designated to collect donations to finance the protection of cultural assets and heritage practices. While the economic feasibility of these ideas needs further research, it is clear that there are many opportunities for creative financing for farmland protection policies that could work in this region.

Application to Other Regions

While these specific results and recommendations may not be directly transferable, there are several ways that this research can be useful to other regions. First, it provides a model for how to engage communities in the process of inventorying the many benefits that agriculture provides. The methods used here emphasize a "from the ground up" approach to identifying the benefits of MFA. The precise portfolio of benefits will likely look different in other parts of the country or have different relative levels of importance than in western North Carolina. For example, the benefits that people derive from farmland that is predominantly pasture may differ significantly from the benefits they perceive from tilled land. The pattern of farmland — whether there are large areas of contiguous farmland or if housing or other visual intrusions are present — may also affect the perceived scenic amenities associated with farmland (Irwin et al., 2003). Future research should collate and compare the benefits of MFA that accrue in different geographic regions so we

can learn how space and place affect demand for MFA in the U.S. Because of the United States' diversity in agriculture and extensive geographic footprint, the demand for MFA is likely to look different than what the literature currently documents.

Second, agricultural regions without a developed agritourism sector should be interested to learn that agricultural lands can play a significant role in tourism development even when agritourism itself is not developed. An inventory such as the FVP that makes the invisible functions of agriculture more visible can help decision-makers better understand the role natural resources play in economic development, perhaps leading to new marketing opportunities.

A third way that this research may be helpful to other regions is by providing a portfolio of ideas for engaging stakeholder groups in farmland preservation efforts. Whether the goal is to raise funds to finance farm protection or to engage citizens and policy-makers in the process of prioritizing tracts for consideration in a community's farmland protection plan, it is useful to know which messages resonate among diverse citizen groups in a community.

Knickel, Kröger, Bruckheimer, and Engwall (2009) call for better links between qualitative and quantitative methods of evaluation as well as improved data on multiple functions that go beyond production statistics. Thus a final way that our study can be applied to other regions is through recognizing how various types of data can be used to inform local policy and evaluation. For example, our method of focus groups, surveys, and PGIS techniques could be replicated in the same five-year intervals as the Census of Agriculture, thus providing qualitative data on the perceptions and preferences of community members that would align with the quantitative data provided by the census. Over time, this would allow community members and officials to determine how *perceptions* of agriculture change along with the changing *practices* of agriculture. Research-based policy decisions could be implemented to improve both efficiency of policy actions and community outcomes.

Limitations and Suggestions for Future Research

There are three limitations of the method described in this research. First, the techniques used in this project require financial and time commitments that are not readily available in many communities. Second, because of the time commitment required of participants to meaningfully engage in the process (either by attending a focus group or PGIS session, or completing a detailed questionnaire in a survey), many individuals will not participate. Those who are most interested in the MFA are also those who are most willing to take the time to participate. While the engagement of stakeholders is essential to effective research, this self-selection can lead to biased results if the self-selected participants are not representative of stakeholder groups. Future research could address these issues by refining the method so that its replicability is streamlined and participant time commitment is minimized while also ensuring representative participation from stakeholder groups.

A final shortcoming of the method outlined here is that, like most research, it is static; it provides a baseline inventory of the benefits of a region's MFA. With changes in farm operation, land use, and population, it is likely that the portfolio of benefits provided by MFA will also change. Research to inventory the benefits should be replicated at regular intervals to ensure continued compatibility with community preferences. This longitudinal effort to link community input with outcomes would be similar to the successful Census-Based Impact-Oriented (CBIO) Approach used in developing countries to monitor and direct public health expenditures (Perry, Robison, Chavez, Taja, Hillari, Shanklin, & Wyon, 1999). Regular inventories would allow us to monitor over time the benefits of MFA as well as the effectiveness of farmland policies designed to protect these benefits.

Conclusion

Recognizing agriculture's multifunctionality serves several objectives. First, it allows community members and local decision-makers to better understand their community's assets. Second, it can help policy-makers identify sources of market failure and potential remedies for those failures, such as ways to compensate farmers for the unpriced services they provide to communities. Finding a way to compensate farmers for the currently unremunerated functions of agricultural lands can help keep land in farms. Third, MFA may contribute to the sustainable development of rural areas if it promotes efficient resource allocation (Garrod et al., 2006; Hediger & Knickel, 2009).

This research demonstrates a method for communities to inventory the multiple functions of agriculture. Results suggest that a portfolio approach is necessary to understand and sustain local agricultural economies; this reflects the portfolio of agricultural values (and assets) that we hold. Expanded use of community-based methods for documenting agriculture's multiple functions will lead to an improved understanding of U.S. agriculture and provide opportunities for effective monitoring and assessment of agricultural and land-use policies.

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"Food security" and "food sovereignty": What frameworks are best suited for social equity in food systems?

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Abstract
This paper contextualizes the discourses of "food security" and "food sovereignty" within the history of the global industrial food system and aims to increase understanding of these different discourses among food activists, and food justice activists in particular. The paper highlights some of the epistemological, methodological, and ethical challenges of defining, measuring, and alleviating food insecurity, using the U.S. as a case study. As suggested in the conclusion, social scientists must continue to engage with activists and through campus-community partnerships to help decipher the trade-offs and implications of employing different discursive frameworks.

Keywords
campus-community partnerships, engaged research, food security, food sovereignty, right to food

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Introduction
During the recent years of alternative agrifood activism, there has been an increasing conflation of discursive frameworks terms in use. The goal of this paper is to increase awareness among users of the agrifood activist toolkit — the repertoire of discursive, political, and communicative strategies among activists — by delineating the concepts that often frame our work. In the pages that follow, I demonstrate how the evolving and pluralistic discourses of "food security" and "food sovereignty" parallel the development of a global industrial food system characterized by privatization, deregulation (or neoregulation), trade liberalization, and increased food insecurity and hunger. It is common practice among some scholars and activists alike to pivot the interests of multilateral organizations, transnational corporations, and governmental agencies against nongovernmental organizations (NGOs), Third World farmers, peasants, indigenous peoples, and community-based groups. This paper does not continue with this trend since, as I will demonstrate, alliances and divisions are much

more fluid when we delve into the underpinnings of global–local food relationships.

"Food security" and "food sovereignty" as theoretical bodies and operational approaches are worthy of rigorous comparison and contrast because both have played a significant role in responding to "food insecurity." Food insecurity is defined as prolonged lack of access to enough food to meet basic needs (Food and Agriculture Organization (FAO), 2009). The Food and Agriculture Organization of the United Nations (FAO) estimated that in 2010, 925 million people in the world experienced chronic hunger (FAO, 2010), a small decrease from 2009 when it estimated 1.02 billion (FAO, 2009).[1] Despite popular misconceptions, food insecurity and hunger are real domestic problems in the United States; the United States Department of Agriculture[2] (USDA) found that in 2009, 14.7% of U.S. households (17 million) were food insecure (Nord, Coleman-Jensen, Andrews, & Carlson, 2010), meaning that at some time during the year, these households had difficulty providing enough food for all their members. Additionally, 5.7% of U.S. households experienced "very low food security," meaning that food intake among members was substantially disrupted at some point during the year (Nord et al., 2010). Only a year prior, Nord et al. (2009) observed that the prevalence of food insecurity had increased from 11.1% (13 million households) in 2007 to 14.6% in 2008 and was highest since nationally representative food security surveys were initiated in 1995.

From the perspective of the international peasant organization Via Campesina (regarded as the global leader in the food sovereignty movement), along with others mobilizing for alternative food movements, food security begins and ends with food sovereignty (Patel, 2009). While food sovereignty represents a form of resistance to neoliberal economic development, industrial agriculture, and unbalanced trade relationships, and although some ambiguity surrounds the term, at its most basic form food sovereignty is the people's right to determine their own agricultural and food policies (McMichael, 2008; Pimbert, 2007; Rosset & Martinez-Torres, 2010). One reason that food sovereignty advocates deem as ineffective past and ongoing "food security" approaches to food insecurity and hunger is because these approaches have not elicited participation by marginalized food communities in every stage of the planning process, from defining and measuring to designing policies (Patel, 2009; Pimbert, 2007; Schiavoni, 2009; Windfuhr & Jonsén, 2005).

Alternative food movements are becoming increasingly popular in the U.S. (Allen, 2004; Wekerle, 2004), some emerging from marginalized communities that have adopted the rhetoric of "food sovereignty" as it has been used by Via Campesina (Rosset & Martinez-Torres, 2010). The U.S. Food Sovereignty Alliance, formed in 2010, is also championing the causes of broader adoption and implementation of food sovereignty principles throughout the country. These U.S.–based alternative food efforts tread against the needs-based programs and policies dominated by the rhetoric of "food security" that have performed inadequately in responding to rising food insecurity (de Schutter, 2009; Mittal, 2009; Pimbert, 2007). Interestingly, however, some of these efforts also replicate structural inequalities reminiscent of the global industrial food system (Freidberg, 2004).

Another goal of this paper is to examine how food sovereignty advocates propose to shift away from food security approaches. I unpack critiques of food security to uncover a series of shifts necessary for yielding to a food sovereignty approach, and these are suggested throughout: needs-based to rights-based rhetoric; top-down to bottom-up streams of power; technocratic to participatory planning contexts; and compartmentalized to integrated food and agricultural policies.

[1] The FAO considers 1600 calories as the daily requirement for individuals.
[2] The USDA considers 2100 calories as the daily requirement for individuals.

Food Security

Understanding "Food Security": History and Revision of the Definition

The concept of "food security" was formally launched at the first World Food Conference in 1974 (Pottier, 1999). Agricultural policies typified by the Green Revolution[3] were among different strategies proposed to alleviate food insecurity. One of the key assumptions of these policies was that increased productivity, or enhanced supply of crops, would lead to improvements in economic livelihoods. In delivering agricultural inputs to resource-poor farmers in the Third World, promoters of the Green Revolution predicted increased agricultural productivity.

Higher yields abated concerns about insufficient food supplies for a rising population, and the Green Revolution was deemed a "success." These yields were assumed to provide income to poor farmers, helping them to "climb out of poverty" and to provide more food, translating into less hunger. The increases in yields among larger, wealthier farmers and enhanced supply of grains available to a growing population led many to believe that the Green Revolution had brought benefits to the Third World (Simmonds and Smartt, 1999). Skeptics of the Green Revolution, however, claim that these benefits were "distributed unevenly" (Simmonds & Smartt, 1999, p. 353). They blame similar agricultural policies for actually exacerbating the world food problem. These skeptics note that many small farmers were displaced due to labor-saving techniques and the expansion of big agriculture. Moreover, economic purchasing power became further concentrated among elites, causing an increase in the number of food-insecure and hungry people globally (Simmonds & Smartt, 1999).

It was not until the early 1980s that a parallel discourse, this time focused on demand, joined the supply-side concerns. In 1983 the FAO redefined "food security," emphasizing increased access to rather than increased production of food, having been particularly influenced by the work of Amartya Sen (1981), who argued that free-market processes actually caused — rather than remedied — famines (Pottier, 1999). World leaders and food experts revised the definition of food security at the 1996 World Food Summit in Rome and produced an "ambitious" (Katz, 2008) global commitment to halve the number of hungry and malnourished people by 2015 (FAO, 2003). Katz (2008) observes that the delegates in Rome never would have anticipated the surge in food prices and food shortages of the new millennium. The consensus among attendees at this summit was that understanding the nutritional status of vulnerable groups and individuals was much more complex than had been previously assumed (Pottier, 1999).

Maxwell (1996) contends that delegates were moving toward the "postmodern" in that the experience of food insecurity could not be tied to a single set of empirical conditions. Delegates argued that hunger and food insecurity were complex conditions experienced differently and resulting from dissimilar social, political, economic, and environmental forces. Subsequent definitions even accounted for culturally specific food preferences and socially acceptable food practices, yet "expert opinion" still overshadows the lived experiences of vulnerable groups when these definitions are operationalized (Pottier, 1999). The latest FAO definition describes food security as "a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2002).

How food security has been approached in a global context is very similar, if not shaped by, how this

[3] In response to widespread hunger and malnutrition during the 1960s, the Rockefeller and Ford foundations funded agricultural research and the transfer of technological approaches to agriculture, particularly for rice and wheat production to developing countries. New technologies in agriculture transferred to Asia and Latin America included improved varieties, chemical inputs and fertilizers, and irrigation (International Food Policy Research Institute, 2002).

concept is defined and approached by the U.S. government. Many agricultural and food development programs are historically rooted in the diplomatic relations of the United States with other countries. Despite the United States being a major player in most international programs to curtail world hunger, hunger and food insecurity are also significant domestic problems. Popular discourse in the United States has tended to focus on food insecurity and hunger as "external" problems. The idea that hunger is something happening "over there" — perhaps reinforced by U.S. leadership in foreign "food aid" programs and media portrayals of malnutrition and hunger in impoverished areas of the world, particularly Africa — has been confounded by scholarly attention to the paradoxical phenomenon of "hunger in the land of plenty" (Poppendieck, 1997).

Although the importance of hunger as a U.S. policy concern can be traced back to the time of the Great Depression and when the Food Stamp Program (FSP) was first established (Biggerstaff, Morris, & Nichols-Casebolt, 2002), it was not until the presidency of John F. Kennedy in the 1960s that hunger gained the attention of a broader national public. (For an extensive history of U.S. responses to domestic poverty and hunger, see Berg, 2008, and Himmelgreen and Romero-Daza, 2010.) The television documentary "Hunger in America" and a report by a Citizen's Board of Inquiry titled "Hunger U.S.A." (Radimer, 2002) shocked audiences who were previously skeptical that hunger could exist in the "land of plenty." In the 1970s President Nixon called a White House Conference on Food, Nutrition and Health to begin conceptualizing the causes of and approaches to the issue of hunger in the U.S. (Radimer, 2002).

The United States promoted strategies for addressing the issues of domestic food insecurity and hunger as it also addressed these issues abroad. U.S.-based donors funded many of the development projects typified by the Green Revolution in the 1970s, and in the 1980s President Reagan founded the President's Task Force on Food Assistance (Wunderlich & Norwood, 2006). The task force developed more concise terms for differentiating and describing the fractured modes of access to food, consequences for nutritional status, and the physical sensation of hunger (Himmelgreen & Romero-Daza, 2010). "Food security," "food insecurity," and "hunger" emerged as conceptual and operational terms for use in formal policy. The idea behind this parsing of different frameworks was that food insecurity could exist without the physical sensation of hunger (Himmelgreen & Romero-Daza, 2010). During the 1990s an instrument for measuring household food security was established and administered for the first time, and a U.S. definition for food security was introduced (Wunderlich & Norwood, 2006):

> Access by all people, at all times, to enough food for an active, healthy life and includes at a minimum: a) the ready availability of nutritionally adequate and safe foods and b) the assured ability to acquire acceptable food in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, and other coping strategies). (Anderson, 1990, p. 1598).

Participants at the First National Conference on Food Security Measurement and Research in January 1994 established a conceptual basis for defining and measuring hunger in the United States, and developed a sample questionnaire to be administered to the population (Wunderlich & Norwood, 2006). Within a month of the conference, the USDA, along with the Census Bureau, created the Food Security Supplement (FSS) to be included with the Current Population Survey (CPS) (Wunderlich & Norwood, 2006). In 1995 the USDA established recommended daily allowances (RDAs) through the food pyramid, around which looms much controversy in both popular and expert opinion (Nestle, 2007).

The FSS includes more than 70 questions regarding expenditures for food, various aspects of food spending behavior and experiences during the 30 days and 12 months prior to the interview, use of federal and community food programs, food suffi-

ciency and food security, and coping strategies (Wunderlich & Norwood, 2006). Contained within the FSS is the Household Food Security Scale Module (HFSSM), a set of 10 questions for households without children and 18 questions for households with children. The HFSSM has been included in the CPS every year since 1995, allowing the USDA to monitor the prevalence of household food insecurity (Wunderlich & Norwood, 2006). Wunderlich and Norwood (2006) note that, "prior to the development of the current standardized measure of the prevalence of household food insecurity in 1995, estimates of the prevalence of lack of access to food varied widely and there was little consensus over which measure was most accurate" (p. 23). The HFSSM has since been used in other surveys, including many statewide efforts to understand regional differences in the food security of households (Wunderlich & Norwood, 2006). The California Health Interview Survey (CHIS) serves as one such example, having employed the short six-item food security module, adapted from the HFSSM, since 2001.[4]

The USDA conceptualizes and measures food insecurity at the household level and defines *food insecurity* as, "uncertain, insufficient, or unacceptable availability, access, or utilization of food" (Wunderlich & Norwood, 2006, p. 4). Wunderlich and Norwood (2006) explain that households are classified as food secure, low food secure, or very low food secure. Questions probing at "frequency and duration" are given much weight, as "more frequent or longer duration of periods of food insecurity indicate a more serious problem" (Wunderlich & Norwood, 2006, p. 4).

In 2006, the USDA revised its terminology in an attempt to reflect more objective diagnoses of food insecurity. More specifically, the term "hunger" was eradicated from the terminology, explained by Haering and Syed (2009, p. 13):

> The purpose of the elimination of the word hunger from the classification schemes was to reflect both the evolution of the understanding of hunger as a phenomenon distinct from, though closely related to, food insecurity as well as to recognize the limitations of extant measurement instruments for accurately gauging hunger.

Some responded to this change by accusing the USDA of "depoliticizing" the experience of food insecurity and hunger by "swaddling" the issue in "the cloak of science" (Allen, 2007). Himmelgreen and Daza (2010) reference studies by Nord and Radimer that demonstrate how current terminology as implemented by the USDA does not correspond to the lived experience of hunger, and raise concerns about potential consequences for food assistance, specifically that such discursive changes will translate to an obstruction of resources (e.g., financial capital, food) for those occupying this empirical reality. The USDA revised its terminology again in regard to the food stamp program, which since 2008 has been referred to as the Supplemental Nutrition Assistance Program (SNAP) and invited states to further rebrand the program (e.g., CalFresh since 2010 in California). Social scientists have called for more research that examines how such discursive changes to policy shape public perceptions of social and economic conditions and garner or diminish support among voting constituencies (see for example Himmelgreen and Romero-Daza, 2010, among others).

Understanding "Food Security": Application and Praxis

On an international scale, lack of coordination among different groups and sectors, lack of monitoring of programs, and lack of program evaluation are behind most impediments to success or causes for failure of "food security" programs (de Schutter, 2009). Olivier de Schutter (2009), the UN Special Rapporteur on the Right to Food, calls attention to perhaps the greatest impediment to "food security" approaches, which is the political unwillingness to address the structural causes underlying hunger and barriers to access, namely

[4] See more about the California Health Interview Survey at http://www.chis.ucla.edu/

how state policies, multilateral organizations, transnational corporations, and other nonstate actors cause or allow for the persistence of hunger.

Multilateral financial aid and lending institutions such as the World Bank and the International Monetary Fund, and international trade agreements promoted through the General Agreement on Tariffs and Trade and the World Trade Organization, have significantly shaped agricultural production and policies (de Schutter, 2009). In this way, food has been governed "within and beyond nation-states" (Phillips, 2006, p. 42), and rarely have policies dealing with trade and deregulation been integrated with policies to address food insecurity and the human right to food (Pottier, 1999; Spieldoch, 2007). Pottier (1999) discusses how this is problematic: "Acknowledgement of how food domains interconnect is vital if policy-makers are ever going to write integrated food policies, as opposed to agricultural policies" (p. 193) and that policymakers need to "end the practice of compartmentalizing the food question into what they deem to be manageable sectors" (p. 194).

Food sovereignty advocates view governments as unfairly obliged to multilateral donors of whom there is minimal oversight. Many of these donors in fact are supporting the "Green Gene Revolution" for Africa, funded by the U.K. Department for International Development, the Rockefeller Foundation, and the Bill & Melinda Gates Foundation, with buy-in from multiple governments. To date, the Gates Foundation has awarded over US$160 million through its Agricultural Development program, which includes developing nutritionally enhanced crop varieties for this impending "green" revolution (Doughton, 2011). Several critics have noted that such a narrow focus on single crops treads against the advice of expert panels on world hunger whose argument around the difficulties in transferring technologies to resource-poor farmers resonates with critiques of the Green Revolution of the 1960s and '70s (Doughton, 2011). In recent years, governments have increasingly prioritized these technocratic solutions to food insecurity, working closely with private donors to manufacture drought-tolerant, disease-tolerant, and biofortified crops as a primary way to alleviate famines. In the realm of corporate and cultural politics, governments have yielded to transnational corporations whose activities obfuscate liberal understandings of "sovereignty" and citizenship (Ong, 2006), often proving detrimental for "food citizenship" (Phillips, 2006). Multilateral and bilateral agreements also threaten the decision-making of sovereign groups through structural adjustment programs and misdirected lending activities that are frequently culturally inappropriate, underestimate local knowledge, and exacerbate existing food insecurities (Holt-Giménez, 2009).

U.S. Programs for Food Security

In the United States, food insecurity currently affects about 50.2 million people, or close to one-fifth of the civilian population (Nord et al., 2010). This national epidemic is estimated to cost about US$90 billion per year in increased medical care costs, lost educational attainment and worker productivity, and investment burden into the emergency food system (Brown, Shepard, Martin, & Orwat, 2007).

The USDA spends 48.4%, or US$45.39 billion — the largest share of its total annual budget — on food stamps and nutrition programs (Imhoff, 2007). Since the recession that began in 2008, enrollment in food assistance programs has soared (DeParle & Gebeloff, 2009), growing by nearly 40%, or 10 million recipients, from 2007 to 2009 alone (DeParle & Gebeloff, 2009), for a current total of 43 million (Food and Nutrition Service (FNS), 2010). SNAP feeds one in eight Americans and one in four children (DeParle & Gebeloff, 2009) and is expanding at about 20,000 people a day (DeParle & Gebeloff, 2009). However, SNAP,along with other forms of federal food assistance — school lunch program, school breakfast program, and the Women, Infants, and Children (WIC) program, etc. — have been criticized for a number of shortcomings and inadequacies in fulfilling the parameters of household food security. Data on food-insecure households from specific geographic regions of the United States reveal severe underutilization of fed-

eral programs (Berg, 2008). In California, for instance, over 50% of households that are eligible for food assistance do not apply (DeParle & Gebeloff, 2009). Many U.S. households may prefer instead to obtain assistance from private programs such as food banks, food pantries, and other charitable nonprofits that distribute food.

Poppendieck offers explanations for the underutilization of federal food assistance programs: "People [are] unaware of their eligibility, [do] not believe that they need the stamps, or [feel] that the costs of participation in terms of stigma, travel to the program office or the rigors of the certification process outweigh the benefits" (1997, p. 155). The idea of formal "food assistance" in place of other social services or community economic development may also dissuade eligible individuals, in part because "resolving problems of hunger and food insecurity requires more complex solutions than simply providing food to the needy" (Pothukuchi, 2004, p. 360). Moreover, energy-dense but nutrient-poor foods characterize many of the items being subsidized through federal food assistance and may actually contribute to malnutrition among populations dependent on these programs (Townsend, Aaron, Monsivais, Keim, & Drewnowski, 2009).

Conversely, some have argued that an anti-hunger approach, which promotes use of federal food assistance programs and healthy eating habits, may best address the "structural issues" around food insecurity because it reduces the need for food banks as "welfare agencies" (Husbands, 1999, p. 108). In theory, an antihunger approach also focuses on mitigating food insecurity through policy by conveying the needs of food-insecure households to legislators, and recognizes that underserved food-insecure individuals desire self-sufficiency, have preferences in regards to what they eat, and want a more active role in improving their own food security (California Food Policy Advocates (CFPA), 2010; Husbands, 1999).

Despite contributions by the USDA to welfare assistance, and prior commitments to the Healthy People 2010 initiative with the priority of reducing national food insecurity by half (to 6%), the U.S. has made no advances in this direction, according to Chilton and Rose (2009). Conversely, recent results of the HFSSM demonstrate that the prevalence of household food insecurity is at its highest since the establishment of the survey in 1995 (Nord et al., 2009). Causes for this increase are linked to the absence of a board or agency that "takes the lead in reducing food insecurity, not just measuring it" (Chilton & Rose, 2009, p. 1205). Pothukuchi argues for structural changes such as "living wages, better jobs, education, and health and child care," that should be at the forefront of policy reform for improving food security (2004, p. 360). Needs-based, federal food assistance programs as response to national food insecurity at best mitigate the experience of food insecurity but do not undermine the structural causes of hunger, which continue to disproportionately affect certain households more than others. For instance, rates of food insecurity are substantially higher than the national average for households with incomes below the official poverty line (43%), households with children headed by single women (36.6%) — almost 3 times the national average — or single men (27.8%), Black households (24.9%), and Hispanic households (26.9%) (Nord et al., 2010). And "very low food security" is higher than the national average (5.7%) for households with children headed by single women (12.9%), women living alone (7.4%), men living alone (7.1%), Black and Hispanic households (both at 9.3%), households with incomes below the poverty line (18.5%), and households located in principal cities of metropolitan areas (6.8 %)[5] (Nord et al. 2010).

Food Sovereignty

Understanding "Food Sovereignty": Origins of the Concept

On the difficulty of recounting the historical and conceptual foundations of food sovereignty, Patel (2009) observes, "The term has changed over time,

[5] Food insecurity rates increased from 2007 to 2008 but remained more or less unchanged in 2009 for all groups mentioned.

just like 'food security,' but while it is possible to write an account of the evolution of 'food security' with reference to changing international politics, it is much harder to make coherent the changes with 'food sovereignty'" (p. 666). The origins of food sovereignty in scholarly discussion are relatively recent. This rather short history is characterized by the concept emerging primarily from the agrarian reform movement and responses of small farmers and peasants to the global industrial food system (Rosset & Martinez-Torres, 2010). However, the human right to food and rights-based approaches to food security that predate food sovereignty provide a global and national context to better comprehend the circumstances under which food sovereignty proponents encounter opposition. Resistance to rights-based food systems also reveals why food-security approaches continue to dominate the status quo.

The Human Right to Food

> A human rights framework repositions our understanding of food insecurity to acknowledge and actively address its social and economic determinants. It provides a venue for public participation in the food and nutrition discourse from people most affected by food insecurity. Perhaps most importantly, it provides a mechanism through which the general public can hold the U.S. government accountable for making progress in ending food insecurity. (Chilton & Rose, 2009, p. 1203)

Food has appeared in the official language of human rights since the first signing of the Universal Declaration of Human Rights (UDHR) under the auspices of the United Nations in 1948. Article 25 of the UDHR stated that everyone had "a right to a standard of living," including the right to food and the right to be free from hunger (Chilton & Rose, 2009, p. 1206). The International Covenant on Economic, Social, and Cultural Rights (1966) later included "freedom from hunger" as a fundamental human right and as an obligation of states to improve food production and distribution systems for equitable access. When faced with the question of whether to adopt the notion of food as a basic human right at the Rome Declaration on World Food Security in 1996, the U.S., along with Australia, stood in opposition to all other countries that were in support of the measure. Terms were again ratified in 1999 to explicate the right to food and to oblige states in respecting, protecting, and fulfilling this right. The 1999 document defined the right to food as, "when every man, woman and child, alone or in community with others, has physical and economic access at all times to adequate food or means for its procurement" (Committee on Economic, Social, and Cultural Rights, 1999).

Right to food discourse and rights-based food system approaches remain controversial in the U.S.; while the government officially embraces the UDHR, the Department of State insists that the Constitution does not protect or recognize economic, social, and cultural rights, including the right to food (Messer & Cohen, 2007). In fact, the U.S. has repeatedly "opposed formal right-to-food legislation as overly burdensome and inconsistent with constitutional law" (Messer & Cohen, 2007, p. 1) and votes against the annual Right to Food Resolution in the U.N. General Assembly, "usually as the sole dissenter" (Messer & Cohen, 2007, p. 16). While the U.S. has signed the International Covenant of Economic, Social and Cultural Rights — indicating that it agrees with the tenets — it has not *ratified* the covenant (meaning that they are not willing to hold themselves legally accountable for implementation) (Chilton & Rose, 2009).

Reasons for voting against the Right to Food Resolution include fears that the right to food is "associated with un-American socialist political systems" (Messer & Cohen, 2007, p. 2), that fulfilling such legislation would be too expensive, and that rights-based approaches do not culturally resonate with the American model of self-reliance (p. 2). Advocates reject each of these claims, arguing against dissenters that the right to food *is* protected by the U.S. constitution, fits into President Franklin D. Roosevelt's concept of "freedom from want," and thus exemplifies an American political value. In addition, right-to-food advocates claim that programs would increase cost

effectiveness and reduce expenditures, and that "the right to feed oneself" resonates with American ideas of self-reliance (Messer & Cohen, 2007).

Aside from a formal right to food, rights-based frameworks are also absent from how the U.S. government defines and measures food security (Chilton & Rose, 2009; Kent, 2005). Chilton and Rose explain:

> Although the terminology used in [the HFSSM] report should be easily understood by all concerned, the report is often misunderstood by the American public and by the media. Of greater concern are changes to the definition of food insecurity (e.g., eliminating the word *hunger* from the most severe form of food insecurity) made by the US Government in 2006 without public participation. (2009, p. 1205)

Messer and Cohen argue that continued opposition by the U.S. toward rights-based food system approaches undermines all other commitment to the UNDR, upsetting the "basis for world civil and political order" (2007, p. 3), reinforcing cultural relativist interpretations of human rights, and allowing for continued support of neoliberal economic policies as the path to global food security. In contrast, proponents of the right to food argue against needs-based approaches that do not consider issues of land reform, health, and education in the formation of food security policies (Kent, 2005). Within a needs-based approach, citizens instead become passive beneficiaries of nutritional handouts rather than "claims-holders who mobilize around human right to food demands and hold governments accountable" (Messer & Cohen, 2007, p. 18). Proponents of rights-based approaches also argue that opposition by the U.S. to right-to-food legislation confounds notions of citizenship and the rights that go with it (Anderson, 2008; Holt-Giménez, 2009; Schiavoni, 2009; Via Campesina, 2009).

Right to Food and Food Sovereignty

First defined in 1996 by Via Campesina, food sovereignty is the "people's right to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems" (Via Campesina, 1996). Food sovereignty may delve deeper than food security into the driving forces of food insecurity, in that "it proposes not just guaranteed access to food, but democratic control over the food system — from production and processing, to distribution, marketing, and consumption" (Holt-Giménez, 2009, p. 146). Right-to-food rhetoric articulates closely the principles of food sovereignty in that "local small-farm agriculture should receive priority in national policies and that global trade agreements and aid policies must not undermine sustainable rural livelihoods in either the North or the South" (Messer & Cohen, 2007, p. 15). Support by the U.S. of organizations such as the WTO and others that are liberalizing trade and promoting neoliberal policies has been interpreted as a violation of food sovereignty and an affront to the human right to food (Rosset & Martinez-Torres, 2010). An important lesson from recent trends in the global industrial food system is perhaps that food sovereignty, and the right to food, as powerful ideologies and palpable movements exist whether or not governments choose to recognize them.

Food Sovereignty vs. Food Security

While the rhetoric of "food security" dominates international aid and U.S. agrifood policies, many NGOs, human rights organizations, and small farmers strongly favor replacing the dominant rhetoric with "food sovereignty" (First Nations Development Institute, 2004; Phillips, 2006; Pimbert, 2007, 2009; Rosset & Martinez-Torres, 2010; Spieldoch, 2007). As the right to autonomous food systems, food sovereignty is about radically restructuring the streams of power that control and distribute resources, a stance rarely adopted by food-security advocates.

Consistent with the philosophy put forth by Freire's 1970 *Pedagogy of the Oppressed,* Meares argues

"the only valid transformation in a community is one in which people are not just liberated from hunger but made free, or enabled, to create, construct, and produce" (1999, p. 92). In practice, food security approaches have rarely cultivated self-reliance. Instead, organizations operating within this approach have often reinforced trickle-down schemes for distributing resources to vulnerable populations (Anderson, 2008). Such practices negate human right aspects of food and replicate paternalistic relations by food-secure groups toward food-insecure groups. Anderson summarizes, "The right to food cannot be met long-term through external donations. It requires local control over practices and policies to reinforce the ability to grow or buy stable amounts of nutritious food for one's household and community" (2008, p. 602). Advocates argue that food sovereignty cannot be accomplished without recognizing the human right to food, and this implies a tremendous shift in power, from centralized to community-based decision-making, and reorganization of the relationship of multilateral organizations and national governments to vulnerable groups (Patel, 2009).

Food sovereignty is a thread in the larger political debate on sovereignty and parallels indigenous peoples' movements as well as claims for group sovereignty in other contexts (Pimbert, 2007). A food-sovereignty approach contests the traditional position of authority assumed by Western researchers to instead include "plural forms of knowledge within a more comprehensive, power equalizing dynamic of participatory learning and action" (Pimbert, 2007, p. 10). Community food assessments (CFAs) and associated planning activities provide an example of the democratization of research and opportunities for autonomous learning and action (First Nation's Development Institute, 2004; Pothukuchi, 2004). CFAs attempt to provide more dynamic measurements of household and community food security than those provided through national and statewide surveys (Allen, 2007; Community Food Security Coalition (CFSC), 2002; Pothukuchi, 2004; Pothukuchi, Joseph et al., 2002). Moreover, CFAs capture nuanced accounts of the experience of food insecurity as they manifest at the level of communities and households (Pothukuchi, 2004; Pothukuchi, Joseph et al., 2002). Food-sovereignty assessments provide another example of community-driven research and policy (First Nation's Development Institute, 2004).

In theory, food-sovereignty approaches tread against the centralized, technocratic methods and solutions administered by international and national forms of "aid," yet without any prescribed method for doing so. As anthropologists and other social scientists have campaigned for more "open" definitions of food security and criteria for evaluating food insecurity (Pottier, 1999), the concept of food sovereignty prioritizes open participation by food-insecure groups and individuals in the formation of food policies.

Interpretations of Food Sovereignty

Some scholars have attempted to bring together different manifestations of the transnational movement, perhaps to instill it with more coherence and legitimacy, especially for the sake of gaining attention by multilateral groups and other decision-making bodies. These authors (e.g., Michel Pimbert, Eric Holt-Giménez, Raj Patel) seem concerned with conveying a sense of solidarity within the food-sovereignty movement, despite concerns about it being monolithic, recognizing the movement's diversity but also arguing for some degree of cohesion.

Pimbert for instance examines the activities of community-based organizations composed of farmers and peasants abroad, arguing that these groups sustain "ecologies, livelihoods, and the flexible governance of food systems" (2009, p. 7), yet must be able to do so while responding to the ecological and social characteristics of a given environment. He argues that farmers and peasants contest "liberal understandings in which citizenship is viewed as a set of rights and responsibilities granted by the state. Instead, citizenship in the context of locally-determined food systems is claimed, and rights are realized, through the agency and actions of people themselves" (Pimbert, 2009, p. 48). Pimbert (2009) concludes that communities

striving for food sovereignty must realize and practice "emergent" rather than conventional forms of citizenship.

Others perceive the transnational social movement as more fragmented. Holt-Giménez (2009) identifies local organizations of peasants and farmers as representing one "current" of food sovereignty, while another current is witnessed in the activities of NGOs. He argues that adversarial relationships between these two currents stem from the different "political and institutional origins" (Holt-Giménez, 2009, p. 147) that inform group goals. He explains that while peasant organizations and federations are agrarian-focused (with the goal of maintaining rural livelihoods and traditional farming practices), smallholders working with NGOs are focused on promoting sustainable agriculture (ecologically sound and socially equitable farming practices). However, Holt-Giménez speculates that the recent world food crisis may be necessitating more collaboration between these currents. Similar trends have been observed in the U.S. between sustainable agrifood movements that had been led by predominantly Anglo, middle- to upper-class constituencies, and food and/or environmental justice movements that have founded by low-income groups and minorities (Guthman, 2008). Practicing food democracy as expressed through the formation of food policy councils and areas of civic agriculture is how certain groups propose to bridge racial, ethnic, cultural, and socioeconomic divides, promoting collaboration through community-based food policy-making, and revitalizing relationships based on reciprocal exchange (Harper, Shattuck, Holt-Giménez, Alkon, & Lambrick, 2009; Pothukuchi, 2004, 2007).

The discourse of food sovereignty has not been as widely applied to efforts in the U.S. as it has in other parts of the world, although many U.S.-based organizations are engaged in the fight for food sovereignty abroad (e.g., the U.S. Food Sovereignty Alliance). Instead, many of the movements for social, ecological, and economic justice around food have emphasized the discourse of food justice and community food security.

The concept of community food security "emerged from the North American context in the late 1980s and early 1990s to expand international food security theory beyond the medical model developed by international health organizations and to include more subjective dimensions of hunger" (Johnston & Baker, 2005, p. 314). Lobbying efforts for funding community food security within the 1995 U.S. Farm Bill provided an opportunity for "defining a common position among a diverse group of activists, community-based organizers, and academic researchers and practitioners" (Hamm & Bellows, 2003, p. 38). As a result of these efforts, the 1996 Farm Bill included the Community Food Security Act with a pool of annual funds (US$5 million) to support community food security projects through the Community Food Projects (CFP) Competitive Grants Program (Tauber & Fisher, 2004). Although the granting program has been important to community food security efforts, it makes up a negligible proportion of the total USDA budget (US$87 billion) and thus is only a minor area of national concern and litigation.6 The Community Food Security Coalition (CFSC) is a nonprofit organization based in the U.S. whose mission is "building strong, sustainable, local and regional food systems that ensure access to affordable, nutritious and culturally appropriate food for all people at all times" (Tauber & Fisher, 2004, p. 16). The CFSC encourages self-reliance and change initiated by the grassroots through training, networking, and advocacy (Tauber & Fisher, 2004). At the 2009 annual meeting in Des Moines, Iowa, the CFSC awarded the first-ever Food Sovereignty Prize to Via Campesina, not coincidentally the same week that the World Food Prize, honoring achievements in plant breeding and increased crop productivity, was bestowed on scientist Gebisa Ejeta at the city's capital building. The CFSC also featured the launch of the U.S. Food Sovereignty Alliance at its 2010 annual meeting in New Orleans.

[6] Between 1996 and 2003, more than US$22 million in grants was distributed to 166 awardees (Tauber& Fisher, 2004).

Challenges to Food Sovereignty; Opportunities for Social Scientists and Practitioners

Challenges to and tensions within the food sovereignty movement occur across multiple geopolitical scales and speak to the unwillingness of some groups to relinquish power and other groups to organize. Challenges may be witnessed through industry-government partnerships, transnational corporations, and multilateral groups promoting neoliberal policies that threaten food democracy and participation by vulnerable groups in the food system. Tensions arise from discontinuity among transnational social networks, community-based groups, organizations, and socially constructed markers of difference (i.e., race, ethnicity, class, gender, occupation, and citizenship). However, the host of limitations to food sovereignty movements also represent areas ripe for collaborative applied research (i.e., campus-community partnerships), a process that may also placate certain tensions through the strategies of broad citizen engagement, co-production of knowledge, and shared research benefits. The autonomous nature of food sovereignty, both in its approach and by definition, has served dually as a major strength and weakness of the movement. Different groups have adopted the term in different ways. At the Forum for Food Sovereignty (also known as Nyéléni 2007), a global gathering of small farmers and food producers held in Selingue, Mali, a declaration with guiding principles for food sovereignty was established. Schiavoni notes how:

> These guiding principles, along with the declaration and other outputs of Nyéléni, provided necessary cohesion for the food sovereignty movement, while *leaving ample room for interpretation and local adaptation.* One point that was reinforced throughout the forum is that while it is critical to have a common framework, there is no single path or prescription for achieving food sovereignty. It is the task of individual regions, nations, and communities *to determine what food sovereignty means to them based on their own unique set of circumstances* (emphasis added). (2009, p. 685)

Yet this opportunity for interpretation of the concept may hinder the food sovereignty movement from ever developing any traction or holding up to the current world food regime as a viable alternative for addressing food insecurity (McMichael, 2008, 2009). Furthermore, the basic guidelines for food sovereignty are so general that *everyone* is included in the movement. In referring to the definition by Via Campesina, Patel writes, "The phrase 'those who produce, distribute and consume food' refers, unfortunately, to everyone, including the transnational corporations rejected in [a latter portion of the declaration]" (2009, p. 666). Patel also notes a "glossing-over" in the definition, "of one of the key distinctions in agrarian capitalism — that between farm owner and farm worker" (p. 667) whose relative social positions are drastically different.

Anthropologists and social scientists can contribute to theory on food citizenship more generally, and collaborative applied research more specifically:

> Because as anthropologists, we understand food as a marker of difference, we can make important contributions to policy by demonstrating how, in different ethnographic contexts, notions of gender, ethnicity, race, age, class, and nation are drawn into service for new border-making projects that systematically exclude some people, and not others, from healthy food. (Phillips, 2006, p. 47)

Phillips (2006) continues to say that anthropologists should engage with the process of forming alternative and inclusive spaces of food governance. Herein lies another contradiction of the concept of food sovereignty. Patel claims:

> To demand a space of food sovereignty is to demand specific arrangements to govern territory and space. At the end of the day, the power of rights-talk is that rights imply a particular burden on a specified entity — the state. In blowing apart the notion that the state has a paramount authority, by pointing to the multivalent hierarchies of

> power and control that exist within the world food system, food sovereignty paradoxically displaces one sovereign, but remains silent about the others. *To talk of a right to anything, after all, summons up a number of preconditions which food sovereignty, because of its radical character, undermines* (emphasis added). (2009, p. 668)

In other words, rights as discussed in the liberal sense are recognized by and actualized within the context of states. To dismantle the authority of the state, a prospect favored by many food-sovereignty advocates, is also to dismantle a state-centric framework of rights in favor of universal human rights.

Accordingly, social scientists may have a role to play in the formation of policies and programs that honor the principles of food sovereignty. The model provided by community food assessments presents one avenue for conducting more participatory, ground-level research. Yet this model could only be improved with input from social scientists who are well acquainted with cultural nuances and the pragmatics of learning local discourse. The results of CFAs have paved the way for more participatory planning and coordination at the community level (McCullum, Pelletier, Barr, & Wilkins, 2002; Sloane et al., 2003). As researchers are called on to engage in more interdisciplinary work, particularly policy-oriented work, getting involved in CFAs and community-based food planning could become an applied area of utmost importance, especially in the context of perpetual world food crises.

Conclusion

As stated at the beginning of this paper, food security and food sovereignty may be framed through a common dialectic. I aimed to demonstrate how the emergence of "food security" and "food sovereignty" as discourses also parallel the development of a global industrial food system that has rendered food insecurity and hunger more prevalent. However, a major question that emerges from this comparison and contrast is whether these terms are irreconcilable or complementary. According to Via Campesina, food sovereignty is declared a *precondition* for food security:

> Long-term food security depends on those who produce food and care for the natural environment. As the stewards of food producing resources we hold the following principles as the necessary foundation for achieving food security. . . .Food is a basic human right. This right can only be realized in a system where food sovereignty is guaranteed. Food sovereignty is the right of each nation to maintain and develop its own capacity to produce its basic foods respecting cultural and productive diversity. We have the right to produce our own food in our own territory. *Food sovereignty is a precondition to genuine food security* (emphasis added). (Via Campesina, 1996, quoted in Patel, 2009, p. 665)

Food security, as discussed by Via Campesina, begins and ends with food sovereignty. While the current world food regime discusses food security in terms of consumption, i.e., access to nutritionally adequate and culturally appropriate foods, there is no indication of monitoring production or distribution practices. In theory, food sovereignty focuses on the governance of *all* stages of human interaction with food, from production to consumption, and guarantees a human right to food, which as discussed previously, would imply civic participation in the formation of a definition for food security. In a food sovereignty framework, the postconsumption stage of the human interaction with food also would be accounted for by resource recycling, i.e., maintaining a closed loop food system.

It seems that there is minimal opportunity for reconciliation as these concepts currently stand. Insofar that "food security" resides within a political-economic framework of global capitalism, "food sovereignty" may continue to be relegated to the margins.

Thus, it is important for actors within the alternative food movement to think carefully when employing these different discursive frameworks in order to ensure that rhetoric aligns with practice. In other words, an entity employing the discourse of "food security" is theoretically setting different objectives and desired outcomes than one operating within a discourse of "food sovereignty," as these terms are couched in particular histories and represent different value-based assumptions about the human relationship to food. While there is considerably much at stake when deciding which discursive framework is best suited to the needs of a particular community or organization, it is arguably more problematic to continue in the practice of using these terms interchangeably.

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Cultivating narratives: Cultivating successors

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Abstract

This paper analyzes oral histories of eight northwest Ohio farms on the theme of farm succession. We report several significant findings: a process of succession that is less orderly than some recent studies suggest; that farmers hope for, even expect succession but do not plan for it; the importance of wives to the adaptation and diversification of on-farm operations; and that contrary to some claims, the "farmer's boy"–type successors can innovate and adapt, suggesting the future of family farms may be in sounder hands than some believe.

Keywords

family farms, farm transfer, floriculture, intergenerational succession, Ohio, oral history

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Introduction and Background of Study

While much of the popular and academic narratives surrounding "the family farm" have focused on the various crises that have threatened their existence, family farms persist (Calus & van Huylenbroeck, 2010; Inwood, 2008; Machum, 2005). The persistence of small family farms seems

to defy the logic of industrial capitalism (Friedmann, 1978; Mann & Dickinson, 1978). Even a cursory examination of the literature demonstrates that few farmers view their activities solely through the lens of industrial farming, which emphasizes economies of scale, debt, substitution of capital for labor, and profit maximization. Research on rural survival strategies in both the U.S. and Europe point out how family farmers have diversified their operations to include alternative farm activities and/or off-farm income sources to stabilize the household's finances (Barbieri, Mahoney, & Butler, 2008; Bessant, 2006; Inwood, 2008). The purpose of this paper is to closely examine one of three themes to emerge from oral histories of northwest Ohio farmers: succession. The process of succession of family farms, that is farms whose owners manage and rely almost solely on their own and family labor to operate the farm business(es), is important not only to the families involved as a part of intergenerational wealth transfer, but also to the ongoing productivity of the nation's agricultural system.

Why Concern for the Future of Small Family Farms?
To some this seems an odd question to pose. A Google search of "why save the family farm" suggests that public sentiment overwhelmingly supports saving the family farm. However, scholarly examinations of the facutual reality of the public's view demonstrates it is inaccurate, especially relative to the current situation with regards to farming (Conkin, 2008). Family farms are still overwhelming the norm. What has changed is the number and size of farms, the mix of what they grow, and the relationship between farmers and their consumers (Census of Agriculture, 2007a).

Some (Bahls, 1997) argue that it is misplaced to be concerned about transformations in agriculture. This view holds that farmers who cannot adapt to the industrial model of farming should be forced out of business in the name of economic efficiency. They argue for the inevitable workings of the market (Conkin, 2008). This view, however, ignores the effect of current policies on favoring certain players or types of farming operations over others. Despite the reasons offered by historians and economists, there are at least three reasons to be concerned about the future of small family farms: sustainability, food security, and demographics.

Sustainability. Ikerd (2008) argues that economics emphasizes short-run self-interest and devalues stewardship. Profit-maximization, he argues, inevitably leads to the degradation of soil, water, and air, which are necessary to grow food. "Stewardship," a value that is inherent to the small family farm where a lifestyle is passed on to younger generations, is not inherently about self-interest, but about the common good, which he argues is not rational according to economics. Economic viability of the family farm is necessary, but viability and profit-maximization are not the same thing (2008, p.114). The corporatization of farming, Ikerd (2008) argues, leads to soil depletion as the short-run interests of the corporation lead the soil to be "mined," rather than managed or conserved. As more farmers decide to sell out rather than pass on holdings, this increases the pressure on them to mine the soil rather than manage or conserve it.

Food security. Food security is usually a concern in the developing world, not in the developed North. Lawrence, Lyons, and Wallington (2010) argue that food security goes beyond food availability to also encompass agricultural diversity, regional prosperity, environmental integrity, biodiversity, and the predictability and fairness of the system of production, sale, and delivery. In these areas, they argue, we see degradation, especially over the last 30 years or so. Perhaps the most telling difference between food security in the developing world and in the developed North, is that in the North food is abundant but nutritionally poor (Lawrence, Lyons, & Wallington, 2010, p. 7). In short, fresh foods are more nutritious, and fresh foods are more likely delivered locally by smaller family farms.

Demographics. Since succession can be a time of vulnerability for a farm, it is a key issue for the future of small family farms. Yet, young people are

not farming. Farming may be, demographically, the oldest occupation, with farmers averaging over 55 years (Conkin, 2008, p. 148). Add to this the low rate of succession planning among family-owned farms (Mishra & El-Osta, 2007) regardless of size, and these facts threaten the future of the family-owned farm regardless of reasons for maintaining them, even in states with anticorporate farming laws (Bahls, 1997). It is succession that is the focus of this paper.

Study Area

This research examines family farmers in northwest Ohio (hereafter NW Ohio). Historically, NW Ohio was a rich and diverse agricultural area, but it is now characterized by rapid suburbanization (from Toledo, Ohio, and southeast Michigan). Like many Midwest subregions, it has experienced a decline in the total number of family farms as well as overall acreage in agricultural production. In addition to standard agricultural products such as commodity grains, vegetables, and some livestock, the NW Ohio area also has a long history of general floriculture. NW Ohio's floriculture industry is a major production center. The region's family-based (owner-operated) floriculture industry is characterized by both large-scale and small-scale greenhouse operations serving both as wholesalers and retailers. This research project was focused initially on floriculture, as the region's industry was threatened by competition related to NAFTA[1] from the nearby Canadian province of Ontario (Reid, Smith, Gatrell, & Carroll, 2008). However, the research team quickly realized that most farmers are engaged simultaneously in traditional field crops and floriculture, and that the challenges went well beyond that of international competition.

Since 2004, NW Ohio agriculture has been the focus of an intense research initiative on greenhouse growers that has recently been expanded to include the region's entire local food system. The research program was developed in response to U.S. Representative Marcy Kaptur's interest in family farms, and U.S. Department of Agriculture (USDA) funding has been used to identify mechanisms (policy, science, and/or market-driven) to enhance the overall competitiveness of NW Ohio agriculture and enable farmers to navigate the challenging terrain of maintaining the family farm. For Rep. Kaptur, the issue of the family farm was not purely an economic concern. While family farms play a critical role in the region's economy, the values attributed to family farms and the degree to which they reflect the unique cultural heritage of NW Ohio was also a critical — albeit symbolic — concern. That is to say, increased suburbanization and heightened competition threaten the historical identity of NW Ohio and the viability of its family farms. As part of the project and under the primary leadership of the University of Toledo, a network of greenhouse growers was created to support and enhance the local industry vis-à-vis a number of projects, including collaborative marketing, bulk energy purchases, and other collective action (Reid, Carroll, & Smith, 2007; Reid & Carroll, 2006a, 2006b; Reid, Smith, Gatrell, & Carroll, 2008; Gatrell, Thakur, Reid, & Smith, 2010). In practical terms, the research project sought to establish a distinct economic cluster organized around specialized agriculture inclusive of floriculture.

Over the course of grant cycles, the team has examined the perceptions of growers, their marketing and production activities, and their business practices (see Gatrell, Reid, Steiger, Smith, & Carroll, 2009; LaFary, Gatrell, & Griffey, 2005; LaFary, Gatrell, Reid, & Lindquist, 2006). In the process, researchers recognized that the practices and strategies associated with local farmers (in this case primarily greenhouse growers) were not in the strictest sense "rational" That is to say, the decision-making practices of greenhouse growers and their resulting business practices were simultaneously driven by cultural factors — not just economics (Gatrell et al., 2009). Indeed, family concerns have informed and shaped the everyday business practices of these farmers, for example experimenting with new crops to create an income stream for an adult child, diversifying to utilize the

[1] NAFTA = North American Free Trade Agreement. According to Investopedia (http://www.investopedia.com), "[NAFTA is a] trade agreement between Canada, the United States and Mexico that encourages free trade between these North American countries."

special skills and interests of family members, or lending equipment to help a relative start up a new farm business.

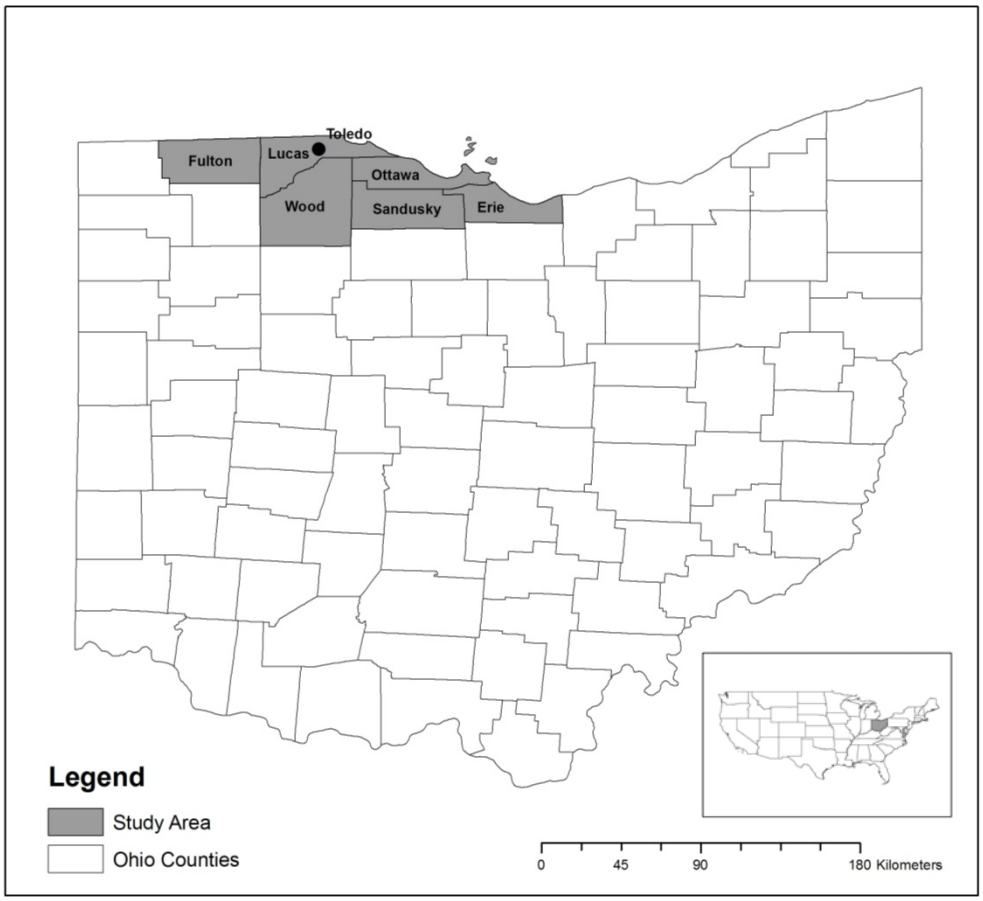
In 2009, the University of Toledo's Urban Affairs Center obtained a grant from the Ohio Humanities Council to document the oral histories of farmers. The oral histories initiative not only document the histories of the farmers, but also provided the research team from the University of Toledo, The Ohio State University, Bowling Green State University, and Indiana State University with new insights into the everyday lives of family farmers, their practices, and their families. More importantly, oral histories provide an opportunity for the interviewee to define the issues instead of having them defined for them by the interviewer. This paper reports the findings on the theme of succession that emerged from the oral histories of NW Ohio farmers.

The collective efforts of the larger research project to investigate the plight of family farms across NW Ohio within the context of a shifting economic and policy landscape (most notably NAFTA) has underscored the importance not only of family, but also the many forces facing family farms and succession. Factors such as suburbanization, big box stores, changing property tax structures, the emergence of new expensive technologies (such as point-of-sale inventory control systems), increased international competition, the perceptions of growers with respect to the trajectory of the overall industry, and the career preferences of future generations inform the succession strategies of individual growers. These factors as well as the cultural imperatives associated with "family," coupled with changing conceptions of "family," make the succession issue especially complex in urban, suburban, and peri-urban regions such as NW Ohio (Inwood, 2008).

NW Ohio Agriculture in Context

For the purposes of this study, northwest Ohio has been defined as the Toledo Metropolitan Statistical Area (MSA) (made up of Lucas, Wood, Fulton, and Ottawa counties) and the two adjacent counties of Erie and Sandusky (figure 1). As table 1 indicates, the total land in farms and mean farm size declined between 2002 and 2007 for the state and counties.

Figure 1. The Northwest Ohio Study Region



Statewide the overall trend was a decrease in total farms; however three counties observed a net increase. With respect to the overall productivity and value of agricultural goods, the trend was an upward one across the region, but the increase was most pronounced in Ottawa and Fulton counties. The poorest performing county across nearly all metrics (except mean farm size) was Lucas, home to the region's anchor city, Toledo. Finally, it should be noted that government payments and related subsidies per farmer declined as well (USDA National Agricultural Statistics Services [NASS], 2007b, 2007c).

The data with respect to the observed change in total farms and the observed decrease in mean farm size suggests that small farms persist. Indeed in three counties (Erie, Ottawa, and Wood) the number of farms increased. When compared to national trends that indicate an increase of 4% in total farms between 2002 and 2007, the performance of Ohio and most counties in the region may be disheartening to some. Yet the observed growth in Ottawa, Wood, and Erie counties suggests that farming may be on the rebound. In fact, the 2007 national figures represent the first expansion of the number of farms since World War II (USDA NASS, 2007b). Likewise, the observed trend toward smaller mean farm size between 2002 and 2007 is consistent with the trends observed nationally. While the decline in the total number of farms has halted and many objective indicators suggest growth in the industry nationally, the experience and perceptions of NW Ohio farmers continue to be shaped by cultural and political narratives that reinforce images of "decline" and "fear" associated with heightened competition.

Table 1. Farm Change in Northwest Ohio, Selected Indicators, 2002–2007

	Total Land in Farms (% change)	Mean Farm Size (% change)	Total Farms	Total Product Value (% change)	Mean Government Payments (% change)
Ohio	–4	–2	–2	66	–11
Lucas	–19	–12	–8	16	–41
Wood	–10	–18	10	55	–15
Erie	–11	–14	3	24	18
Fulton	–7	–4	–3	91	–11
Sandusky	–8	–5	–3	55	–26
Ottawa	1	–12	14	93	–26

Source: USDA NASS, 2007d

Research Methods and Data

According to Yow, "oral history is the recording of personal testimony delivered in oral form" (2005, p.3). The approach is inductive, that is, no formal hypotheses have been formed by the researcher. Indeed, often the aim of the oral history is to preserve the "testimony" for posterity. Only later, after the recording and transcribing is complete, are the documents examined for emergent themes and hypotheses or research questions formed.

Use of oral history as a method of inquiry differs from conventional surveys or face-to-face interviews, where the researcher assumes total authority for knowledge and the subject is a passive conveyor of information to an authority. With oral history, the relationship between interviewer and interviewee is different. Both are seen as holding authoritative knowledge about the situation; the interviewer perhaps has knowledge about the larger context in which the narrator lives, but the interviewee is the recognized expert on his or her experiences and understanding of the situation. Together, the interviewer and interviewee produce new understandings and knowledge. There is no claim, however, to complete objectivity (Yow, 2005, pp. 1–2). Indeed, it is the interviewee who ultimately determines what is important by story-telling about it. The researcher seeks common patterns among what the individual narrators see as important. As social

historian Paul Thompson notes,

> One of the greatest advantages of oral history is that it enables the historian to counteract the bias in normal historical sources; the tendency, for example, for printed autobiography to come from the articulate professional or upper classes, or from labour leaders rather than the rank and file. (1988, p. 125)

The discovery of patterns and themes is objective, but the substance — the themes themselves — are inherently subjective. The analysis presented here is in the voice of farmers as framed by social science concepts.

These oral histories were collected as part of "Sustainability Family Style: Documenting the Lives of Growers, Gardeners, and Family Farmers in Northwest Ohio," a project funded by the Ohio Humanities Council in 2009.[2] The oral history project preserved the stories of these farms. The process of oral histories is often to just let the interviewee talk. The interviewee more than the interviewer defines what is important, what he or she wants preserved.

Farms were identified through local contacts. Farms were included that had multigenerational local connections. Hence, farms were included where existing farms had passed directly to a child or relative and new operations where the farmer had relatives who operated other farms. Consent was obtained from all participants to create the oral histories with the understanding that confidentiality, because of the nature of oral histories, could not be promised. Nevertheless, we use pseudonyms for both individuals and the farms as their true identities do not add anything to the substance of the findings and recommendations.

Eight farms were included in the data analyzed for this paper. Brief descriptions of these farms can be found in table 2 along with the pseudonyms of the farmers associated with them.

Surnames that match reflect family relationships among individuals. Sixteen people were interviewed. In two cases, a husband and wife were conjointly interviewed. In the others, family members were interviewed separately. In two cases, a future successor to the farm was interviewed. The conjoint interviews were separated for purposes of analysis to make for 16 interviews comprising oral histories of eight family farms in northwest Ohio. Interviews lasted between nine and over 60 minutes, with an average of 20 to 25 minutes.

NVIVO™ software (QSR International, version 8) was used to code the interviews and identify emergent themes. Analysis of the interviews occurred in three steps: coding, frequencies, and themes. Initial coding yielded 48 different codes. The next step was to examine two dimensions of the frequency in which codes appeared. The first was in how many sources (interviews) they appeared, and the second was in how many references (instances) the code appeared across all sources. (A single source could have multiple "references" of the same code). In short, focusing on the most frequent codes in terms of both sources and references helped us identify the emergent themes. This process produced three emergent themes: (1) succession (the passing of farming and the farm into the next generation); (2) gender relations; and (3) challenges to surviving locally in an industrial world. The third round of analysis created a dialogue between the oral history themes and published research related to the theme. This process may also result in further coding to examine the fit of the oral history data with other publications using different data sources and theories.

Results: Succession May Be the Ultimate Measure of Success

Identifying a successor and planning for succession are perhaps the most important issues that most family farmers face (Mishra & El-Osta, 2008). They drive economic decision-making on the farm (Inwood, 2008) and together are an "essential

[2] The complete audio files of the oral histories can be found at http://uac.utoledo.edu/mvgoh/mvg-oh.htm (University of Toledo Urban Affairs Center, 2011).

Table 2. Brief Sketches of the Farms and Greenhouse Operations

Dietrick's Greenhouse (Tony and Luke) Dietrick's Greenhouse was established in the late 1890s by Tony's grandfather. It originally had retail shops selling cut flowers, but the operation is now a single 8-acre (3.2-hectare) greenhouse operation growing strictly for wholesale. Tony Jr., the current president, started in 1976. The owners now focus more on potted plants, bedding plants, and hanging baskets. They employ nearly 50 people and have been successful in the wholesale business by doing the majority of their business with other independent businesses. Tony Jr.'s son Luke, who is the fourth generation, works in the business and is preparing to run it himself one day.
Evans' Greenhouse (Frank and Natalie; Mike) Evans' Greenhouse has been in operation for over 25 years. The owners grow primarily bedding plants and flowers for their prized hanging baskets, as well as produce. Frank's grandfather began farming in northwest Ohio, beginning with livestock but eventually shifting to vegetable production. Frank and Natalie were living and working on the family farm when a greenhouse operation across the street became available. They bought it and Frank taught himself how to grow tomatoes in the greenhouses. They originally grew tomatoes for processing, but shifted to farm stand production when the processing plants began to close. The Evans' sons are actively involved in the business, with each family member having distinct responsibilities. The Evans also grow commodity crops.
For the Future Farms CSA (Tim Hutchens) Shared Legacy Farms is a small vegetable farm that was established in 2008, as a subsidiary of Hutchens Farms. Tim grew up on his parents' farm, then spent time in Europe and Chicago learning new technologies and philosophies. He returned home and, with the help of borrowed equipment and advice from his parents, he and his wife created For the Future Farms CSA (community supported agriculture operation) with the goal of promoting sustainable agriculture and fostering relationships between farmers and local consumers. The CSA model allows them to create relationships and ensure they have a guaranteed market before they start planting. They strive to use organic practices wherever possible.
Hutchens Farms (Denise and Carl) Hutchens Farms was founded in 1940 by Carl's parents, originally operating as a dairy farm and vegetable farm, raising primarily sugar beets, pickles, and tomatoes for processing. In 1941, they shifted away from dairy production and focused on vegetable production. Carl and Denise took over the farm in 1982. Denise became interested in flowers and plants, specializing in rare varieties. The Hutchens moved away from growing tomatoes and sugar beets for processing, as many of the local processing plants shut down, and they now focus on growing vegetable varieties for their roadside market. They are especially known for their sweet corn. The Hutchens do still grow some commodity crops.
Norton's Greenhouse (Tom and Barbara) Established in 1941, this farm and greenhouse began with two brothers, Tom's father and uncle, growing wheat, soybean, and field corn, but by the 1950s they were focusing more on vegetables, growing up to 30 acres (12 hectares) of tomatoes to be sold to a tomato processor for ketchup. In 1962 they built their first greenhouse. Through the next decade they built more greenhouses and added orchards. They opened a produce market in 1975 to meet growing demand for homegrown produce. In 1980, the brothers divided up the business. Tom's father took the greenhouse operation, and father and son started growing flowers in flats for the greenhouses. In 1983 they opened the retail store. Tom took over the business from his father, and today Tom and his wife Barbara own and operate the 20-acre (8-hectare) farm and business, including plants, flowers, orchards, and field crops. They have 6 children, many of whom are involved in the business.
Willow's Greenhouse (Nate and Gary) Willow's Greenhouse has been in operation since 1893. The greenhouse has had different locations throughout the years. Nate is the fourth generation of Willows to work the business, and his son Gary is the fifth. The Willows grow primarily bedding plants, annuals, and perennials. They are strictly a greenhouse operation; they do not grow field crops. Over the years they have begun to shift from being a wholesale seller to a retailer. At one point much of their wholesale production was for a family member's retail operation.
Yancy Lake's Greenhouse (Yancy) Yancy Lake's Greenhouse was established in 1989 when Yancy, the son of Sam Lake, Jr., and Nancy Lake, purchased his own land and left the family farm business. Yancy Lake's Greenhouse originally had several greenhouses dedicated to wholesale, but as small independent stores began to close, the business lost clientele and has shifted toward retail. Most of its retail sales are to its loyal customers at the area's farmers' markets. It grows bedding plants, cut flowers, and produce.
Zaichek Gardens (Terrence, Mark, and Ed) Zaichek Gardens began with no family history of farming. Ed's uncle, a painter by trade, decided to try his hand at farming based on his love of the outdoors. Ed and his two sons have all had to work outside the business to make ends meet, but they keep the business because they love it. They grow bedding plants, annuals, hanging baskets, and field crops. In the past they sold produce to independent grocers, but with the closure of those types of stores they now focus on direct-to-consumer sales.

question" (Lidestav, 2010). That succession emerged as a theme from the oral histories seems to support the importance of the issue to family farmers. Yet according to a national survey on family farms, just 34% of farm operators who plan to retire within five years had succession plans (Mishra & El-Osta, 2007, p. 4).

There is much scholarly research on farm succession. One thread of that research furthers understanding of farm succession by categorizing the outcomes of succession and/or the process. An excellent example of that approach is Lobley, Baker, and Whitehead (2010).

Types of Succession

Lobley, Baker, and Whitehead (2010) offer a typology for the succession process as well as a typology of successors based on cross-cultural data from the U.S., Canada, the U.K. and other European countries, Japan and China. Their analysis suggests two routes to succession: (1) the direct route, where successors go directly into farming after leaving school; and (2) the diversion route, where successors are employed in an off-farm job after school and return to the home farm at a later date (Lobley, Baker, & Whitehead, 2010, p. 56).

The authors go on to identify four types of successors: (1) the farmer's boy, who has little to no responsibility for decision-making and mostly provides manual labor; (2) the separate enterprise, where the home farm is large enough to support a second one run by the successor; (3) the stand-by holding, where the successor is set up on a separate holding to develop his or her skills; and (4) a partnership, where the successor shares decision-making responsibility with the farmer to learn necessary skills to take over (Lobley, Baker, & Whitehead, 2010, pp. 56–57). The different paths and successor types offer different levels and kinds of experiences that may impinge on the eventual success (and next succession) of the farm.

After the initial coding of the oral histories was completed and succession identified as a theme, the data was recoded into "routes" of succession and into "types" of succession. Lobley, Baker, and Whitehead's (2010) descriptions and operationalizations informed that recoding.

Each of Lobley, Baker, and Whitehead's (2010) routes and types were evident among the eight farms. However, while Lobley, Baker, and Whitehead's data focused on the farmer and future succession, the oral histories were taken of current farmers who had inherited the farm (making themselves successors). Interviews were also completed with at least two likely future successors, capturing somewhat the process of succession as it is happening. The oral histories provide some insight into: (1) the succession of the current farmer from the last generation; and (2) succession of the next generation. This provides a three-generation view of some of these farms.

The oral history data also suggest that the process and types of successors may be not as clean as suggested by Lobley, Baker and Whitehead (2010). For instance, six of the eight farms show evidence for a direct route of succession. A particularly good example: "Then in 1980 I was, uh, I graduated. My dad said he would retire when I graduated. So I took over for him" (Tom Norton). There is one ideal example of the diversion route:

> I worked for a wholesale plant nursery for seven years out in Chicago…It was a pretty big facility, it was about, I'd say maybe one of the top ten wholesale nurseries in the country. And a really good place to work for…then I sort of just got a chance to develop into who I really am today. Because if I would've stayed in Ohio, everybody knows the Hutchens name and I would have gotten a lot of favors because of my last name. Out there I made a name for myself and I grew upon that and it really helped me out. (Tim Hutchens)

Others, though, seem a combination of the direct and diversion routes; call it an "indirect" route:

> Well, I always worked here, but, I drove a milk, Pet Milk truck in the winter for a

> couple years, and I drove cab for about 10 years to pay for my house. And I worked at Heinz when I was in school. (Ed Zaichek)

The oral histories also show examples of most types of successors identified by Lobley, Baker, and Whitehead (2010). A good example of the farmer's boy: "Grew up, grew up working the fields. Just kind of basically learned everything on hand" (Tom Norton).

Natalie Evans provides an example of a (developing) "partnership":

> And as the kids got bigger and started to be more involved in the operation, Mike went to school at ATI and when he came back then he took over seeding, and just been trying to teach the next generation what we know and what we do.

Tim Hutchens provides an example of a "separate enterprise":

> But, you know, my brother and sister say why don't we all farm together and my parents have been against that because they've seen, with my father's experience with his brothers and my grandfather, how that didn't work at all. So we're sort of going about it a different avenue where we each have our own businesses, so my brother grain farms right now and I do vegetables, the CSA thing.

Others defy the categorization suggested by Lobley, Baker, and Whitehead (2010). The literature on succession seems to assume a single successor, but in one case in NW Ohio, there are multiple partners who eventually will take over:

> We're all kind of team players, but dad gets, say, five to eight houses that he's responsible for, and then my brother gets—we just kind of divide it up and we all, all the growers here are family. So I mean the only time something is watered by somebody else is if we get behind, or it's in the store. Then the retail girls take care of it out there. But I also am in charge of all of the seeding, my fiancé and I run the seeding room, and that just means we run the machine that puts the seeds in the trays and then responsible for labeling and recording and all that stuff. So I guess that would be one of my major roles, that and one of the growers. (Mike Evans)

This excerpt may suggest multiple succession models overlapping. Mike Evans could be describing multiple stand-by holdings, with individual brothers (the eventual successors) having responsibility for one or more greenhouses. However, Mike is responsible for all seeding, which fits with the idea of a partnership.

An interview was conducted with Mike's parents, the current growers. The following excerpt elaborates on the complex process of succession and suggests a mixture of succession types, perhaps a mixture of stand-by holdings and a partnership but where the partnership seems to extend to new areas, not to the parents' operation:

> We've been talking to the boys because, you know, as they're getting older they kind of want more money out of the enterprise, and we'll have to see whether we can keep going, whether…one of them started to take off and do mulch, Mike is doing the strawberries and then the vegetable stand. Whether one of them wants to start doing, you know, cuttings and growing ground cover, or you know, we've talked a little bit about trees or aquascape or any of those things…I said we're open to it, I'm not sure if I want to tackle them, but if they do…One of the wives is really interested in water gardening and water plants, so…we'll try it if they show an interest. They've got to learn too. (Natalie Evans)

Farmer Culture

According to Salamon, "an implicit assumption generally made is that US farmers typically evolve

management strategies to optimize financial returns" (1985, p. 325). She examined two farming communities in south central Illinois, whose culture, measured by ethnicity and religion, produced very different management principles and definitions of success. In effect, her research produces a typology of two ends of a possible continuum. On one end of the continuum sits the "yeoman" (a type associated with peasants or a precapitalist form of agriculture, emphasizing persistence and family and/or community legacy) and on the other end sits the "entrepreneur" (a type associated with a commercial focus "run unsentimentally for profit"). Salamon produces a typology of these two categories describing their contrasting goals, strategies, farming organization, family characteristics, and community structures (1985, p. 326). A cursory comparison of Salamon's (1985) types to the oral history data locates all of the farms in the yeoman type, but the match is not perfect. There are family, community, and farming organization differences. The differences do not fit the entrepreneur type, either. They lie somewhere between the two.

Salamon's (1985) "entrepreneur" seems to be the preferred model for farm decision-making among policy-makers and scholars, especially those influenced by neoclassical economics, including some of the authors of this paper. At the same time, those same authors point to a "strong rural farm culture" (Danes & Lee, 2004) to explain economic decisions that do not conform with the "entrepreneur." The "yeoman" is posited as one with values that contrast with the preferred model of farm decision-making. The oral history data suggests something different: the importance of social relations to economic decision-making. Salamon's entrepreneur conforms to an "undersocialized" view of people, while the yeoman conforms to an "oversocialized" view of people (Granovetter, 1985). Granovetter argues for the importance of "embeddedness," that is, "the [economic] behavior … to be analyzed are so constrained by ongoing social relations that to construe them as independent is a grievous misunderstanding" (p. 482). It does not appear to be an overwhelming adherence to "rural culture" that drives Barbara Norton; instead, it is the unfolding of the social relationships of her children that drive farm decision-making.

> And that's been a great success for us as parents, to let our children — we have six kids — and to let them, you know, Tom and I made that decision when our children were younger, that we were going to let them…discover the purpose and their desire, what they wanted to do in life, you know, and not push them to do so, to follow in our footsteps or follow our dream. And it's been great to see…three of our children and our daughter-in-law, you know, jump on board and they're having fun and they love what they do.

The oral history data confirm that succession is an important goal to most of the farmers, but the process in reaching that goal differs.

Succession is not just an important value of rural (yeoman) farming culture; it is important to the system that grows our food. In addition to the capital stocks bound up in machinery, buildings, and the land that are pushed into the next generation, so is the knowledge of local conditions and the peculiarities of the land. Many have noted the resilience of family farms, even in the face of forces that should eliminate them (Friedmann, 1978; Mann & Dickinson, 1978; Vandergeest, 1988). Some, like Lobley, Baker, and Whitehead (2010), see family farms as particularly important in the face of globalization and world markets to preserve local food security. Although they do not investigate it, they suggest that the process and type of successor may play a role in the ability of future family farms to retain their resiliency in the face of these challenges. Indeed, they suggest that the "farmer's boy" type has a:

> potential lack of wider farming knowledge, business and managerial skills, and the motivation required to drive the business forward in such uncertain times. Multiplied up, this may lead to farm businesses less well placed to adapt to and succeed in

> responding to the challenges of the future. (2010, p. 61)

Six successors in our study fit the "farmer's boy" type. However, some of the "farmer's boys" show good business and managerial skills and high motivation, perhaps more so than their fathers.

> About 1992, I tried to convince my dad to do a little more retail. He wasn't really keen on it, he gave me a little space. And then he went on vacation, and while he was on vacation I took down the first 100 feet [30 meters] of benches to make retail space while he was gone on vacation so when he got back he didn't have much choice, because it was done (laughter). That's about the only way I could get it done. (Gary Willow)

Willow's experience might be a common one for the farmer's boy. The farmer's boy may follow in the farmer's footsteps, providing little more than farm labor, but it need not be the farmer's shadow. In this case, the farmer's boy waited for this opportunity and diversified.

The very label, "farmer's boy," suggests a male successor, and there is no evidence in the oral histories of any "farmer's daughters" (a female successor who took over the farm after years of living on the farm and providing labor to the parents' or husband's business). However, farmer's boys do get married. Presumably all of the farmer's boys in this sample married, and for three of them, their wives clearly influence the farm operation. Much has been written of the traditional gendered division of labor on the farm (Brandth, 2002; Brandth & Haugen, 2010; Evans & Ilbery, 1996; Lobao & Meyer, 1995). The theme of gender from these oral histories is the focus of another paper, but it seems the wives in this sample bring good business and managerial skills, motivation, and creativity to the operation. For instance, Tom Norton would be a classified as a farmer's boy: "I grew up, grew up working the fields. Just kind of basically learned everything on hand." His wife, who is not from a farming family, followed a traditional gendered division of labor. In describing her history with the farm:

> Initially at the onset I wasn't really involved. We have six children. It's just been exciting. Again, it was great because that was during the wholesale phase, where we would come up here and hang out but I wasn't really involved working, which made it kind of nice because it — it made it *really* nice with our children and stuff, and so my involvement became more and more probably in the early nineties, late eighties or early nineties, again it afforded me the opportunity to be there and do my sole purpose in raising our children and that's been great, but it's been neat to see it change over the years, you know. (Barbara Norton)

She took care of the household and children while her husband, Tom, took care of the business. But, once the children were older, she became more involved in the business, and the changes referred to above may have been her responsibility. As she describes her current role in the business:

> Design, just with the container design, landscape design, that's been fun to develop that over the years and see that happen, which has all lent to our goal, is to become a destination garden center and a full-service garden center. So my role, you know, I plant containers, do a lot of the container design as well as landscape design. (Barbara Norton)

In another case, Carl Hutchens was a farmer's boy when he married Denise, who was working in a hospital. This is a variant on the traditional rural gendered division of labor, where the wife works off farm for supplemental income. However, she soon quit: 'he [Carl] says, "you're more valuable on the farm, you've got to come back and help me"' (Denise Hutchens).

It is likely that her help was more than just providing physical labor, as her grandparents were

farmers and she spent much of her time growing up working on their farm. The Hutchens' farm, too, has experienced a significant change during the tenure of the current owners, moving from growing for wholesalers to selling its produce retail. It seems this is a good example of the wife's influence on both the farm and the farmer's boy.

> Well, I guess the business started when Frank and I got married, but we were part of a family business. So we were married in '76, and at that time he just did grain farming, tomatoes, strawberries, and pickles. And 10 years later when we had four kids we were still looking for something that could be just ours, and we also needed a house because we lived with his grandmother, and it was getting very crowded. So the man across the street… decided he was going to have an auction and sell the place. So [Frank] came home and said "so what would you think about running a greenhouse operation?" And I said "if it comes with a house that's just fine." (Natalie Evans)

This quote suggests that both Natalie and her husband Frank were anxious to get out on their own, and when they did, they moved from growing grains, tomatoes, and other vegetables, to growing flowers. That this is a full partnership seems the case. In response to a question about their biggest accomplishment:

> Sure, working together! [laughter] Thirty-three years, there's a lot of people who say they wouldn't be able to do that. And I can't say that we haven't ever had a disagreement, and sometimes the employees feel like they're working for two different bosses. But, just that this was ours and that we started over, for me it's just bringing it this far. (Natalie Evans)

Hoping for and Expecting Succession

Although succession emerged as a theme in the analysis of the oral histories, planning did not, at least not a conscious, formal planning process involving estate planning and legal plans for succession such as that reflected in the booklet "Transferring the Family Farm" (New Jersey Farm Link Program, n.d.). Such a plan would reflect a highly rational act on the part of the farmer, but evidence suggests that such planning is not commonly practiced, despite the advantages to doing so (Pitts, Fowler, Kaplan, Nussbaum, & Becker, 2009). As cited above, a national survey of farmers who indicated they were retiring within five years found that only 34% had such a plan (Mishra & El-Osta, 2007). Given our small sample, it should not be surprising that none of the farmers indicated having a formal plan for succession. And we lack enough information about farm size, revenues, and family demographics to compare our sample to other research that has found such variation on having a plan varying by farmer's education, age of children, and size and value of farm.

One of the initial text codes of the oral histories was "future of the interviewee's business" which was later combined with other codes as the theme of succession. There is no evidence of any formal plan for succession from our interviews, although that does not mean such plans do not exist. However, formal succession planning is "complex, requiring family members to address issues such as authority, control, retirement, and death" (Pitts et al., 2009). It seems likely that if any of the individuals had entered into a process that might take a year or more to complete and at a significant cost, involving accountants, tax lawyers, and counselors, they would have mentioned it. Instead of formal planning, references to the future are better characterized as hopes and expectations. Perhaps this is an example of the replacement of "rule" with "strategy." Farmers use "strategies" to negotiate the "different symbolic domains" they face (Vandergeest, 1978, p. 24). Think of the yeoman farmer as embodying one symbolic domain and the entrepreneur another. Today's rules include inheritance and estate taxes, planning, corporate and farm business structures, authority, and ownership. In talking about the future of the farm after retirement, a "strategy" might sound like this: "I have four kids involved now, and I feel they would take over. They love, I believe they love everything they

do" (Tom Norton). A reluctance to retire and transfer control is commonly cited in research (Lobley et al., 2010; Bjuggren & Sund, 2001; Salamon, 1985). That is evident with farmers in our sample, too:

> I don't know if we ever will fully retire, but we're trying to give the boys more responsibility. One of them is married now and the other one is getting married, and trying to get their spouses and let them start feeling, you know, that it's part their business so we can hopefully wean ourselves out and they can — and they do have good ideas, and the last couple years have come up with some good ideas that have helped build the thing so hopefully within four or five years we can, you know, spend a little more time away from this place. I don't know if we ever will, like I say, but that's kind of what our plans are. (Natalie Evans)

Tim Hutchens, a young man and a possible eventual successor for his parents' farm business, is just starting out on his own farm. He has a young son, Joey. Nothing in the following quote suggests any formal planning, but it does reflect expectations and norms. He is conscious of them and he reflects on them:

> I mean, I'd love to see the farm passed down to the next generation, maybe it might be my nephews or nieces or whoever. But it doesn't have to be Joey, and I think it's important that he lives his life out to what he's called to do and go from there. But that's part of it, you know, my wife, we're thinking about purchasing this place and it's like, what do we do when we retire in 30 years or whatever. We'll get to cross that bridge when we get there, let's enjoy right now and just have fun. Because today may be the last day, so. There's part of, you know, being a guy and having a son, you know, you're like, oh, you know, you sort of want that, but I just really want him to really live out his life.

Discussion

Succession, more than any other single matter, may be the most important challenge facing the future of the small family farm. Past research makes the case that economic decisions for the farm are made with an eye to the future for purposes of succession (Inwood, 2008). Children (generally sons), consciously or not, are socialized to be a successor. These strategies can be seen in the hopes and expectations that characterize how parents talk about the future of their farms. These hopes and expectations reflect the conservative rural values that especially characterize the "yeoman" type farmer. At the same time, parents talk about their kids as following their own paths, doing what they want to do (with their fingers crossed that at least one will choose to stay on the farm). These latter values are more characteristic of the "entrepreneurial" type values, where lifestyle, tradition, and legacy give way to rational economic calculation (Salamon, 1985).

The oral histories with multigenerational members of the farm family shed additional light on the long process of succession, a richness that is typically lost in cross-sectional surveys about farm succession. Those studies tend to focus more on outcomes and less on process, and even less on how the farmers and their successors understand the process. The process appears less planned than reacted to, captured in such metaphors as "crossing that bridge when we come to it," or with references to God's plan or "farming is in their blood."

Growing up on the farm is the beginning of a path in which retiring, one day, from the farm is a good possibility. Research suggests that the earlier a successor is identified and significant authority delegated, the better for the successful transition of the farm (Lobley et al., 2010). And as these authors also noted, successors often have to wait a long time for the current owner to retire. The farms in this project reflect a similar pattern.

Early succession is more characteristic of the yeoman type of farming, whereas later retirement and succession geared more to personal desires is more characteristic of the entrepreneurial type of

farming (Salamon, 1985). All those interviewed who spoke to the issue indicated a hope that one of their children would one day take over, but they also expressed that it was important that the children make that choice. That males are so much more likely to be a successor than females suggests that perhaps males are more encouraged, directly, indirectly, or through larger societal norms about gender, to be successors.

The data also suggest that while the farmer's boy type of succession did appear to be the most common type of succession, as in other studies, these farmer's boys do not seem to be as unwilling to change and incorporate new business strategies as Lobley, Baker, and Whitehead (2010) fear. This is probably a good thing for the future of these family farms. The adaptations made at farms in this study with farmer's boy successors seem to follow a similar path. That path is from a wholesale operation to a more diversified operation that includes some retail, or to an entirely retail operation, but still growing for their own operation. In short, this means diversifying and vertically integrating their businesses. Wives on these farms oversee the retail portions of the business and appear to be full partners in the farm operation.

While the literature on succession suggests that rural values do not always emphasize narrow rational economic decision-making (Gatrell et al., 2009; Hennon & Hildenbrand, 2005), diversifying farming operations to include a retail market makes economic sense because in the case of the NW Ohio farmers, the city is getting closer: the population has grown over the last 25 years, and while land once was a plentiful resource for wholesale (industrial) farming operations, the encroaching metropolitan area makes land scarcer (and more expensive) but also makes customers more plentiful. Diversifying to include retailing "out the front door" what they are "growing out back" makes sense not just from the point of view of future succession (keeping the productive land in the family), but also is economically viable to meet the needs of the current family.

Conclusions

Scholars as well as policymakers, farm business advisors, and farmers categorize farmers into different types. In this paper we've relied on at least two such devices: Lobley, Baker, and Whitehead's (2010) categories of succession routes and successor types, and a typology of farmers proffered by Salamon (1985). In both cases, however, even though the categories and typology were derived empirically, our oral history data did not completely fit the succession categories or typologies.

Analyzing the oral history data was not unlike closely "listening" (Gatrell et al., 2010) to the farmer. Listening is the lesson for professionals who work with farmers and for farm and economic policy officials. It is easy to paint a statistical, academic (theoretical) picture of farmers. This research team has surveyed many of the farmers in the NW Ohio region and has interviewed them to find answers to research problems we posed. In those cases, we listened only to answers to questions we posed. The oral histories made us listen to them and to what they wanted to talk about. As familiar as we were with the farmers in this region and their challenges and their successes, the oral histories were both surprising and illuminating.

The farmers whose oral histories we analyzed in many ways fit the categories we later used to assess the data. But in important ways they did not. "Farmer's boys" innovated. They showed good business sense. Wives were crucial to the success of the farm operations, but not because of their off-farm income sources. Wives were active partners in the businesses, and it is hard to see them as anything but full partners who helped to diversify the farm in the face of a changing economy. Hence, it is important to include wives in any evaluation of the farm (such as for a loan) or for potential business deals, because these oral histories show how important the wives are to the success of these small farms and their associated businesses.

Those who provide services to farmers and policymakers should listen to farmers. Many solutions

that experts proffer do not necessarily solve the problems of the people they are supposed to help. Much of the interaction between the expert and the farmer becomes a matter of the expert trying to educate or convince the farmer about how the expert's solution is in the farmer's best interests. That approach does not necessarily respect the farmer, which may partly explain why many farmers are reluctant to seek the help of farm service and economic development professionals. Listening is an act of respect. Greater understanding of the individual farmer's goals, how he or she defines success, and what motivates and discourages him or her, will avoid typecasting them. 

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Is a geographical certification a promising production and commercialization strategy for smallholder sheep farming in Ceará, Brazil?

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Abstract

Producing a local sheep meat product under a geographical certification label may enhance market competitiveness of smallholder farmers. This study focused on sheep farms in Ceará (Northeast Brazil); we explored their potential for adopting such a strategy, described the production chain of the salted, dried sheep meat product, and evaluated its potential certification. The study built on an existing unpublished dataset about the socio-economic conditions, production techniques, and commercialization characteristics of 129 sheep producers in the Tauá municipality. Multiple correspondence analysis followed by a nonhierarchical cluster analysis resulted in five farm clusters. In-depth interviews about socio-economic and production characteristics were conducted with a subsample of 23 farmers. The production chain was evaluated by applying methodological and data triangulation. The dried mutton product showed potential for geographical certification. However, essential preconditions for establishing a successful and sustainable geographic certification system were currently lacking.

Keywords

Brazil, farming systems, food value chain, geographical indication (GI), sheep

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Introduction

The farming systems in Brazil's Northeast region are diversified, favoring flexible responses to unpredictable and semi-arid conditions. Farm management of and decision-making for agricultural activities are based on the availability of resources (Holanda Júnior, 2004). The primary objective of smallholder farms in rearing small ruminants is to meet short-term socio-economic needs, thereby ensuring sustenance of the family (Guimarães Filho, Souares, & Araújo, 2000). As reported in other parts of the world (Ayalew, King, Bruns, & Rischkowsky, 2003), small-scale farmers rarely rear livestock solely for market.

The majority of the farmers in the study region regularly sell live animals to retailers. However, neither production nor processing standards for sheep and sheep meat exist in Brazil, and the commercial channels for sheep meat are generally short and focused on local markets (Holanda Júnior, 2006). Problems identified with commercialization include the costs of animal collection, missing product and sanitary standards (Guimarães Filho, Borges, & Nogueira, 2006); the low price of imported sheep meat; and the heterogeneous, nonstandardized butchering of sheep carcasses (Maia, 2007).

In the early 2000s, the Brazilian Ministry for Agriculture, Animal Husbandry and Supply (MAPA) identified a dried and salted sheep meat product, locally produced in the semi-arid area of Ceará, as showing high potential to receive a geographical certification. The proposed certification label for the product, called "Manta de Carneiro de Tauá" (Manta), was considered as a strategy to improve the livelihoods of smallholder sheep farmers.

According to article 22 of the TRIPS agreement (Agreement on Trade Related Aspects of Intellectual Property Rights; World Trade Organization [WTO], 1994), geographical indications (GIs) are "indications which identify a good as originating in the territory of a Member, or a region or locality in that territory, where a given quality, reputation or other characteristic of the good is essentially attributable to its geographical origin." The value attached to a typical product can be seen as a competitive advantage over similar products produced outside the certified geographical area (Muchnik, Biénabe, & Cerdan, 2005), and a label signifies both qualitative and spatial product differentiation. Economic, financial, and administrative consequences of implementation differ among countries (Addor & Grazioli, 2002), as each is allowed to determine country-specific rules and regulations.

The introduction of GIs may bring benefits through improved market access and protection against prices of competing products (Porto, 2007; Scintu & Piredda, 2007). While GIs can strengthen community development (Pérez Centeno et al., 2007; Sautier, 2006), and support the valorization of traditional knowledge and the conservation of natural resources (Sylvander et al., 2006), they may affect biodiversity positively or negatively (Thévenod-Mottet, 2010). Indirect benefits also can be reaped; for instance, in Europe only the formalized GI labels are exempted from the prohibition of promoting products with state aid (Becker & Staus, 2008).

Developing countries, however, face major challenges concerning the introduction of a GI due to generally weak institutional environments (Larson, 2007). They may struggle to develop specific legal systems for the protection of GIs, and seldom have the means to control and sustain them (Belletti & Marescotti, 2006). As a result, the economic benefit and power allocation within the production chain can be unequally distributed, and the production for market niches may exclude producers as well as consumers (Larson, 2007). Further exclusion effects may occur due to required compliance with international rules, such as food safety or sanitary product requirements (Belletti & Marescotti, 2006), which exclude countries that do not possess the required structure and knowledge. For example, there were 706 origin-labeled products registered in European countries in 2007, with around 900 projected for 2010 (Becker & Staus, 2008). In contrast, there were only six GIs in Brazil in 2010, two of which were animal-source products: beef and leather produced in southern Brazil. A third

GI for a honey from the Northeast region was under development in 2010 (Diário do Nordeste, 2010).

We hypothesized that a certification concept can improve the livelihood of farmers under particular internal and external frame conditions. Thus this study aimed at determining the conditions and factors under which GI certification of a traditional, processed meat product is economically promising and advantageous, or disadvantageous, for farmers in the study region.

Material and Methods

Study Area and Regional Environment of the Proposed GI Product

The municipality of Tauá (latitude 6°00' S, longitude 40°18' W) is located in the microregion of Sertão do Inhamuns in the state of Ceará in the Brazilian northeast. The municipality is subdivided into eight districts and occupies an area of 4,018 km² (1,551 mi²). In 2006, Tauá had 54,273 inhabitants (IPECE, 2007), with a population density of 13 inhabitants per km² (34 inhabitants per mile²) (IPECE, 2008). The distance between the town of Tauá and the state capital, Fortaleza, is 337 km (209 miles) (Tauá, 2008).

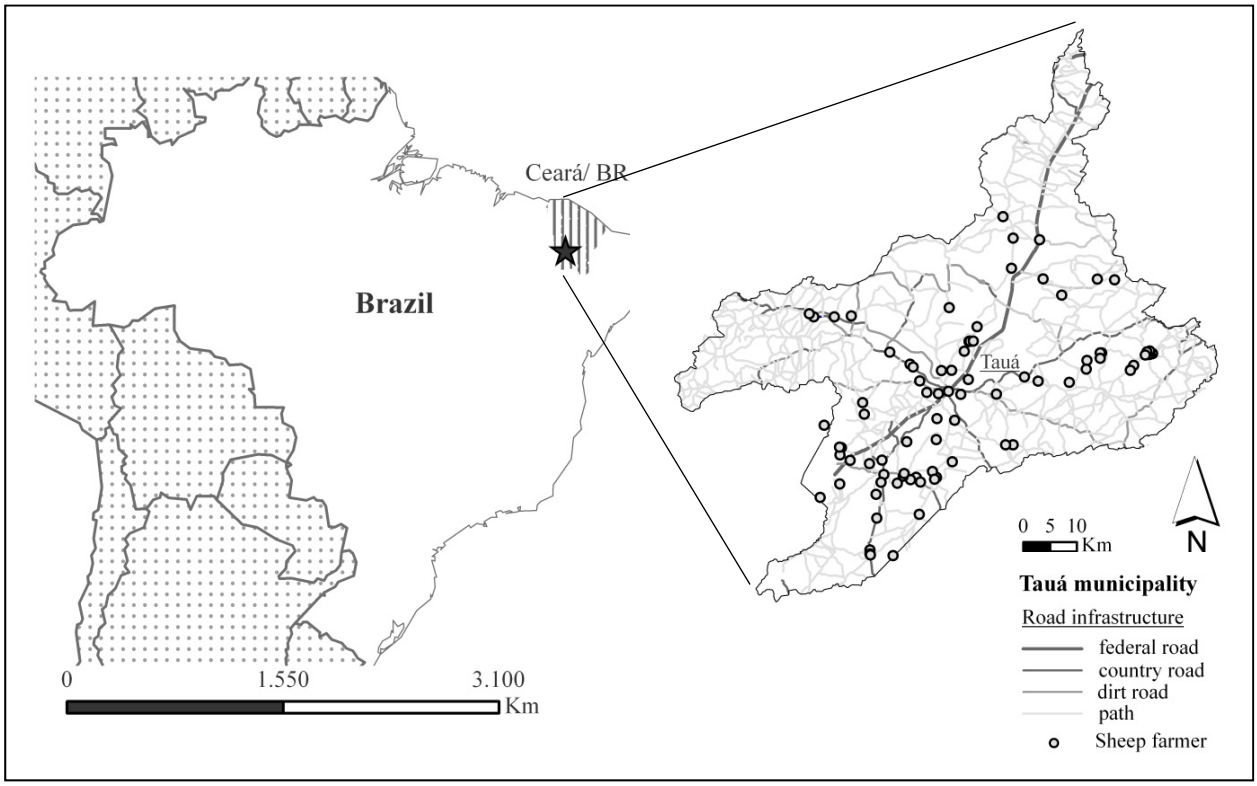
The climate is semi-arid, and can be described as a dry savannah zone (Gerstengarbe et al., 2000). Average annual rainfall is 600 mm, ranging between 155 to 1474 mm (6.1 to 58.0 inches); the average temperature the year round is 26°C (78.8°F); the altitude ranges between 400 and 800 m (1,312 to 2,625 feet) (Herfort et al., 2003). The rainy season lasts from February until the end of May, and the annual estimated evaporation rate is about 2000 mm (79 inches) (Frischkorn, Araújo, & Santiago, 2003). The Caatinga biome is divided into the arboreal, shrubby, and open Caatinga range vegetation. The typical vegetation protects and conserves soil and water resources and is characterized by a high heterogeneity, decreasing the vulnerability of the system (Maia, 2004). The available dry matter biomass varies seasonally between 1.2 and 2.3 Mg/ha (0.5 and 1.0 ton/acre); sheep browse on 62% of the tree and shrub species (Araújo Filho, Leite, & Silva, 1995). The combined effects of probable changes in land use and climate may alter groundwater recharge and lead to higher biomass variability in the future (Montenegro & Ragab, 2010).

Studies from 2008 indicate that 56% of Brazil's ovine flock was reared in the Northeast region, 22% percent was reared in the state of Ceará, and 7% were reared in the Tauá municipality (Instituto Brasileiro de Geografia e Estatística [IBGE], 2009). In 2006, the average flock size in Ceará was 27 head per household and 53 head per household in Tauá (IBGE, 2007). The sheep are mainly the hair type; they are reared primarily for mutton, and secondarily for sheepskin products. In Ceará, 90% of the farms are considered family farms (IBGE, 2007). Family farms are defined as having up to four fiscal modules of land (one module in Tauá is 90 ha or 222 acres) run by the family using mainly family labor and deriving income mainly from farm activities (Presidência da República, 2006).

Application of Existing Data Sources

This study was based on data of an unpublished 2006 project on integrated sheep production. One hundred twenty-nine Tauá sheep farmers (figure 1) were interviewed by the Embrapa Caprinos e Ovinos (Embrapa), the Sheep and Goats division of the Brazilian National Corporation for Research on Plant and Livestock Husbandry, in cooperation with local organizations. The farmers were randomly sampled from three groups of farmers that had already participated in different governmental programs. These included a breeding program, the National Project for the Fortification of Family Agriculture (PRONAF) project, and the APRISCO project, which promoted "integrated and sustainable sheep and goat husbandry." A fourth group consisted of randomly sampled farmers who had not received technical assistance or credit. Standardized questionnaires containing open- and closed-ended questions were pre-tested, adapted, and applied to collect data on socio-economic conditions, production techniques, and commercialization.

Figure 1. Study Area and Locations of Sampled Sheep Farmers



Based on 102 complete data sets of farmer interviews, multivariate data analysis was employed (using SAS, versions 8 and 9) to detect farming system structures. A multiple correspondence analysis (MCA) was used to establish all possible correlations between the observations (farmers) and the variables. Sixteen variables were selected to characterize each farm regarding land, labor, animal stocks and infrastructure, the fate of the sheep, volume of crop production, and off-farm income generation (table 1). Results then were entered in an agglomerative hierarchical cluster analysis applying Ward's minimum-variance linking method, forming five clusters. The proportion of variance accounted for by the clusters (squared multiple correlations) was 88%. Subsequently, the dataset was subjected to k-means clustering. The k-means method is a nonhierarchical clustering method identifying cluster nuclei predicted on least squares estimation. Since the variables were not normally distributed, significant differences between the clusters were tested using the chi-square test for the qualitative variables and the Kruskal-Wallis test for the quantitative variables.

Data Collection in 2008: Farmers and Other Key Persons in the Value Chain

Twenty-five percent of the farmers in each cluster were randomly sampled, and 23 farmers finally participated in in-depth interviews conducted in May and June 2008. The semistructured questionnaire addressed family size, labor force participation, living standard, crop and forage production, sheep production, and the classification of income sources. The geographic coordinates of the farms recorded in 2006 were measured using a GPS device (Garmin GPS 12). The distance from Tauá town to individual farms ranged between 4 and 46 kilometers (2.5 and 28.6 miles).

We conducted interviews with six key people, including a federal inspection service (SIF) staff member, two veterinarians from the Embrapa, and one staff member of the local health inspection

Table 1. Variables Used in the Multiple Correspondence Analysis

Section	Variable (units or levels)
1. Land and labor rights	Total land area of farm (ha)
	Legal condition of farmer (owner, leaseholder, tenant, homestead)
	Number of employees (headcount)
2. Farm infrastructure	Quantity of motor pumps (number)
	Quantity of telephones (number)
	Quantity of reservoirs (number)
	Quantity of wells (number)
	Quantity of forage silos (number)
3. Animal stocks and crop production	Sheep flock size (annualized number of adult head)
	Goat flock size (annualized number of adult head)
	Cattle herd size (annualized number of adult head)
	Crop production (kg/year)
4. Fate of sheep	Destination of sheep sales (no sales, middlemen, retailer, trader, consumer)
	Sheep consumed in the household (head/year)
5. Off-farm income	Total family revenue without revenue of product sales (R$/year)
	Revenue through retirement (R$/year)

agency. They were interviewed about national regulations and their enforcement, the existence of production standards, the regional sheep meat value chain, and sanitary control of local slaughterhouses and butcheries. The questionnaires used with the different key persons contained similar open-ended questions that also were complemented by additional questions related to the person's specific area of expertise. We interviewed a local and reputable historian in order to investigate the tradition and reputation related to the product. For cross-checking purposes on historical information, we also consulted the local Tauá library and the Embrapa library at Sobral. We conducted a further interview with the president of a cooperative founded in 2008 to support the production and commercialization of Tauá sheep and goat products (COOMANTA), which focused on the aims, objectives, and structure of the cooperative. Finally, we sampled processors, retailers and butchery owners according to their frequencies of nomination by the 23 farmers. In these semistructured interviews we explored the purchase and sale of sheep and carcasses, slaughtering and processing procedures, and demand and supply for sheep and carcasses.

The majority of those interviewed in 2008 (23 farmers, six key persons, six retailers, seven retailer-processors, four processors, and four butchery owners) were identified in pre-studies conducted by the Embrapa. We employed methodological and data triangulation (Denzin, 1970) to validate data concerning the actors in the production and marketing chain, and to address their functions and the linkages between them. Questions on sale and purchase prices and demand patterns (increasing or decreasing) were included in all interviews. Two sheep markets in Tauá and Fortaleza and the local slaughterhouse were visited to enhance and validate interview-derived information.

We compared geographical certification requirements according to the Brazilian National Institute of Industrial Property (INPI) to the current status of GI development in Tauá. The structural and motivational preconditions and the quality of cooperation necessary for successful implementation of a GI-product (Belletti & Marescotti, 2006; Larson, 2007; Marescotti, Belletti, Tregear, & Arfini, 2008) were contrasted with the existing situation in Tauá (based on this study's results).

Results

The Product — "Manta de Carneiro de Tauá"— and its Processors

Fifty years ago the "Manta de Carneiro de Tauá" had not yet been commercialized. It remains unclear when it emerged for the first time, though it was probably developed by travelers searching for an effective meat conservation method for long journeys through the dry hinterland of Northeast Brazil. The term "manta" relates to the shape and size of the product, which brings to mind a blanket. "Carneiro" refers to wethers and rams, the sheep categories preferred for the product.

Interviews indicated that animals selected to produce Manta should exhibit visual healthiness, be vaccinated and dewormed, and show good body condition. The selected sheep were generally males with an average age of 18 months (range: 5 to 48 months); castrated animals were preferred, although female adult sheep and lambs were also used. The sheep's breed was not a consideration for Manta producers. Six of eight processors and retailers stated friendship and confidence with the farmer as reasons for buying from him or her. The others considered the locality where the animal was raised and the purchase price. At the time of data collection, laboratory analyses highlighting particularities of the Manta were nonexistent.

The processing was generally done in the processors' backyards. First the animal was stunned using any means at hand, hung up by the hind legs, and then the carotid and jugular veins were severed to ensure complete bleeding. The animal was skinned, eviscerated, and the feet and head were removed. Then the pelvis bones were removed and the heads of the ribs were dissected from the vertebral column before the same was removed (lumbar vertebrae then the thoracic vertebrae, and finally the cervical vertebrae with the axis and the atlas), making the carcass relatively flat. The opened carcass was laid down on a wooden table in dorsal-ventral position and, using a meat chopper, the ribs were slashed three times laterally, followed by linear cuts in the breast musculature without slicing completely through the meat. The carcass then was turned around into ventral-dorsal position, and the femurs were exposed and separated from the tibiae by making cuts through all the muscles of the pelvic limb. Following this, linear cuts were made in the lumbar and abdominal muscles. To begin the curing, the processor dispersed fine salt over the carcass. The carcass was folded together and left to rest for 20 to 30 minutes before it was hung up for drying (figure 2). Three out of seven processors left it for an average of 2.25 hours in the sun and afterwards for an average of 5.4 hours in the shade. Others dried it in the shade only. On average, a 35 kg (77 lb.) live sheep yielded 11 kg (24 lb.) dried Manta. The Manta was sold directly or stored in the freezer as a whole or in parts.

All of the interviewed Manta processors were male; ages ranged between 28 and 75 years old and processing experience between 2 to 55 years. They further differed in the time needed for processing one carcass (20 to 40 minutes) and the commercial

Figure 2. Drying Manta

scale of production. For the majority of the interviewed processors, Manta processing represented a secondary economic activity and was described as a sound source of income.

Social and Economic Indicators of Farming Families and Their Farms

In the 2006 survey, the 129 farmers ranged from 21 to 89 years old (average 50 years). Most farmers were landowners; otherwise, contracted families, *moradores,* share-cropped the farm. In general, the *moradores* earned every fifth animal and were allowed to use a plot for their own cropping. A few were *assentados,* beneficiaries of a governmental settling program. As far as educational attainment, only 4% of the interviewed household heads were illiterate, 14% did not complete the first degree (9 years), 39% did complete it, 6% completed the second degree (12 years), and 8% had higher education. More than 90% of the households had radios, gas stoves, and televisions. Eighty-six percent owned at least one refrigerator, and 52% had at least one cell phone or landline phone. The average total labor force per farm was 5.4 persons (n=97), including 3.3 family members and 2.1 wage laborers.

Complementary information on the farm households, collected in 2008 on a sub-sample, revealed that 22 of 23 households used public electricity, employed a cesspit as a sanitary system, and had concrete flooring. Gas and collected firewood were used by 72% of the families as fuel, 6% cooked with purchased firewood and gas, and 22% used only collected firewood. The majority of the farms (83%) used their own cisterns as sources of drinking water; the others fetched water from canals and wells. None of the interviewed farming families said that they suffered from food insecurity.

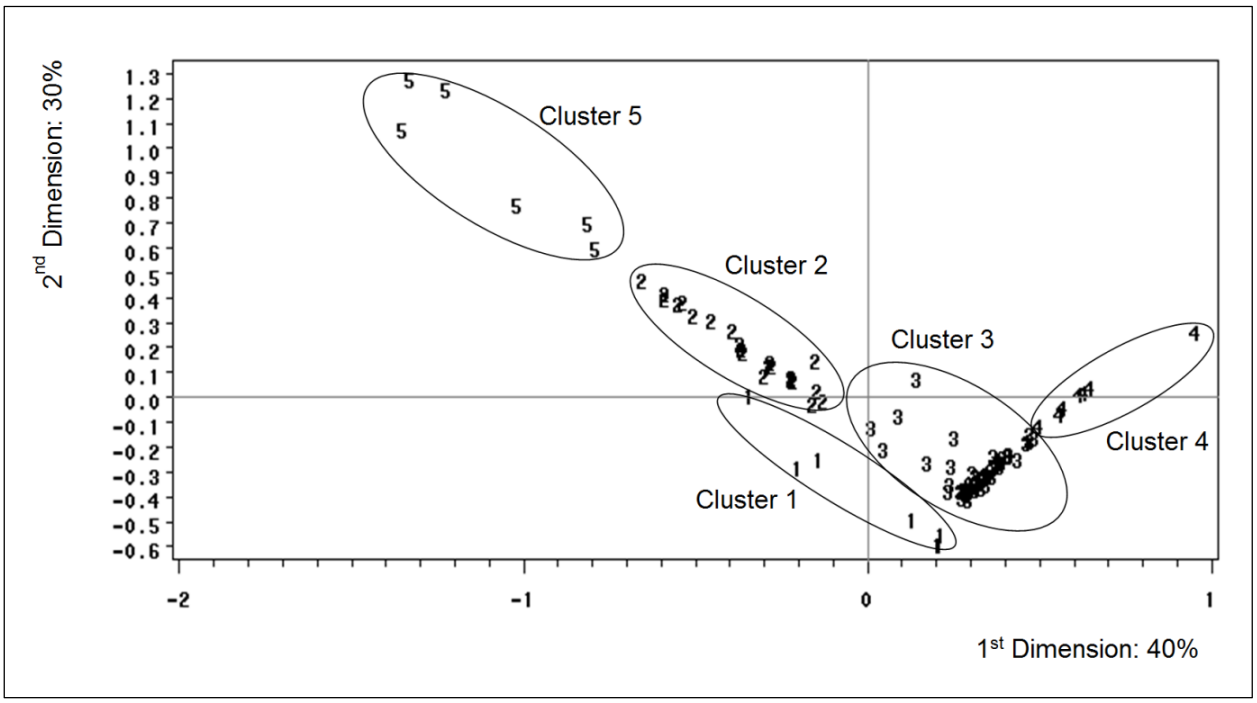
The farms (with an average size of 206 ha, or 509 acres) were usually divided into two to three plots. One was used for cropping and forage production, and the second, mainly managed Caatinga, was used for grazing sheep, goats, and cattle. The third was a reserve of Caatinga range to comply with a law that a minimum of 20% of the farm area has to be conserved. The average sheep grazing area accounted for 57% (n=22) of the total farm area, while cropping and forage production were an additional 15%. Grazing density averaged 1.7 sheep per hectare (0.7 sheep per acre). Temporary workers were employed during labor peaks (harvest or silage preparation). Wage laborers were paid 14–15 R$ per day (approximately USD8 in 2007–2008). After concluding school at age 16, farmers' children often continued helping on the farms. The sons were usually involved in animal and crop production, and the daughters in taking care of the house gardens, milk processing, and housekeeping. Sixty-one percent of male farmers worked predominantly on their own farm, 22% combined agriculture with part-time government employment, and 17% had a trade activity along with their farm. Twenty-nine percent of the women did household and farm work (taking care of chickens and the house garden, and processing milk into cheese, cream, and sweets), 33% worked full time in the household, and the remaining 38% had part-time jobs as teachers, school assistants, or vendors along with their home chores.

Characterization of Sheep Farming Clusters

Multivariate analyses were performed to detect structures in the sample. The first three dimensions of the multiple correspondence analysis (MCA) explained 92% of the total variance, and therefore were preferred over the two-dimension solution, which explained only 70%. Figure 3 shows the location of the farms after clustering in dimensions one and two of the MCA. Although clusters could be distinguished, they were generally not very distinct from each other.

Farms from clusters 1, 2, and 5 were rain-fed, mixed-farming systems (classified according to Steinfeld & Mäki-Hokkonen, 1996). Clusters 3 and 4 were livestock-production systems, though a small crop sector existed in cluster 3. Although some means of irrigation was present in roughly half the farms, the estimated contribution to total crop value was low. The number of farms per group was uneven, ranging from 6 to 56 (table 2). The five clusters were characterized as follows:

Figure 3. Distribution of the 102 Study Farms by Cluster, Presented Visually According to the Two First Dimensions of the Multiple Correspondence Analysis



Cluster 1: Pensioners still active in mixed farming system (n=7). The average farmer age was 66 years, and 86% of the owners lived on their farms. Over 50% of the farms were managed by family labor. Revenues realized from crops, small ruminants, and cattle were comparable; 67% of product sales were derived from livestock activities. The total revenue from product sales (TRPS) was 13,791 R$. This corresponds to 3.3 minimum salaries of 350 R$ per month in 2006. In contrast to other clusters, a large share of the total household revenue (34%) was generated from old-age pensions.

Cluster 2: Mixed farming system with focus on cow milk processing (n=23). A quarter of the farms were grouped into this cluster. Milk production and processing activities were relatively high in this cluster. Despite the lowest average number of sheep sold, sheep product sales contributed 25% to the total income; livestock in this cluster provided 44% of the TRPS, which accounted to 12,933 R$.

Cluster 3: Diversified livestock-farming system with intensive sheep production (n=59). This cluster included approximately half of the farms in the sample, had the largest average sheep flocks (148 head/household) and highest total revenue from sheep sales (4,309 R$). However, revenue from cattle production (including milk and derivates) equaled the sheep revenue, and secondary goat production was highest among the clusters. Livestock provided 95% of TRPS, which was 12,935 R$.

Cluster 4: Extensive sheep farming system (n=7). This cluster was characterized by extensive animal production. More than half of the farms (57%) were managed by sharecroppers who were practicing subsistence cropping and value their sheep as liquid assets. The TRPS was substantially the lowest (947 R$), 85% of which was from sheep. Secondary income sources of off-farm owners could not be identified, nor were the animal and crop production volumes and revenues recorded by the sharecroppers.

Table 2: Comparison of Sheep Farming Clusters Regarding Farm Labor, Household Characteristics, Livestock, Annual Production and Income

		Clusters					
		1	2	3	4	5	
Observations (n)		7	23	59	7	6	Signifi-
Variables	Unit	Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)	cance
Labor endowment and household characteristics							
Family labor force	Number	5.1 (0.8)	2.6 (0.3)	2.9 (0.3)	3.1 (1.5)	2.7 (0.9)	n.s.
Wage labor force	Number	0.6 (0.3)	1.5 (0.3)	1.4 (0.3)	2.4 (1.3)	4.5 (2.1)	n.s.
Age of the farm owner	Years	66 (5)	42 (2)	52 (2)	46 (5)	40 (7)	**
Owners that live on the farm	%	86	59	75	43	83	n.s.
Annual production and stocks							
Sheep, average flock size	Head	120 (27)	97 (9)	148 (14)	103 (20)	107 (25)	n.s.
Goat, average flock size	Head	17 (10)	26 (6)	72 (12)	42 (42)	39 (31)	n.s.
Cattle, average herd size	Head	28 (7)	21 (4)	23 (3)	33 (29)	36 (28)	n.s.
Cow milk solda	Liters	385 (250)	1,317 (571)	1,005 (594)	0 (0)	9,600 (6,350)	**
Cow milk derivates sold	kg	301 (195)	498 (99)	368 (100)	0 (0)	0 (0)	**
Crops sold	kg	2,047 (650)	3,579 (685)	195 (85)	0 (0)	6,077 (3,248)	***
Crops consumed on farm	kg	1,300 (639)	2,757 (418)	74 (32)	0 (0)	9,407 (4,177)	***
Annual revenues and pension							
Total product sales	R$[d]	13,791 (3,153)	12,403 (971)	11,197 (1,323)	947 (230)	11,801 (3,541)	***
Sheep	R$	3,700 (668)	3,071 (288)	4,309 (662)	807 (239)	2,033 (933)	**
Goat	R$	714 (520)	472 (141)	1,627 (350)	0 (0)	0 (0)	**
Cattle	R$	2,143 (609)	2,259 (475)	1,715 (313)	121 (121)	792 (526)	*
Milk[a]	R$	263 (171)	950 (404)	667 (378)	0 (0)	6,554 (4,335)	**
Milk derivates	R$	1,353 (857)	2,200 (449)	1,920 (501)	0 (0)	0 (0)	**
Other from animals[b]	R$	1,016 (522)	290 (152)	288 (101)	19 (11)	995 (669)	*
Crop and fruit	R$	4,601 (2,696)	3,161 (335)	583 (168)	0 (0)	1,427 (841)	***
Old-age pension	R$	7,329 (941)	98 (55)	131 (34)	0 (0)	127 (127)	***
Total household revenue[c]	R$	21,257 (3,825)	12,933 (1,013)	12,935 (1,585)	1,539 (733)	12,116 (8,704)	***

Note: Sample size = 102 farms; labor force n = 101; owners that live on the farm n = 98; SE = standard error of the mean; significance levels: *** $p<0.001$, ** $p<0.01$, * $p<0.05$ according to Kruskal-Wallis or chi-square test.

[a] Quantities of milk sold and revenue from milk were not consistently mentioned. A few missing values were replaced by the average price of 0.68 R$/L.

[b] Other product sales from animals included sheepskins and other animals. [c] Total household revenue included total product sales, old-age pension, transfer payments from social programs and donations, pasture rented out and part-time off-farm revenue. [d] 1R$ in 2006 ≈ USD0.46 (www.oanda.com).

Cluster 5: Intensive mixed farming system with significant cow milk sales (n=6). This cluster was the youngest, with a mean age of 40 years. More than 80% lived on their farms, but permanent wage labor was dominant (on average 4.5 wage versus 2.7 family laborers). Cow milk production was substantial, and provided the main source of income (56%). The farmers practiced subsistence cropping, consuming the majority of crops at home, coupled with an intensive animal-production system in which crops were converted into silage to feed livestock. TRPS was 11,801 R$, of which 88% was derived from livestock.

Sheep Management and Production Practices
Thirty-two percent of the farmers separated their animals by sex, and 16% separated their sheep according to their age. Castration was carried out by 84% of the farmers, and was generally done between the age of 2 and 6 months. Additional breeding rams were either bought or borrowed from neighbors. Average litter size from 71 farms calculated from the recalled number of single, twin, and triplet births in 2005 was 1.56 (range 1.0–3.0). The lambing interval was 8 months and the mortality until weaning (at about 3 to 6 months) was 14% in the 2006 sample. Lamb mortality up to the age of 18 months was low (3%) in the revisited subsample of cluster 5, while it was between 10% and 15% in the other revisited subgroups. The majority of farmers (68%) did not maintain records for the flock, although some recorded births and litter sizes. The main reasons for culling ewes were giving birth less than once a year (40%), the need for money (24%), and ill health of the animal (21%).

The interviews from 2008 described production systems ranging from extensive to semi-intensive. The main breeds raised were Santa Inês (27%), crossbreeds or sheep without defined breed (26%), Somali Brasileiro (19%), and Bergamácia (18%); the remaining 10% were nominal numbers of Morada Nova, Rabo Largo, Dorper, and local wool sheep. Generally, animals grazed and browsed the Caatinga vegetation throughout the whole year. Forty percent of the farmers modified the Caatinga vegetation by selective thinning, removing shrubs and trees with low forage value. Usually, animals spent every night or every second night in an enclosure, returning to the range in the morning. A quarter of the farmers divided the range in different plots. Water was not a major constraint even in the driest of seasons. In the rainy season, the animals fed exclusively on Caatinga vegetation, whereas in the dry season additional feed was provided by 82% of the farmers. The fodder was usually maize (*Zea mays* L.), sorghum (*Sorghum bicolor* L.), and/or a mixture of different grass species. More than 50% of the farmers prepared silage for feeding in the dry season, mainly from the above mentioned feeds. Further feed sources were algarroba pods (*Prosopis juliflora* (Sw.) DC.), cotton seed cake (*Gossypium* sp.), soybean (*Glycine max* (L.) Merr.), forage cactus (*Opuntia ficus-indica* (L.) Mill.), leucaena twigs (*Leucaena leucocephala* (Lam.) de Wit), and wheat bran (*Triticum aestivum* L.). About two-thirds of the farmers provided feed only for certain animal categories — rams, lactating and lambing ewes, and very weak animals. No systematic fattening protocol was found. In the dry season 45% of the farmers irrigated pastures with water from their small farm reservoirs or open wells. Most of the farmers (90%) provided mineral salt to the sheep. All farmers provided antihelminth preparations for the sheep (averaging 3.3 applications annually), and an average of 80% of each flock was vaccinated against rabies, clostridiosis, foot-and-mouth disease, and symptomatic carbuncle, while brucellosis control was only done in cattle.

Few (6%) of the farmers sampled in 2006 specialized in producing breeding animals for specialized markets. They used defined breeds, and mating was controlled by targeted selection of the ram. Concentrated feeds were provided, including during the rainy season. The specialized breeders appeared to attach a higher value to their animals, compared to the other farmers, as indicated by following the vaccination schedule more carefully and administering helminth-controlling preparations and vaccinations 3.6 times per year. Furthermore, their animals were registered, which implies record-keeping about births, live weights, applied drugs, and mating.

The Sheep Meat Marketing Chain, Estimated Trading Volume, and Prices

At the time of this study, the sheep meat production chain in the Northeast was weak and not formally organized. The 2006 study indicated that sheep were sold with an average live weight of 30 kg or 66 lb. (range 14–40 kg or 31–88 lb.), at an average age of 11 months (range 5–24 months). Neither lamb producers selling directly after weaning nor those who fatten lambs to a target weight could be distinguished. Few sheep were sold for breeding. Some were channeled through PRONAF, a government support program for emerging sheep farmers. Others were sold at specialized animal fairs and auctions, where breeding animals fetched significantly higher prices than slaughter animals.

The farmers sold approximately 90% of live sheep to retailers at the farms, and 10% at the market in Tauá. Forty-six percent of these sheep (approximately 46,000 head annually) were collected weekly from the farms by retailers, sold in a sheep market in the state capital, and subsequently bought by butchery and restaurant owners. Local butcheries processed approximately 30% of the sheep marketed in Tauá. They fattened the animals on their own farms and in this way secured a constant meat supply for their butcheries. Some interviewed butchery owners mentioned specifically purchasing lean animals at relatively low prices from farmers who were in need of money, indicating distress sales on the part of producers. This was confirmed by farmers who claimed they were preselecting weaker or older animals before they contacted the retailer. In other cases, the retailers approached the farmers when they intended to make a purchase. Selling Manta represented a secondary commercialization channel for 12% of the retailers, who in this case sold the sheep or the carcass — some retailers also did the slaughtering — to the Manta processor. Most Manta retailers also processed it. The processed Manta was sold in local butcheries, on the local market, in restaurants and to private persons.

The prices in figure 4 represent average prices per live sheep, carcass, and Manta throughout the production chain. Transport, slaughter, processing, and transaction costs were not included in these prices. Additional revenue through the sale of byproducts (such as the sheepskin and a local dish prepared from offal) was included in the prices of the meat and Manta. The margins between purchasing price and resale price were, on average, very small. Thus the Manta processors gained only minimal, if any, added value; profit margins were higher for those who both purchased and slaughtered the sheep themselves. To make a profit on Manta, the entire Manta must be sold for a minimum of 86 R$ (a 16 kg carcass, priced at 6.50 R$ per kg[1], yielded 11 kg Manta), assuming the processor had no further costs, did not remunerate labor, and sold the byproducts for approximately 18 R$.

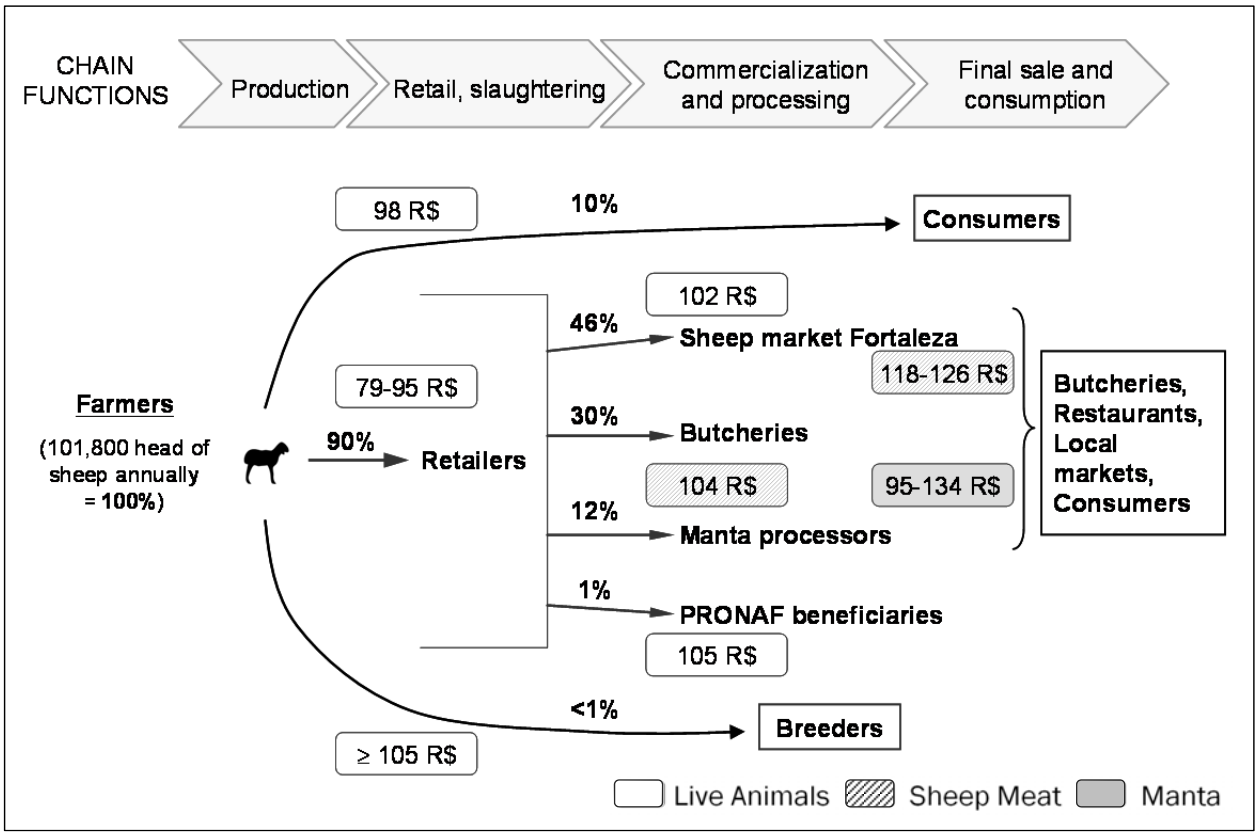
Most farmers sold animals year-round; others sold twice a year, receiving higher prices at holiday markets in July and December. In the dry season (July to December) the live weight prices generally increased by 0.10–0.40 R$ per kg due to lower supply. The interviewees generally perceived an increasing demand for sheep meat and Manta. Possible reasons for the increase that were mentioned include wider recognition of the nutritional value and taste of sheep meat, and the rising fame of Tauá sheep. Six of nine retailers did not report any difficulties in securing a constant sheep supply, while the others mentioned shortages of supply in the dry season and farmers' decreasing willingness to sell the animals due to the highly valued liquid asset function of animals.

Legal, Structural and Motivational Preconditions for Obtaining an Origin Certification

The legal preconditions in order to obtain a geographical indication label in Brazil according to the INPI resolution number 75/2000 (Instituto Nacional da Propriedade Industrial [INPI], 2000) are:

1. Evidence that Tauá has become known as a center of extraction, production, or manufacture of the "Manta de Carneiro de Tauá";

Figure 4. Estimated Relative Trade Volumes of Sheep, and the Respective Sale Prices of Live Animals, Sheep Meat, and Manta, Corrected to One Animal



Note: 1R$ in 2008 ≈ USD0.55 (www.oanda.com). The average live weight per sheep was 35 kg, with a carcass weight of 16 kg, yielding a Manta of 11 kg. PRONAF = governmental development project.

2. The establishment of a Manta production control system;

3. Proof that Manta producers are residents in the delimited geographic area (which implies that the geographic area has been defined); and

4. The need for a "description of the quality and characteristics which exist exclusively or essentially due to its geographic environment, including natural and human factors."

Apart from the legal requirements, further preconditions for successful implementation of a GI label (Belletti & Marescotti, 2006; Larson, 2007; Marescotti et al., 2008) can be summarized as:

1. Development of institutional, organizational, and infrastructural support related to the availability of and access to local and regional markets, and a demand and supply structure for the product; and

2. Motivational preconditions and a sufficient quality of cooperation, including capacity and motivation of initiators to guide the process; networking and collective action; fair and transparent attitudes among production chain members; and a personal motivation from the chain members themselves.

Feasibility of Introducing a Protected GI Label for the Manta de Carneiro de Tauá

Two challenges stand out to introducing a GI label

for Manta: Delimitation of the geographic area and differentiation from similar products. The "Manta de Carneiro de Tauá" is known as a regional specialty and the name "Tauá" is said to aggregate value to the product. In the interviewed historian's opinion, the commercialization of Manta likely began in Tauá. Knowledge of its processing spread to surrounding municipalities, where similar products are produced and sold under the same, a different, or no special name. According to study participants, Tauá sheep meat is regarded as special and unique due to specific forage plants found only there. Some interviewees mentioned an increase in demand, though at present this demand seems to be local. Demand from other states was due to migrants originating from the Northeast, and no indicators of national or international demand could be identified.

At the time of this study, neither official standards for mutton production, processing or carcass conformation nor laboratory analysis specifying meat quality traits were available, reflecting the heterogeneous production practices among the farmers and processors. According to the federal inspection service staff member, only 1% of all processed sheep in Ceará were slaughtered in formal slaughterhouses. Additionally, four of the five existing small ruminant slaughterhouses had to be closed due to irregular animal supply. Since supermarkets, butcheries, and restaurants willingly purchased meat without sanitary inspection seals, informal slaughters were common in the region. In Tauá, the physical structure of the slaughterhouse met cattle-slaughtering requirements, but not for small ruminants, which likely contributed to few locally processed sheep being slaughtered there. The health inspection agency, which supervised meat sold in Tauá's butcher shops and restaurants, did not control the origin and the visual appearance of the meats, which would be necessary for a GI protocol.

Formal commercialization structures for Manta and sheep meat in general were not present in Tauá, and the production chain was not transparent. Only economic profits realized by farmers were evaluated in this study. The Manta was marketed on a small scale along short informal channels. At the time of the survey, it was locally acknowledged that formal commercialization was almost nonexistent.

At the time of the study, several governmental and nongovernmental institutions in Tauá were willing to support GI implementation. However, integration in local policy and production seemed poor. The COOMANTA cooperative aimed to create a direct-market location for Tauá sheep and goat products and a small-ruminant slaughterhouse. A GI was not yet planned, but establishing such a slaughterhouse may facilitate the process of GI implementation. Cooperative membership implied membership in the Association of Sheep and Goat Keepers in Inhamuns (ASCOCI), which listed nearly 40% of farmers in clusters of three, four, and five as members in June 2008. Potential exists for predicting, recruiting, and tracking farmer participation through ASCOCI. However, the project had not been realized due to lack of funds and low stakeholder motivation.

Discussion

This study assessed current sheep production infrastructure and volume in the Tauá municipal as prerequisites for evaluating the farmers' and region's potential and limitations for introducing a GI label for the local sheep meat product Manta de Carneiro de Tauá. While there is some literature on GI certification of animal-source products in Europe, the present study is a rare case of a certification project for an animal-source product in a tropical country. The introduction of the proposed label faces the following series of obstacles.

Product Quality: Hazardous, Typical or Standardized

The present study confirms the statement of Holanda Júnior, Alves, Silva, and Lopes (2007) and Lousada Júnior (2007) that Manta represents a typical, traditionally processed product. From this point of view, and considering the organoleptic nature of Manta as a "quality, which exists exclusively or essentially due to its geographic environment, including natural and human factors" (INPI, 2000), it may qualify for a geographical certification label. However, the parameters distinguishing its

uniqueness will have to be proven to achieve legal approval. Furthermore, the selection and extent of standards — currently nonexistent for Manta — are crucial and complicated, as they may alter the typicality of the product. When "quality" is defined not only by sensory quality and originating from a specific place, but also by processing hygiene, food safety, and animal welfare aspects, Manta as it is currently produced does not meet certification requirements.

The primary reason for this is that production and processing conditions do not follow any standard. Observation of Manta processing confirmed that critical control points identified by Holanda Júnior et al. (2007), like hygienic measures taken to reduce the risk of contamination, e.g., changing of clothes before processing the meat, were poorly addressed. A laboratory meat quality analysis of Manta samples from Tauá to be compared with samples from a different origin was under way in 2010 (M. Suely Madrugada, personal communication, 19 September 2010). Applying microbiological tests on inspected and noninspected bovine dried meat, Costa and Silva (2001) found high levels of hazardous bacteria in both samples, and significantly high feces contamination in the noninspected sample. However, this might not be problematic, as high levels of hazardous bacterial strains in a traditional salted and dried sheep meat can be controlled due to the characteristics of the product (low water activity due to salting and drying; Bennani, Zenati, Faid, & Ettayebi, 1995). Introducing hygienic measures to prevent a suggested but not proven hazard may result in a change of the product's typical flavor (Scintu & Piredda, 2007).

Production Systems and Target Groups

Contrary to expectations, revenues were comparable among clusters, excluding pension payments and the extensive system (where owners' off-farm revenues could not be accounted for). Sheep played the most prominent role in the biggest cluster, forming a large target group for improvements in the sheep sector. In contrast to findings in Bahia (Holanda Júnior, 2004), cropping and off-farm activities were restricted and livestock-based farming systems prevailed. A small group of farmers was observed to be applying more sophisticated management practices, including commercializing breeding animals. A similar situation was described for the state of Rio Grande do Norte, where a very small number of farmers, generally with larger farms, specialized in producing ewes and rams for breeding (SEBRAE/RN, 2001). Breeding animals could fetch exceptionally high prices, yet it was a small market niche for auction enthusiasts. Producing breeding animals, however, signals a readiness for substantial adjustments in the production and commercialization process.

Sheep Management

The harsh local environment with an irregular rainfall distribution, high temperatures, and lack of feed resources in the dry season negatively affects sheeps' growth (Fernandes, Buchanan, & Selaive-Villarroel, 2001; Gertner, 2006). This is reflected in the sheeps' weight-to-age ratio. The average sheep in this study reached 30 kg (66 lb.) at an age of 11 months (all values based on recall; no recurrent on-farm measurements could be made for validation). Sheep grown in traditional systems in Rio Grande do Norte reach 27 kg (60 lb.) at an age of 12 months (Guimarães Filho et al., 2000). A technical manual (Banco do Nordeste do Brasil [BNB], 2008) states that the weight of a sheep at an age of 12 months ranges between 31–33 kg (68–73 lb.) live weight in the traditional system, and reaches 33–35 kg (73–77 lb.) in a more specialized system. Medeiros (2006) showed that Morada Nova sheep fed on the lowest level of concentrates in a station trial required over one year to reach a slaughter weight of 30 kg (66 lb.). Literature and study results suggest production of young lambs (up to 6 month old) for slaughtering is unusual in the Northeast; slaughters at one year of age or older were more typical. COOMANTA (2008) suggested the following selection criteria for Manta production: young animals before the eruption of permanent incisors (less than 12 months), with an average carcass weight of 13 kg (29 lb.), a normal to slightly fatty body condition (score 3 to 3.5 on a scale from 1 to 5), and in perfect health. The animals should be slaughtered in slaughterhouses and be inspected before being transported to the processing house.

Not all sheep sold were immediately slaughtered. Emphasizing the liquid asset function of sheep, farmers sometimes contacted the retailers themselves after preselecting old, weak, and sometimes undernourished sheep. The retailer benefitted from a low price per animal by doing the final fattening before slaughtering. This practice is confirmed by a study in the state of Bahia where 68% of the interviewed farmers preselected old cull sheep and thin animals (Holanda Júnior, 2005). In the Tauá study, the reason for sales, such as culling, need for emergency cash, and sale of finished animals, could not be determined.

The mortality rate of the lambs before weaning identified in this study (14%) was similar to the lowest technological level in the Brazilian Northeast (BNB, 2008), and similar to that identified by Girão, Medeiros, and Girão (1997) for lambs from single births (15%). Guimarães Filho et al. (2000) identified higher levels (15%–25%) in the traditional husbandry system.

The feed and forage composition described by the farmers in this study is, according to Campos (2003), typical for the region. Additional nutritional feed resources would be needed to reduce slaughter age and thereby increase turnover or marketability for lamb or premium lamb markets. Substantial changes in the feeding basis, however, would not comply with the GI-certified product concept, since browsing was one criterion for its uniqueness. Additionally, sanitary measures have to be applied properly and appropriate breeds must be chosen. Any potential advantages accruing from management changes must also be contrasted with increased costs and labor demand. The sheep production systems in this study were all at a low to medium technological level. However, the existence some advanced techniques, like silage-making and preventative health management, hints at an openness toward system changes on the part of at least some of the farmers.

Marketing of Sheep Meat

Almost half the sheep were sold to retailers at the farm gate, heading for markets in the state capital. The other half, which was consumed locally, reached the consumer via retailers or direct farm sales. Tauá has the tenth largest total sheep stock out of 5,564 municipals in Brazil and the biggest in the Northeast (IBGE, 2009), highlighting its regional importance. Nevertheless, in the prevailing traditional trade procedure the animals are not weighed or health-inspected; they are only classified visually according to their body condition (Holanda Júnior, 2005). Thus the sheep markets in the Northeast are informal and use low levels of technologies (Fernandes, Selaive Villarroel, & Osório, 2007). Moreover, they lack infrastructure and show low organizational levels throughout the market chain (Brisola and Santos, 2003, as cited by Fernandes et al., 2007). According to Benitez-Ojeda (2002), this leads to a product without quality control, as confirmed by the present study.

Existing slaughterhouses had to close in the region as sheep supply was short, although the number of sheep kept was reportedly high. Informal slaughters turned out to be a common practice in the Tauá region. This was similar in Bahia, where the majority of the sheep (97%) were slaughtered informally without inspection, thus preventing the marketing of sheep products to distant — and formal — markets (Holanda Júnior, 2005). Gertner (2006) further identified informal slaughters as the major obstacle for the development of the sheep and goat meat value chain in Bahia.

Demand for Manta de Carneiro de Tauá

In this study, an increasing demand for Tauá sheep in general, and for Manta de Carneiro de Tauá in particular, was suggested but could not be quantified. Lousada Júnior (2007) and Fernandes et al. (2007) similarly stated that for many years the supply has not been able to meet the increasing demand for sheep meat in the cities of the Brazilian Northeast region. Cerdan and Sautier (2003) indicated that consumers search for products that represent a link to their cultural background and values. Our findings support this, as consumers demanding Manta in Ceará and throughout Brazil seem to be almost exclusively people originating from Tauá or the states of the Northeast. A rough estimate of the current production volume of the Manta in Tauá is up to 12,800 carcasses processed

into Manta annually (approximately 250 Mantas weekly). This number corresponds with a total of 800 animals being processed into Manta weekly in Tauá and the nearby municipalities of Independência, Crateús, and Parambu, 90% of which are consumed locally (França, 2006). It was furthermore estimated that only 12% of the sheep were currently used for Manta preparation; the majority entered other marketing channels. Even if the demand for Manta was increasing, farmers still receive the same prices for their live sheep, regardless of the intended final product. The current production systems seemed not to assign specific production goals for lambs. Manta production reinforced this nondifferentiation, as a fixed sex, age, or weight of the animal was not demanded, nor a specific breed. Therefore currently there is no incentive for farmers to produce more sheep for Manta, since they have various alternatives to sell their sheep.

Potential of Sheep Production for Manta

A higher profit through sheep sales could benefit farmers, especially those with a high share of income from sheep sales. In particular, the farms in cluster 3 generated a large share and absolute amount of their total revenue via sheep sales. The Brazilian agricultural ministry suggested that the production of sheep for Manta could increase farm profits. Under the current extensive to semi-intensive production conditions, the present study could not confirm this. The certification of Manta would involve changes and investments that bear price and commercialization risks for the farmers. The animals used for Manta preparation do not meet a specified standard, apart from the preferences of each processor. Formulating uniform production standards and carcass characteristics is a prerequisite for successfully increasing sheep production for Manta, since the product may enter new markets with specific expectations. The standards have to be communicated explicitly and transparently in order to assign a unique product identity to Manta that is substantially different from a Manta without a label. This will be crucial for local consumers, who would have a choice between products with and without the label.

The technical regulations for Carne do Pampa Gaucho da Campanha Meridional, a beef produced under a GI in the south of Brazil, clearly defined the animal breeds, a specific feeding regime, and minimal weights accepted at a certain age, and delimited the geographic area (APROPAMPA, 2010). The delimitated area can be extended beyond current administrative borders if a produce qualifies. This could reduce the exclusion of farmers producing sheep for Manta outside Tauá. Accepting only specific local breeds would ease process control (as well as assist the conservation of local breeds). Capping flock sizes could protect smallholders' stakes.

Incentives for a farmer to produce sheep for Manta would include receiving a premium price for the respective sheep or participating fully in the production chain until final sale. An analysis would necessarily build on a comprehensive standard of good practices. Whether the benefits of the Manta GI would outweigh its implementation and maintenance costs was not estimated in the present study, although an investment analysis for a tentative GI of a Costa Rican cheese suggested a positive return in the third year (Granados & Álvarez, 2007). This is a crucial point, since no clear evidence supports the general assumption that GI benefits reach farmers in developing countries and improve their livelihoods (Jena & Grote, 2010). The possible negative externalities or risks accruing from a GI also need to be evaluated, such as those that may emerge from unequal development of standardization or organizational modifications (Roussel & Verdeaux, 2007).

A recent Brazilian policy supports the implementation of research results aimed at organizational and technical innovations that improve the livelihoods of rural people (Farias & Mendes, 2009). Since the conclusion of our study, the proposed processing house was built in Tauá with funds from Brazilian Services for the Support of Small Enterprises (SEBRAE) and promotion by Embrapa. COOMANTA does not focus on Manta alone; its mission is to add value by developing a range of products from sheep and goats, inspired by the more differentiated beef-processing sector.

However, neither the generally superior sheepskin quality of hair sheep over wool sheep (Fernandes et al., 2007), nor promoting a targeted production of lambs for a premium market, is currently included in product development plans. Emphasizing a value chain, which is linear by definition, masks the web character of livestock-keeping and associated products and services (Otte, 2010). The potential of alternative or parallel production and commercialization strategies for Tauá farmers should be investigated.

A multiple-product approach may be helpful, as it is not evident currently if a geographical certification would have a value-adding function for the product, nor if farmers would benefit economically from its implementation. Investing into a more standardized Manta production may be a useful pathway for some, but perhaps not all, farms. COOMANTA (2008) even suggested that only farmers participating in one of the various programs of technical assistance in the Tauá region should be allowed to deliver sheep for Manta production. In this way, controlled implementation of production standards could be more easily managed. A detailed and consistent farm monitoring program, including following performance and development of individual animals, is needed as a reference for planning. A stakeholder analysis should clarify the roles and interests of the different and increasing number of production chain members in Tauá, along with estimating their economic benefits and risks. Further research remains to approximate the likelihood of meeting the legal, organizational, structural, and functional criteria that are essential for successful implementation. The availability of marketing options for farmers needs to be assessed, as well as the desired level of involvement of various institutions. Effective technical assistance should be secured in order to jointly adapt best practices of production to local conditions. As soon as the quality of production, processing of the meat, and distribution reaches a certain standard, then the (processed) meat may enter the market at higher prices without GI status (Larson, 2007). Officially approved standards could facilitate the certification process. The presence of officially certified products, however, appears to indicate a certain level of development and therefore more a result than a means to trigger it (Marescotti, 2003).

The question emerges whether farmers will be sufficiently better off, and more competitive, by intensifying their systems consistently according to general standards. If so, they may opt to avoid the tedious process of label introduction and maintenance. An answer to these questions requires estimates of future livelihood and market dynamics. Ultimately, it will be complex to merge current local skills with scientific knowledge and regulations without losing the product's identity (Bouche & Moity-Maïzi, 2009).

In conclusion, this study showed that the introduction of a certification concept for Manta de Carneiro de Tauá is not an immediate solution to improving the livelihoods of farmers in the study region. On the one hand, the profitability of the product at the farmer level is not clear, and on the other, a range of preconditions need to be met that are currently far from being fulfilled. Farm types with a higher dependence or focus on sheep sales are more likely to profit from such changes. Yet farm profitability and the feasibility of the related structural and functional changes of the chain could not yet be assessed satisfactorily.

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Unfolding farm practices: Working toward sustainable food production in the Netherlands and Spain

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Abstract

The modernization of agriculture has caused and continues to cause an increasing disconnection between farming, nature, and society, which has also created a series of social, economic, and ecological crises in the food chain. Case study research of farmers responding to this situation can show us what changes are required to encourage a reconnection between farming, nature, and society. This paper provides ethnographic case study research of two farms: one situated in a productive polder in the Netherlands, and the other in a disadvantaged mountainous area in Galicia, Spain. They both employ "novelty production," farmer-driven adaptations to the farm, seen as a socio-ecological system. These novelties change the input-output relations on farms and result in adaptations in different farming domains (technical, economic, and socio-organizational), which we see as "unfolding" farming practices. This paper examines how these farmers have sustained and improved the socio-ecological performance of their farms and how these changes have led to a shift in the farm as a socio-ecological system and changed the configuration and boundaries of the farms. In conclusion we look at prospects for this approach being supported at a wider level.

Keywords

case study research, farming, food production, novelties, novelty production, farm labor

Introduction

The modernization of agricultural food production is leading the contemporary globalized food system towards a social, economic and ecological crisis. The suggested responses to this crisis follow two

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opposing pathways or paradigms: the agro-industrial and the territorial agri-food paradigm (Lang & Heasman, 2004; Marsden, 2003; Sonnino & Marsden, 2006; van der Ploeg, 2003, 2006; Wiskerke, 2009). These paradigms adopt very different perspectives over a number of key issues. The former sees processes of change as driven by externally designed and radical system innovations, whereas the later sees change as driven by incremental, gradually unfolding, *promising* practices that are adapted to and optimize regional potentials. The agro-industrial approach favors the application of innovative industrial technologies provided by the expert system, whereas the territorial agri-food paradigm stresses the importance of skill-oriented technologies based on local knowledge. Finally, they have different views on interactions with the environment, with the former in favor of altering the environment to accommodate a large-scale production system, and the later seeking to create a balance between the environment and the current production system and its further evolution on the basis of *terroir* (see Barham, 2003).

We argue in this paper that sustainable food production *needs to be rooted firmly in the regional context.* The territorial agri-food paradigm aims to re-embed food production within, and upon, the qualities and distinctive features of a region (Wiskerke, van Huylenbroeck, & Kirwan, in press). Yet this approach does not receive much attention in the international debate on the future of agriculture and the sustainability of food supplies. Despite increasing interest in recent years (see for example the report of the United Nation's Special Rapporteur Olivier De Schutter on the potential of agro-ecology (United Nations, 2010)), the mechanisms for fostering these reconnections between farming, nature, and society have not been adequately explored or documented.

In response to this shortcoming, this article provides a comparative ethnographic approach on how the socio-ecological performance of farms can be improved through a process of adaptation, which we refer to as "unfolding" and explain as a series of "novelties": small adjustments done on the farm that result in a shift of farm boundaries (Swagemakers, 2002; van der Ploeg et al., 2004; Ventura & Milone, 2004).[1] We begin by drawing a conceptual framework that describes this process of *unfolding farming,* in which we distinguish system innovation generated by farmers from the one provided by the expert system. Farmer-driven novelty production differs in nature from innovations provided by the expert system, and is better placed to drive the move toward a more sustainable agri-food system as it *involves* regionally oriented system innovation, and hence generates development that balances social and environmental factors. We then describe the methods, rationale, and selected locations used in our case study research. Next we explain how two farmers have converted their conventional dairy farms into organic farms by developing short supply chains. In the final section we analyze the adaptation processes and the shift in farm boundaries that have occurred on both farms in terms of novelty production, and we make some remarks on the more general constraints facing the further enhancement of sustainable food production.

Unfolding farm practices

Farmers can be seen as brokers between nature and society (Toledo, 1990). They work at the interface where society and the natural ecosystem meet in an artificial ecosystem, an agro-ecosystem (Altieri, 1987, 1995, 1999; Sevilla Guzmán & Martínez Alier, 2006). Through the specific interactions and mutual transformation of humans and living nature (Toledo, 1990), farmers continuously (re)produce and reshape, diminish *or* improve the natural resource base (Gerritsen, 2002; Swagemakers, 2008; van der Ploeg, 1997, 2008). Agro-ecosystems have been described as dynamic socio-ecological systems (Rammel, Stagl, & Wilfing, 2007) that are

[1] "A novelty might emerge and function as a new insight into an existing practice or might consist of a new practice. Mostly a novelty is a new way of doing and thinking — a new mode that carries the potential to do better, to be superior to existing routines" (van der Ploeg et al., 2004, p. 1). Novelties are meant to reach a new, desired farming situation and are part of the process of system innovation employed by farmers (Wiskerke & van der Ploeg, 2004; Milone, 2009).

subject to a process of continuous adaptation (Holling, 2001; Stagl, 2007; van der Ploeg, 2008). They can be improved by the "agency of actors" (Giddens, 1984) or when "practitioners" pay more attention to optimizing their performance (Warde, 2005). In this sense, these systems represent objectified and accumulated labor (Bourdieu, 1986) and context-related knowledge about the interrelations between the natural and socio-economic resource bases (van Kessel, 1990). Agro-ecosystems are often further strengthened by incorporating new producer-consumer relationships (Sevilla Guzmán & Martínez Alier, 2006; Holloway, Kneafsey, Venn, Cox, Dowler, & Tuomainen, 2007), a process that Marsden and Smith (2004) defined as "ecological entrepreneurship."

In farming, the mobilization and conversion of resources and the marketing or re-use of end products are interrelated and mutually adapted processes (van der Ploeg, 2008). This means that "resources can be mobilized from the respective markets (and, thus, enter the process of production as commodities) or they might be produced or reproduced within the farm itself (or within the wider rural community). This implies that 'outputs' can also be oriented in two ways: towards output markets or towards reuse (perhaps after socially regulated exchange) within the farm" (van der Ploeg, 2008, p. 153). The farm can be understood as a series of nested systems, each the focus and locus of co-evolving systems (Farell, 2007). In developing their farm, farmers need to look at and balance the technical, economic domain and social-organizational domains (Leeuwis, 2004). These domains, or subsystems, are constantly undergoing a process of adaptation, both internally and in their interactions, which result in novelties — small adjustments in one of the many tasks and activities on the farm (Swagemakers, 2002; van der Ploeg et al., 2004; van der Ploeg, Verschuren, Verhoeven, & Pepels, 2006).

The production and testing of novelties emerges from the tacit knowledge of experienced practitioners. In working toward sustainable food production, farmers' intuitive insights drive them to pursue often complex patterns of action. These insights are based on their experiences of farm development and of the wide range of factors that affect the outcome of context-specific and complicated processes of adaptation. These insights are reflected in and tested, verified and communicated through novelty production (Baars, 2010). Farmers as practitioners employ a "prospective structure" that "has the power of forceful fiction, and opens up space for action" (van Lente, 1993, p. 236). The novelties they create are based on their expectations and generate a wider program of interrelated and mutually reinforcing novelties that might succeed or fail (van der Ploeg et al., 2004, 2006). A set of novelties can be interpreted as a development path (Geels & Schot, 2007) and the resultant agro-ecosystem reflects the "materialized connections" between nature and society (Gerritsen, 2002; Roep, 2000). Through a process of continuous adaptation, the connection between farming, nature and society is reconstructed in a step-by step fashion.

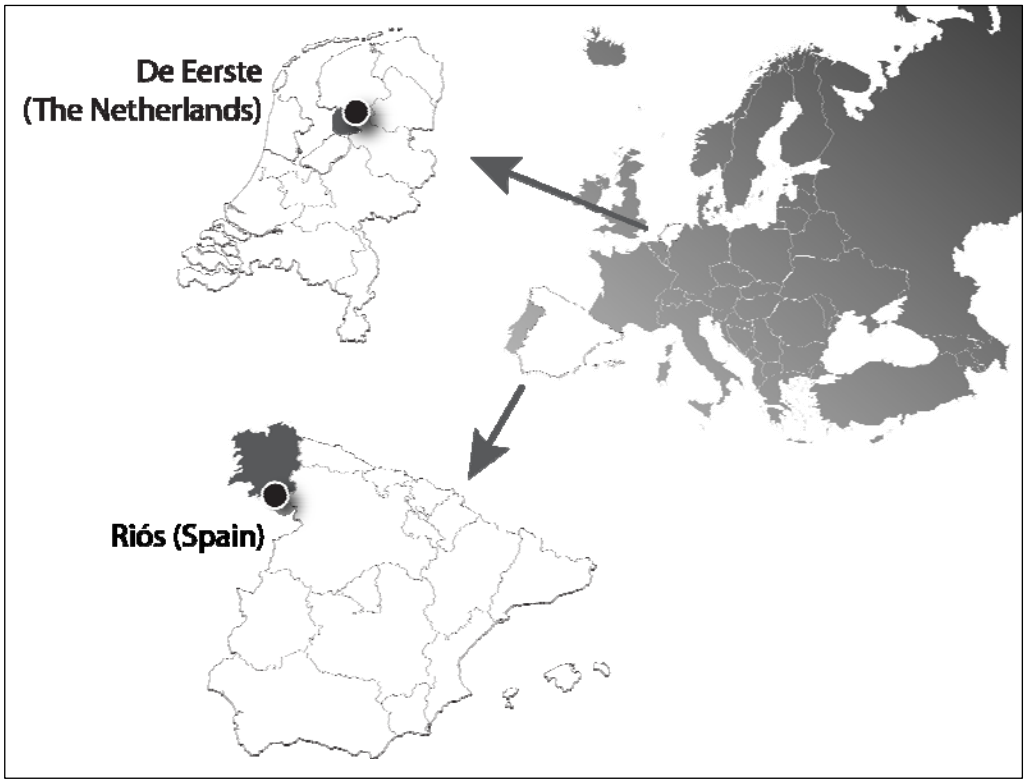
System configurations that stem from, and are based on, farmers' intuitive insights often remain undervalued and receive little attention (van der Ploeg, 2003, 2008). The ordering "rules" that result from these practices (Giddens, 1984), especially the normative and cognitive rules, differ from the rules of externally designed system innovation (Rip & Kemp, 1998; van den Ende, 1999). Since the latter stabilize the existing, recognized, and accepted trajectories (Geels & Schot, 2007), these farmer-developed practices often remain "invisible" or at least unnoticed. They can be considered as "niches" or "incubation rooms" where ideas and new patterns or configurations ripen, allowing the potential emergence of radical system innovations (Geels & Schot, 2007; Hoogma, 2000; Kemp, Schot & Hoogma, 1998; Wiskerke & van der Ploeg, 2004). As niches, these practices allow niche actors as well as "outsiders" (researchers, politicians, farmers, people involved in food industries) to learn about the constraints and the requirements of the system innovations being developed (Hoogma, Kemp, Schot, & Truffer, 2002).

Novelties are new and promising artifacts, concepts, approaches, organizations, and arrangements that are at a stage of *infancy*. They are immature and vulnerable and still have to prove their validity and value, especially outside the contexts in which they have been developed. On the basis of our case study research, we argue the need for a different organization of social, ecological, and economic relations at higher levels of aggregation (Altieri, 1989), that is, at the territorial level. Our analysis of the practices of farmers who work toward increasing their sovereignty of production leads us to call upon scientists, politicians, farmers, and those involved in food industries to recognize and include the potentials of agroecology and the "rules" implicit in reconnecting farming, nature, and society.

Applied research methods

We document two cases of farmers who are reconnecting nature and society by unfolding their farming practices in ways that improve the socio-ecological performance of their farms. We have used a case study research method (Yin, 1984), which provides context-dependent knowledge (Campbell, 1975; Flyvbjerg, 2006) that generates detailed insights about what is happening in the situations studied (Stake, 2000). We have adopted an ethnographic approach (Spradley, 1979), carrying out direct observations, analyzing written documents (articles in newspapers, farming magazines, and on websites) and held interviews that consisted of "active and methodical listening" (Bourdieu, 1996). In order to gain "extensive" knowledge of the subject (Bourdieu, 1996), we spent some time living in the case study areas (see figure 1) and joining in with the farmers' daily activities. Sometimes we stayed for a day, other times for weeks or even months. We drove the tractor, helped with seeding, harvested the hay, milked cows, made cheese, went to farmers' markets, drove the van for home deliveries, got to know the farmers' consumers, and became consumers ourselves. This fieldwork experience (Fetterman, 1989) taught us much about the daily life of the practitioners. Through the application and combination of different sources of information and different research methods (Mathison, 1988; Verschuren & Doodewaard, 1999) we increased the internal validity of the field research.

Figure 1. Map Indicating Locations of Case Study Farms in the Netherlands and Spain



As part of the research process, we planned questions and developed interview protocols to ensure that the interviews covered all topics of interest and drew on an ethnographic tradition to understand the farmers' life histories. Alongside formal interviews, we had frequent informal discussions with our subjects about topics of mutual interest. In the interviews, some lasting two hours, others much shorter, but always *in situ* (Svendsen, 2006), we co-constructed with the interviewee the meaning of their practices (Heyl, 2001) and benefitted from the rich details they provided.

Results

In this section we describe how the two farmers converted their conventional dairy farms into organic production systems and established new producer-consumer relationships. In the first two sections we discuss the specific novelties on the two farms. In the third section we discuss the interrelations of the novelties as part of a newly evolving (unfolding) system configuration at each farm.

Organic farming in a polder in the Netherlands

In 1987, Gerrit and Bertiene Marsman took over "de Eerste" (literally "the first"), originally an experimental state farm that was the first to be established on the virgin sandy soils after the Noordoostpolder (Northeast Polder[2]) was created in 1942. The farm was atypical of the rest of the polder in that it was on sandy (as opposed to clay) soils and had been intensively fertilized to make it productive. The couple began by converting this farm into an organic dairy farm. The first year they started cheese production, partly as a way of increasing their income, but more because there was a very limited market for fresh organic milk at that time, so cheese-making allowed for more flexible sales. During an interview about the conversion to organic farming, Gerrit explained his personal motivation:

> I use the farm to shape a type of ambition. I live with a certain idea. You have to work out things together. You are responsible for each other and for other parts in the world. This farm and these soils, partly determines what happens in other parts of the world. — *G. Marsman*

Gerrit sees organic farming as reducing the environmental impact of farming and providing better conditions for the animals and people who work on the farm as well as in other parts of the world, since organic farming has reduced impact on farmers and the natural resource base overseas (in the Global South). Besides providing environmentally sound and healthy food, Gerrit and Bertiene supply organic food products to households with a wide range of incomes. Over time a series of novelties (outlined below) has evolved that have gradually become more strongly interrelated. This strategy (i.e., a mixed farm) has enabled them to develop their dairy farm much less intensively than most of their colleagues. Typically a dairy farm would have 150 milking cows; Gerrit and Bertiene can generate equivalent revenue from just 60.

1. On-farm milk processing

Converting milk into cheese, yogurt, butter, and buttermilk is labor-intensive, but adds value to milk production. The farm annually produces 33 tons of cheese, one-third of which is sold through short supply chains. On-farm milk processing keeps transport costs low and results in fairer prices for both producer and consumers.

2. New breeding objectives

A smaller breed of cow produces fewer units of milk, but per unit it is richer in protein and fat. This means that similar quantities of cheese can be produced with less input of feed. Although the breed is not optimized for beef production, the less productive cows are slaughtered and their meat sold as mince in a short supply chain.

[2] According to Wikipedia, "A polder is a low-lying tract of land enclosed by embankments (barriers) known as dikes, that forms an artificial hydrological entity, meaning it has no connection with outside water other than through manually-operated devices" (Wikipedia, "Polder," 2011).

> A Holstein-Friesian produces around 9,000 liters [2,378 gallons] of milk with 3.4% protein and 4.2% fat, thus around 570 kilogram [1,257 pounds] of fat and protein. To produce this quantity of milk, they require 2,430 kilogram [5,357 pounds] of concentrates, about 27% of the total production. On the other hand, the Jersey gives 6,000 liters [1,585 gallons] with 4% protein and 5.5% fat — the same volume of protein and fat — but only consumes 1,200 kilogram [2,646 pounds] of concentrates, representing 20% of the production. For me, cross-breeding Holstein and Jersey is very attractive. — *G. Marsman*

3. Short supply channels

The dairy products, meat, eggs, and vegetables produced at the farm are sold through several venues: in the farm shop, at farmers' markets, and via a home-delivery system. Selling a range of organic and fair-trade products generates extra cash flow that makes the shop profitable.

4. Small-scale activities

Raising pigs and poultry often involves high veterinary, feeding, and labor costs. For Gerrit, however, keeping pigs and poultry helps maintain the balance of the farm. Whey, a residue of the cheese-making process, is used to feed five pigs, and the manure of the 500 chickens is used to fertilize the vegetable fields. The labor input for these activities is supplied by the farmers, and the meat and eggs are sold in the farm shop. Overall these activities contribute to the economic and ecological performance of the farm.

5. Manure management

A deep litter house provides shelter for the dairy cows. Fresh straw is put in the house daily in order to keep their udders clean, an important consideration since "dirty" milk results in bad cheese quality. The resultant manure is low in emissions and there are few losses to the groundwater system. Some slurry is also produced, which is used as liquid manure for the horticultural crops (see novelty 6, below). This also reduces susceptibility to disease.

6. Growing cash crops

Soon after taking over the farm, the idea of growing vegetables emerged. This required investments in tractors, a forklift truck, and storage capacity, but these have benefited the farm as a whole. For example, the forklift that is used to transport boxes of vegetables is also used to sweep the fodder in the feed alley. Plant residues are recycled to improve the fertility and structure of the soil. The turnover of the farm has increased, although running it requires more labor input and this requires some organization. This system can best be described as grassland rotation: giving over one-quarter of his grassland to crop production each year. This enables the land to be used more intensively for crop reduction, while minimizing the risk of erosion that is inherent to arable production on these sandy soils.

7. Cooperation between neighboring farmers

Diversifying and expanding activities requires extra labor and machinery. Growing potatoes or making straw or silage requires special machinery and involves peak labor periods. A group of neighboring farmers work together, pooling their machinery and labor to carry out these jobs more efficiently. Once the jobs at one farm have been done, the group moves on to the next.

8. Mobilizing labor

Growing vegetables expanded the labor demands on the farm, and it was decided to acquire a horticultural manager who would act as a partner and have a stake in the farm. This creates a new way of using human resources. This approach is extended wherever possible to other employees, creating relationships that more akin to partnerships than employer-employee relations.

> People are responsible for what they do. My philosophy is that one should see what motivates people, what interests them, what they like to do, and what they will make out

> of something. Then, stimulate this. — *G. Marsman*

The farm land, buildings and machinery are owned by the farmers, and the partner contributes his labor time. A structure has been created to motivate both parties. Both are dependent on the economic results of the activity, and they also share the risks and benefits. The farmers provide the land, manure, machinery, and 500 hours of Gerrit's labor per year; their partner, the manager, invests 2,500 hours in planting, harvesting, and selling the products. All these costs are later recalculated in labor hours. A successful harvest will give a bonus of about 15% in the salary of the partner. This provides a motivation for him to produce as efficiently and accurately as possible, and also gives incentives to use the machinery and land provided by the farmers efficiently. The partner has gradually invested in capital-intensive production factors, thereby acquiring more "hours" (all input factors are calculated in terms of hours), which in turn increases his share of the income when the harvest is sold. The production factors can also be lent or hired to others, again generating revenue for the partner. When there is a high demand for labor (say for sowing or harvesting), the partner can make use of labor available in other parts of the farm. When labor (his or that of his workers) is not in demand, it can be provided for other activities on the farm.

9. Shared use of mechanization

Machinery is in use in several parts of the farm. For example, there is a powerful tractor used to plough, mow, and harvest straw. There are also several old tractors that are used for smaller jobs, such as seeding, weeding, and bringing the straw from the field to the cattle sheds.

> I look critically at how the machinery will be used. I calculate by the hour and the hectare to see what is worth investing in. By cooperating, you can reduce the costs of mechanization. With 600–700 hours of tractor work per year, it makes sense to buy a second-hand tractor. With 1,000 hours per year, a new one becomes profitable. In horticulture, the tractors work 300–400 hours, and new tractors are certainly not profitable. But a hard job like weeding needs a mechanical solution, which can be provided by a smaller, second-hand tractor. — *G. Marsman*

For time-consuming and heavy activities, a powerful tractor pays for itself. While spending similar amounts on diesel, the job is done more quickly. Lacking the money to buy a heavy-duty tractor, Gerrit hired one from a neighbor for a while. Once enough money was available (and his colleague became busier), buying the new, powerful tractor was attractive.

10. Fodder production in nature reserves

The farmers also rent a three-hectare [seven-acre] nature reserve that is used for hay production. This is used to feed the yearlings, which are kept to increase the herd. While it takes as much time as making silage on the farm, this allows them to grow cash crops and to pasture dairy cattle on the farm itself. In dry weather it is cheaper to make hay than silage. An even cheaper option would be to allow the yearlings to graze on the nature reserve, but this is not allowed under the terms of the lease.

11. Optimizing landscape and natural values

Farmland on polders is normally very intensively managed, but Gerrit manages to find space on the farm to include features that enhance the ecological robustness of the farm. There is a subsidized pond, which attracts birds and helps drain the land during wet periods, leaving it drier and more easily worked. Bushes and trees have been planted along the farm tracks. These provide habitats for small animals, provide shelter against rain and heat for the cows, and help prevent the sandy soils from being blown away.

12. Increasing organic matter content

Improving the organic content in the soil is a priority. As an experiment, over the last five years 10,000 tons of compost (equivalent to 300 fully loaded trucks) bought in off the farm have been

spread over 50 hectares (124 acres) of land. Whereas nutrient flows (e.g., dairy products and vegetables) are usually only directed to the market, on this farm they are also circular. The compost is applied either after the grassland has been plowed (80 metric tons per hectare, or 36 U.S. tons per acre) or before the vegetables are harvested (40 metric tons per hectare, or 18 U.S. tons per acre). This experiment was based on having access to a free resource (the compost), but the cost of transporting and spreading the compost was very real and has been calculated at €30,000 (approximately USD39,000) over the five-year period. The results, in terms of improved organic content, are still to be checked, but it is expected that it will have increased substantially.

Organic Farming in a Mountainous Area in Galicia, Spain

Galicia has experienced decades of massive emigration from its poor rural areas, resulting in high concentrations of older residents in these areas. The land and farm structure as a consequence of the emigration also provide few possibilities for earning a living; small-scale and widely dispersed field parcels complicate the viability of pasturing cattle. In 1984 José Luis Páz established a small dairy farm in Riós, a village in the mountainous area close to the border between Portugal and Spain. Although his family was from the village, he started as a young "newcomer" from the city. Following advice from the extension service, he started small, with six milking cows. He planned to improve the farm, and by tapping into subsidies he invested in buildings, machinery, and in purchasing additional milk quotas to expand the farm over the years. However, José Luis began to have doubts about this intensive way of farming. Starting in the early 1990s, he started to be concerned about the health problems of his herd. The cows regularly became infected by disease, shortening their life span and requiring a high input of antibiotics and anti-inflammatories. In 1998, he was invited to visit organic farms elsewhere in Europe at a time when he was thinking about changing things at his farm. This gave him the opportunity to learn about alternatives, and after he returned from the trip he converted his dairy farm into an organic beef cattle farm. He sold his milk quota, began breeding a local cattle breed, and started a cooperative. In the talks we had with José Luis, he explained to us that he lacked a background in farming:

> I came here with a theoretical ambition. I had an idyllic idea about the countryside that was rooted in my youth. My parents migrated to the city when I was seven years old. But I still remembered how I went to the fields with my father, and we took care of the cows and the land. It seemed like a good life and the idea of that beauty remained inside me. — *J. L. Páz*

José Luis learned that his idea of the rural life differed from that of the people who had remained in the village. He searched and experimented with solutions to his farm's problems, a great many of which failed, yet he has accomplished his wish to live a good life and to be working in, and taking care of, the land. While not always successful, his experiments have resulted in the production of a series of novelties as described below, which gradually became more strongly interrelated.

1. Creating a cooperative

The cooperative supplies a range of inputs (organic fodder, solar panels, fencing materials), advice on organic production methods (particularly on preventive, curative, and antiparasitical medication), and administrative support to meet the requirements of agro-environmental and organic production schemes. It also provides transport to the slaughterhouse and sells the organic beef.

2. Short supply channels

Meat is sold directly to clients as vacuum-packed fresh meat. Customers include individuals, organic shops, supermarkets, and consumer associations. There is also a growing customer base among professional butchers and restaurant owners who appreciate the natural identity and taste of the meat. Customers can also buy half a cow, paying a

price that is based on the slaughter weight of the animal.

3. Improving animal health
Alternative ingredients, such as bicarbonate of soda and yucca extract, are used to protect the cattle's digestive system, instead of conventional medicines. This results in healthier cows with a longer life span, lower veterinary costs, and "safer" meat. Such an approach requires farmers to have an open attitude to experimenting with new, often not yet scientifically "proven profitable" fodder strategies.

4. Changing from dairy to beef production
The change from dairy to beef production involved less labor input and resulted in lower costs for external inputs. This was helped by using breeds that are well adapted to local conditions. The reduced cash flow is compensated for by selling the meat in short supply chains.

5. Breeding autochthonous beef cattle
José Luis wanted to introduce *Vianesa* blood into the herd. This is an autochthonous breed which is perfectly adapted to the mix of productive valley grasslands and less productive mountain pastures. He initially acquired and bred a 20-year-old *Vianesa* cow that he located in a remote rural village. After it died, crossbreeding was continued by buying a bull, purchasing sperm, and bringing in cattle from elsewhere. In addition to introducing *Vianesa* bloodlines, José Luis has also introduced the *Cachena* breed to his herd. This is a small indigenous breed that is well adapted to the poorest pastures, especially to *monte bajo* (mountain scrubland). As smaller breeds of cattle, these animals have a lower slaughter weight than conventional breeds like the *Galician rubia* and *Limousin*. Subsidies have helped get more farmers involved in crossbreeding these endangered autochthonous breeds: a subsidy of €200 (approximately USD260) per calf compensates for the 40–50 kilograms (88–110 pounds) difference in weight.

6. Accessing land
Rather than entering the formal land market, José Luis has achieved access to land through informal arrangements with family members. Some 100 hectares (247 acres) of land, all small and scattered plots, is "leased" annually in this way, generally in return for meat products.

7. Pasturing the cows
Cattle grazing outside find heather and other medicinal plants.

> My cows not only eat grass, they also eat the lower branches of the trees and the bushes and scrub. Some of these bushes help keep them clean from parasites. — *J. L. Páz*

Only in summer, in the driest period when the grass production stagnates, and in winter, during the coldest days, do the cattle remain stabled at the farm, where they are fed with silage and hay. The silage and hay provide sufficient energy for the beef cattle. Only when fattening the calves in the last two months before slaughter are any concentrated inputs required.

8. Differentiating meat quality
Consumers recognize and appreciate the flavor, color, and texture of autochthonous breeds. Apart from *Vianesa,* which makes up 90% of the herd, the *Cachena* breed is highly appreciated by professional butchers and restaurant owners, who pay a premium price for this meat.

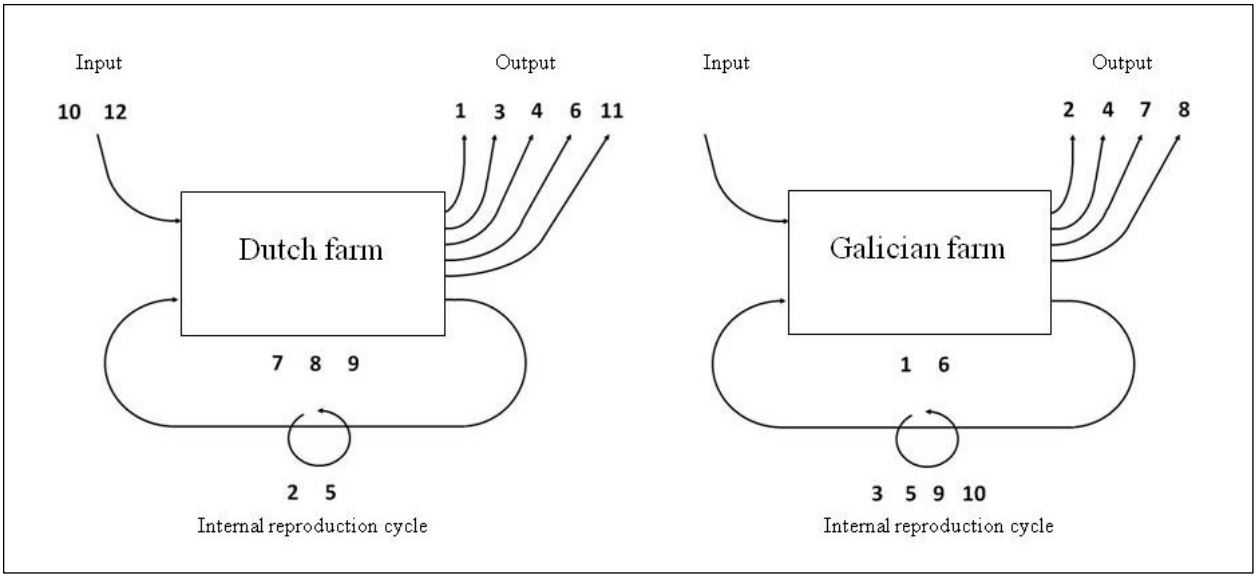
9. Improving organic matter content
The fertility of the soil is improved by leaving the grassland unturned. The plow has been sold and the land is only turned with a rotavator if needed. This saves costs and results in a richer top layer of soil life. The grass mix is richer and more diverse.

10. Composting manure
Soil fertility is further improved by adding a catalyst to the manure. The catalyst, developed in Germany, stimulates worms to grow faster so they more rapidly transform the manure into humus. Although making compost requires more labor, this pays dividends in terms of improving the soil fertility and stimulating grassland production.

Table 1. Overview of the Novelties Developed at the Farms

Novelties at the Dutch farm	Novelties at the Galician farm
1. On-farm milk processing	1. Creating a cooperative
2. New breeding objectives	2. Short supply channels
3. Short supply channels	3. Improving animal health
4. Small-scale activities	4. Changing from dairy to beef production
5. Manure management	5. Breeding autochthonous beef cattle
6. Growing cash crops	6. Accessing land
7. Cooperation among farmers	7. Pasturing the cows
8. Mobilizing labor	8. Differentiated meat quality
9. Shared use of mechanization	9. Improving organic matter content
10. Fodder production in nature reserves	10. Composting manure
11. Optimizing landscape and nature values	
12. Increasing organic matter content	

Figure 2. Transformation of Input-Output Relations: The Novelties Created at Both Farms



Source: Adapted from van der Ploeg (2008, p. 153).

New On-Farm Activities and a Shift in Farm Boundaries

Table 1 provides a summary of these novelties, showing the order in which the novelties were developed by the farmers. Over time, the novelties came to mutually support each other and unfold into improved and more efficient input-output conversion rates (van der Ploeg, 2008). Figure 2 illustrates how this works. The conversion to organic farming and the diversification of farm activities resulted in a shift of farm boundaries, leading to a range of adjustments and new activities being established at both farms.

In the left side of figure 2, we see how at the Dutch farm the milk produced is processed into cheese (novelty 1). This affects the breeding strategy at the farm, leading the farmer to search

for a cow producing more protein and fat per unit of milk (novelty 2). The cheese is sold through short supply channels (novelty 3): a small farm shop, a home delivery service, and several farmers' markets. Apart from dairy products, more than 600 dry products are sold, together with meat and eggs produced on the farm (novelty 4). These new activities support other ones: the manure from the chickens is used in horticultural activities, and the whey from the cheese production and vegetable leftovers from the shop are fed to the pigs (novelty 5). Horticulture and arable crops (novelty 6) generate a demand for labor and a higher turnover per hectare, but could potentially reduce soil fertility. To compensate for this, soil fertility is sustained by the input of manure produced on the farm (novelty 5) and the application of compost

from municipal recycling programs (novelty 12). The conversion to organic farming resulted in a range of new activities, which required a reorganization of farm management. Local farmers exchange their labor and machinery (novelty 7) and partners are drawn in to work in different partnerships created at the farm (novelty 8). The machinery and labor available in the partnerships is shared (novelty 9), increasing efficiency in the use of both in all areas of the farm. Furthermore, land use is optimized by creating new elements in the landscape (novelty 11): the construction of a pond has improved water management; trees act as windbreaks and reduce soil erosion. The grassland lost to horticulture, arable farming, and landscape elements are at least partly compensated for by grassland production in a nearby natural reserve (novelty 10).

Figure 2 also shows the effects of conversion to beef cattle production at the Galician farm (in the right side of the figure), which involved selling organic meat through a cooperative. These two changes led to a range of other adjustments being made at the farm. A cooperative (novelty 1) supplies a wide range of services to the farmer and his neighbors. Initially, it was difficult to convince other farmers to become involved, but nowadays about 70 farmers are members, which strengthens the cooperative's position, especially in negotiations and mediation. The cooperative provides transport facilities (a truck), organic fodder, management (organic certification requirements), technical support, and the information needed to participate in subsidized programs. The organic beef products are sold through various distribution channels all over Spain (novelty 2), and animal health is improved by a reduction in their consumption of concentrates and the routine use of preventive medicines (novelty 3). At the farm, dairy production has been converted into beef cattle production (novelty 4). Autochthonous breeds (novelty 5) such as the *Vianesa, Cachena* and *Caldelás* are used. These are better suited to the poor grazing conditions in the area. The *Caldelás* is particularly well fitted to *monte bajo,* and their grazing restores this land to productive pasture. These varieties also help control invasive bushes and scrub, which is ignored by more productive cattle, which also improves the quality of the pasture over time. Autochthonous breeds recover the traditional functions of the *monte bajo,* which includes providing animal feed, cereals, fruits, and organic manure (see also Soto, 2006; Domínguez García, 2007). Abandoned or neglected land is accessed through family relationships (novelty 6). Bringing the land back into use diminishes the risk of forest fires in the mountainous areas and revitalizes a resource that was once a crucial element in sustaining small-scale agriculture. However, this land arrangement may not be a long-term solution, as the lack of a legal contractual status could endanger the continuity of the farm. This might require new solutions in the future. By grazing in natural fields with mixed vegetation, the cows benefit from ingesting medicinal plants (novelty 7), improving the quality and flavor of the meat (novelty 8) and reducing their susceptibility to disease and the need for antibiotics. No longer renewing the grassland improves the organic matter content of the soil and increases the varieties in the grassland (novelty 9). Initially, the level of grassland production fell as the soil regenerated, but it has since recovered and can now provide sufficient grass and fodder to feed all the beef cattle at the farm while also improving the taste

and quality of the meat. Besides saving costs and benefitting the natural environment, the method saves labor time — time that the farmer invests in marketing the beef products and adding extra value per unit of product. The recent reduction in subsidies for maintaining indigenous breeds and cross-breeding is being at least partially compensated for by selling the meat to specialized butchers and restaurant owners. These cows improve the *monte bajo,* bringing it back into productive use and thereby creating another asset for the farmers, and reducing the risk of fires. The *monte bajo* can be plowed and fertilized with 'Xesta' *(Citysus scoparius),* a native leguminous plant variety that grows well in there. Xesta also contributes to improving the quality of the manure (novelty 10).

Analysis and Discussion

On both farms, the novelties have been developed across a "broad spectrum of the domains of farming" (Leeuwis, 2004, p. 64): the technical domain (soil fertility, crop protection, animal health, production and yield, storage facilities, spatial organization of the farm, regeneration of production potential, etc.); the economic domain (income, profitability, marketability, taxes, investments, cash flow, credit, fixed costs, variable costs, etc.); and the domain of social-organizational relationships (relationships with input-providing organizations, organizations on the output side, state organizations, certification institutes, members of the household, other farmers, community members, farm laborers, etc.). These changes began with more technical tasks in the technical domain. This was followed by adapting tasks in the economic domain and the domain of social-organizational relationships. These in turn resulted in further adaptations in all different domains, generating an *unfolding* of farm practices.

For example, in the technical domain, the improvement of soil fertility is crucial. In the Dutch case, soil fertility has been improved by the application of compost (novelty 12) and the use of grasslands in a nearby nature reserve (novelty 10). These novelties have led to an increase in the input of organic matter into the farm system. In the Spanish case, soil fertility has been optimized by changing from dairy production to beef production (novelty 4) and through the use of autochthonous breeds (novelty 5). These novelties decrease the pressure on soil fertility. The use of the *monte bajo,* an asset that is currently less than fully employed, would further increase the soil fertility of the productive grasslands. In both cases, the animals have been selected in response to changes in the farmers' production objectives. At the Dutch farm, where milk is processed into cheese (novelty 1), smaller breeds more efficiently turn feed and fodder into proteins and fat (novelty 2), which allows the production of a similar amount of cheese using *less* milk and *less* feed and fodder intake. At the Spanish farm, a similar shift in production has occurred: smaller animals are used (novelty 5) that supply meat that is rich in taste (novelty 8) and finds its way to consumers through short supply chains (novelty 2). The Dutch case also uses short supply chains to sell the food produced on the farm (novelty 3). Although the contexts of the farms differ, as does the physical distance to markets, both farms are selling quality products with a local character and identity via short supply chains. Attracting, informing, and engaging consumers in short supply chains allows for a further diversification of production activities. The Dutch farm produces pigs, eggs (novelty 4), and cash crops (novelty 6). The Spanish farm combines the use of autochthonous breeds (novelty 5), methods of accessing land (novelty 6), improving the natural resource base (novelty 7), and improved meat quality (novelty 8).

Producer-consumer relations play a key role in sustaining the improvements these farmers have made to their socio-ecological systems (van der Ploeg, 2010). The extra value added through short supply chain channels "pays the farmer back" for a more labor-intensive method of food production, for the knowledge that needs to be accumulated, and the use, reproduction, and possible improvement of the natural resource base. These case studies show how the farmers convert "ecological" capital into economic capital. This is a mutually reinforcing process: the short food supply chains

sustain the socio-ecological performance of the farms and vice versa. The coordination of the tasks and the opportunities within the domain of social-organizational relationships allow both farmers to expand their farm activities. The diversification of activities at the Dutch farm and the access to more land at the Spanish farm both result from the farmers' capacity to mobilize and optimize locally available resources. In the Spanish case, access to land (novelty 6) is a privilege not granted to everyone, which is paid back in kind. In the Dutch case, similar mechanisms of reciprocity can be recognized: in return for access to the land, the partner returns a "share" of the production to the owner. Hence, the partner has opportunities to expand his activities (novelty 8), which provides new resources (novelty 9) to all those involved.

These dynamics show how differentiating production activities and organizing short supply channels influence patterns of production and reproduction, and create new relationships in the social-organizational domain. In both cases, external inputs are being replaced by internally produced or reproduced resources: soil fertility, local or adapted breeds, food products, labor, and locally specific knowledge about the production process. Both farmers "farm economically" (Dominguez Garcia, 2007; van der Ploeg, 2000), and this improves the overall performance of the socio-ecological systems.

In contrast to conventional food production, the farm activities are developed in a way that increases the autonomy of the farmer. In this sense, these farming practices represent "robust" models of food production (Wiskerke, 2007). The case study research shows how *practitioners* can create their own responses to the degradation of natural resources and the agrarian crises, particularly the frequent outbreaks of livestock diseases associated with intensive farming, which appear to be a result of the increasing disconnection between farming, nature, and society (van der Ploeg, 2006).

As we have argued above, these system configurations provide a "prospective structure" (Hoogma et al., 2002; van Lente, 1993) for alternative pathways along which farming, nature, and society can be reconnected. These systemic configurations unfold in different contexts, but they share the common characteristic that the adaptations are guided by a re-orientation toward the local ecological and socio-economic resource base.

The unfolding of farming within a local context can be further strengthened when scientists explore, test, and verify the interrelations between novelties, while politicians and policy-makers pursue an objectives-led policy — instead of implementing prescriptive measures — that allows for and stimulates the exchange of novelties between producers and promotes scientific research on promising novelties. While it may be difficult to find more than a few farmers who manage to combine a successful social-ecological and economic performance, as exemplars of good practice they should be more involved in strategies to promote and disseminate the much-needed transition to sustainability. They provide a living example of how it can be achieved.

The niche innovations that are developed and carried out by small networks of dedicated niche actors can only be more widely diffused if they are linked up with processes in the "outside" world (Geels & Schot, 2007; Klerkx, Aarts, & Leeuwis, 2010; Schot & Geels, 2008). This uptake implies a shift in the dominant socio-technical regime, i.e., the grammar or rule set in the complex whole through which activities of actors (both insiders and outsiders) are structured (Rip & Kemp, 1998), with the regime here being the mainstream agro-industrial expert system. Such shifts generally occur when the current regime realizes that the existing technological opportunities are exhausted, when governmental policies dramatically change, and/or when new sets of social values emerge (Kemp, Schot, & Hoogma, 1998). Regime shifts are complex transitions (Geels & Kemp, 2000) that entail a gradual but continuous process of adaption alongside structural changes in the character of society (Rotmans, Kemp, van Asselt, Geels, Verbong, & Molendijk, 2000). Each adaptation

and/or link within the new system configuration — the farms in these case studies — involves negotiations, renegotiations, and, usually, the construction of new institutional relations at the regime level (van der Ploeg, van Broekhuizen, Brunori, Sonnino, Knickel, Tisenkopfs, & Oostindie, 2009). It is important that the actors involved in ensuring the stability of the current regime (Geels & Schot, 2007) are aware of the potential of alternative system configurations.

Hence, citizens, farmers, researchers, and politicians should be informed and incorporated in the "real stories" of innovating famers who develop "radical" novelties in niches (Schot & Geels, 2008). We are convinced that the descriptive presentation of the process of novelty production in the case studies, as well as the analysis of the adaptation process itself, have roles to play in helping to build understanding of how we can start building a more sustainable agri-food system.

Conclusions

Our comparative ethnographic case-study research shows how practitioners establish new system configurations that reconnect farming with nature and society. The move toward a sustainable agri-food system requires novelty production: a farmer-driven adaptation process that is specific in place and time, results in improved social and environmental relations, and allows for economic progress. At the farms in the case studies a series of adjustments was identified, which we have conceptualized as novelties. It is through novelty production that the activities at the farms and, hence, the characteristics (or configuration) of farming change. In the Dutch case, the farmer has converted a conventional dairy farm into a multifunctional organic farm with on-farm cheese processing and vegetable production. In the Spanish case, the farmer converted a conventional dairy farm into an organic beef cattle farm by using and reproducing autochthonous breeds. At both farms, the process of unfolding farm practices resulted in a shift of farm boundaries: both configurations are sustained by the construction of short food supply chains.

Such reconfigurations are in stark contrast to the model advocated by the modern agriculture industry. Many of the structures of this regime in terms of food processing, distribution, and retail as well as its regulatory aspects stifle regionally specific, small-scale, diversified configurations. Since established socio-technological regimes are generally resistant to change (Geels & Schot, 2007), the further unfolding of these new configurations is likely to be constrained by either strategic obstruction or inadequate support from the dominant socio-technical regime. Although the establishment of successful transitions cannot be guaranteed by "ideal type" pathways (Geels & Schot, 2007), we think it is important to draw attention to the creativity and success of these farmers who are building a future in what are often seen as the margins of society.

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Could Toronto provide 10% of its fresh vegetable requirements from within its own boundaries? Part II, Policy supports and program design

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Abstract

Urban agriculture in Toronto largely focuses on self-provisioning, but it could be scaled up significantly. Our findings in an earlier paper indicate that the supply of land is not an insurmountable barrier. Rather, other more subtle impediments exist, including taxation systems and structures that assume agriculture is a strictly rural activity; inadequate sharing of knowledge among urban producers; limited access to soil, water, and seeds; and the lack of incentives to attract landowners and foundations to provide financial or in-kind support.

The potential exists to develop urban agriculture so that it supplies 10% of the city's commercial demand for fresh vegetables. Scaling up to this level requires significant policy and program initiatives in five key areas: Increasing urban growers' access to spaces for production; putting in place the physical infrastructure and resources for agriculture; integrating local food production into the food supply chain; creating systems for sharing knowledge; and creating new models for governance, coordination, and financing. Our recom-

Note: An earlier and more wide-ranging version of this paper was published by the Metcalf Foundation as *Scaling up urban agriculture in Toronto: Building the infrastructure* (Nasr, MacRae, & Kuhns, 2010).

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mendations, while focusing on Toronto, offer lessons for those currently attempting to strengthen urban agriculture in other cities.

Key words
planning, policy and program supports, Toronto, urban agriculture

Introduction

As is true for many cities in North America, food production in Toronto is primarily an informal provisioning and recreational activity. The city of Toronto has made several policy commitments to urban food production, but has yet to advance an integrated implementation plan to expand commercial production.

In discussions of urban agriculture in Toronto, the explanation for its limited scale is often that the demand for land in the city has remained robust, offering few abandoned or empty lots to accommodate food production. In an earlier companion article, MacRae, Gallant, Patel, Michalak, Bunch, and Schaffner (2010) make the case for scaling up urban agriculture in Toronto and indicate that access to growing spaces (land and rooftops) may not be the major impediment to implementing urban agriculture in Toronto. The study concluded that Toronto required 5,725 acres (2,317 ha) of food production area to meet 10% of current consumption requirements (based on market purchases).[1] Of this, 2,653 acres (1,073.5 ha) would be available on:

- existing Toronto farms and lands currently zoned for food production,
- areas zoned for industrial uses (some vacant, some in other uses)
- over 200 small plots (between 1 and 4.9 acres or 0.4 and 2 ha) dotted throughout the northeastern and western parts of the city (most in use, but some vacant).

This area could be supplemented with rooftop production; the maximum rooftop area required would be about 3,072.8 acres (1,243.5 ha), or approximately 25% of the rooftop area identified as suitable for rooftop greening in the city of Toronto (Banting, Doshi, Li, Missios, Au, Currie, & Verrati, 2005), though not necessarily appropriate for food production (see discussion below).

Given existing demand for vegetables, a combination of areas cropped more extensively (e.g., potatoes, sweet corn, squash, cabbage) and others grown more intensively[2] (e.g., lettuce, bok choy) would be required. The land and rooftop space available suggests, however, that there would be difficulties matching parcel sizes with production requirements for key crops, including sweet corn, squash, potatoes, cabbage, carrots, and asparagus.

Clearly, numerous obstacles exist to meeting the scaling-up requirements of urban agriculture in Toronto (see table 1). Hardiness zoning, however, is not an impediment to growing the main vegetables consumed (Canada zone 6, USDA zone 5).

In this paper, we set out to identify the essential features of a program to meet this target, based on the following criteria:

- Builds on existing initiatives, including city programs regarding pesticide reduction and organic waste management;
- Assumes a multi-actor program governance model, with the city playing a key facilitating and often financial role, but with a variety of actors providing leadership and financing;
- Involves progressive implementation over a

[1] Ten percent was originally chosen somewhat arbitrarily, but proved to be feasible. Note that this study does not include self-provisioning, since there are no good data on consumption and gardening on which to base an analysis, though such activity could be significant (see MacRae, Gallant, Patel, Michalak, Bunch, & Schaffner, 2010).

[2] Our presumption here is that intensive production would follow something like the Small Plot Intensive (SPIN) approach; see for example Urban Partners (2007).

10-year period, given the current lack of infrastructure and significant policy and program changes required;

- Focuses on import substitution to minimize competition with Ontario producers;
- Is based on active facilitation of demand — supply coordination to optimize the benefits of urban agriculture; and
- Meets other municipal objectives regarding environmental improvement, a livable city,

Table 1. Main Barriers to Urban Farming in Toronto[a]

Soil Compost, Safety, Quality
- Lack of perceived space
- Assessing soil safety
- Site remediation costs
- Suitability of land for farming
- Challenge: Odors from compost, manure

Land Access
- Land-use policies: Selling from city land; public health definition of what constitutes a farm; agricultural zoning; compost regulations
- Short- and long-term land access
- Access to underused land

Land Zoning
- Regulatory and zoning issues
- Bylaws, lease agreements, jurisdictions

Funding, Resources, Infrastructure
- No resources for new immigrants
- Getting inputs
- Resource sharing
- Farm equipment can't be driven on city roads
- Accessing capital and operating dollars
- Living wage for farmers
- Lack of infrastructure: soil, water, storage, greenhouse

Diversity and Equality (overlap all issues)
- Not equitable if local food is not affordable to everyone
- How are we going to subsidize our food and for what purpose? Is health or justice our focus or frame of reference?
- No place for small farmers (i.e., 1-acre sites)
- Transition from successful backyard gardening to larger-scale production

Marketing, Infrastructure
- Infrastructure: electricity, storage (cold, dry)
- Problem of food as a commodity; practical training and solutions to making farming lucrative or viable
- Accessing market research

Training
- Farmer training: business planning, urban farm schools (longer term), support
- Organizational management
- Dealing with bureaucracy

Networks and Communication
- Building up capacity within urban agriculture
- Strengthening capacity to react to new approaches and get involved in new projects
- Ability to know what is going on in urban agriculture in Toronto
- Better linkages with other urban farming folks in other cities

[a] Adapted from the minutes of the meeting of 17 November 2008, of Toronto Urban Growers

and employment opportunities. Toronto has a Food Charter, is preparing to adopt an associated Food Strategy, and identifies local food procurement and production as key actions in its climate change mitigation and adaptation strategy (City of Toronto, 2008). Urban food production is viewed as an integral part of all these strategic developments, yet the potential for urban agriculture is nowhere near being fully realized.

Ultimately, the task is to build the infrastructure for commercial food production. Infrastructure here is understood in its broadest sense as the structural elements that underpin urban food production and either hinder its development or enable it. We offer proposals in five areas:

1. infrastructure for accessing spaces for production;
2. resources, services, and physical infrastructure;
3. food-chain infrastructure;
4. knowledge infrastructure; and
5. governance, coordination and financial support infrastructure.

Some Conceptual Considerations

The approach taken in this study is informed by a number of conceptual frames. This paper makes proposals on how an alternative future might be achieved. Future scenario studies around food and agriculture (cf. Desjardins, MacRae, & Schumilas, 2010; Nassauer, Corry, & Cruse, 2002; Seccombe, 2007) serve a number of purposes: they describe an alternative to a current situation; they can show the potential implications of new policy directions; and they can identify the potential policy instruments to achieve a new future. This study attempts to accomplish those purposes, as it relates to commercial urban food production in the city of Toronto. Note, however, that future scenario studies cannot rely on traditional conceptions of evidence, but rather are informed by experiences from other jurisdictions, numerous analytical frames, and a specific policy context.

This work is also informed by foodshed analysis. The conceptual terrain has been set out by Kloppenburg, Stevenson, and Hendrickson (1996), who argue that this metaphor taken from watershed analysis can serve as a conceptual and methodological unit of analysis for food studies. One of the questions asked in a foodshed analysis is whether a region optimizes its ability to draw food from within its own foodshed, before relying on imports to meet deficits. Peters, Bills, Lembo, Wilkins, and Fick (2009) have applied this approach to foodsheds around cities in New York State, concluding that midsized cities could meet 84% to 98% of their current nutritional requirements from within 32 miles (51 km). However, they found that New York City would be largely unfed from New York State suppliers (only 2% of requirements) in this scenario, and the average transport distance would be 164 miles (264 km). Scaling up urban food production, not explicitly part of their study, adds another dimension to this frame and modeling.

The practice of urban agriculture proposed in this analysis is a product of agroecological theory, the conceptual foundation for sustainable food production (MacRae, Hill, Henning, & Bentley, 1990). This frame has guided proposals on size of parcels, production methods, and distribution scenarios (discussed both in MacRae, Gallant, et al., 2010 and below).

A related conceptual frame is that of organizational ecology. Organizations and organizational alliances have been recognized for some time as having their own ecology (Morley & Wright, 1989; Plumptre, 1988) — an ecology that can potentially mimic that of the systems and processes with which the organization or alliance is concerned (Morgan, 1989; Solway, 1988; Walters & Holling, 1984). We use this framework to guide the proposals for new organizational forms and governance approaches to advance urban agriculture in Toronto.

In constructing these proposals, we reviewed primary documents relevant to Toronto and secondary literature from other jurisdictions, conducted interviews with key informants, and carried out a web-based survey[3] of those on the mailing list of the Toronto Urban Growers (TUG) network, receiving more than 30 responses, a response rate of 45%. Based on these diverse sources, we developed the five areas of intervention proposed here, which we will detail next.

Infrastructure for Accessing Spaces for Production

Using high-cost urban land for food production is a challenge, given dominant urban planning and real estate practices. Urban farmers need stable access to land, some of which needs to be secure for the long term. Ensuring such access will involve changes to official plans, zoning bylaws, and land taxation on the part of government, and ownership or lease arrangements on the part of landowners.

City of Toronto Official Plan and Zoning Bylaws

The city of Toronto's Consolidated 2010 Official Plan[4] contains policies dealing with community and rooftop gardens, including references to gardens in parks and rooftop gardens in multi-unit residential developments. These policies are bolstered through repeated reference to rooftop and community gardens in the nonpolicy text of the Official Plan. They are referred to as part of creating beautiful cities (1.2), as an ingredient in the creation of a high quality public realm (2.2.2), as offering opportunities for passive and active recreation (2.3.2), as an important community facility through which the city and local agencies deliver services (3.2.2), and as part of the diverse and complex system of open spaces and natural areas (2.2.3).

Despite the presence of several hundred hectares of agricultural land within the Rouge River Park in northeast Toronto and other patches of land in the city that are zoned for food production (see MacRae, Gallant, et al., 2010), the Official Plan has only two policies that deal with agriculture:

- Policy 2.1.1(k) states that the city of Toronto will work with its neighboring municipalities to develop a framework for dealing with growth across the Greater Toronto Area that, among a number of other priorities, protects the region's prime agricultural land.

- Policy 4.4.2 notes that agriculture is an acceptable secondary use within utility corridors.

Official Plan land use designations set broad categories of permitted and intended uses on private and public city lands. Zoning bylaws implement these objectives at the site level. They contain site-specific regulations pertaining to land use, and to the size, height, density, and location of buildings. The Planning Act requires that zoning bylaws conform to the Official Plan.

The city of Toronto is currently in the process of updating its zoning bylaws to conform to its new Official Plan. The project has distilled over 1,550 land use definitions into 180 across nine categories: residence, public, commerce, performance, industry, parking, institution, administrative, and accessory. Agriculture is not identified as a category. However, two of the 180 land use definitions, both of which are in the Industry category, are agriculture-related.

- Agricultural Uses: "Premises used for growing and harvesting plants or raising animals, fowl, fish or insects, and may include aquaculture.…The definition of agricultural use should be broad enough to capture the range of uses anticipated. An agricultural use is the cultivation of plants and the raising of animals primarily for food."

[3] The results of the survey are found at http://urbangrowers.wordpress.com/knowledge-library/. TUG was formed in 2008 to serve as an umbrella group for urban farmers, advocates and researchers across Toronto. A listserv for TUG members can be found at http://groups.google.com/group/toronto-urban-growers.

[4] The plan can be viewed at http://www.toronto.ca/planning/official_plan/introduction.htm.

- Market Garden: "A market garden is an area that is used for the growing of plants. A market garden is not on a residential property. Lands such as Hydro corridors or roof tops could also be used for growing food and plants."

Could sites recommended for food production be rezoned to one of these two new designations? Given current political realities, this seems unlikely in the short term, but there appear to be several options, if a permanent food production designation is not approved.

- A minor variance application may be brought to a municipal Committee of Adjustment. This process can take up to three months to complete and costs at least C$500. Permission given is not specific to the use of the land, but more to the structures on and configuration of the land. The duration of the land use can be specified in the application.

- A temporary use bylaw, permitted under the Toronto Official Plan, may be used to zone land or buildings for specific uses for a maximum of three years, with possible extensions. A temporary use bylaw is initiated by the city and includes public consultation; it can take up to one year to complete. It is more specific to the land use of the property in question. The cost is considerably more than a minor variance.

How could the Official Plan and zoning bylaws better support urban agriculture? The key challenge is to permit food growing on lands not covered by current categories. MacRae, Gallant, et al. (2010) identify 90 potential sites in the Industrial zoning category. The two proposed land use definitions (Agricultural Uses and Market Garden) will need to be widely permitted across Industrial zones to allow for cultivation at this scale.

The MacRae, Gallant, et al. study also identifies 75 production sites that are currently designated as Open Space. Agriculture would be a permitted use in Open Spaces zones under the new draft zoning bylaws.[5] The Toronto Parks, Foresty and Recreation Department would need to develop a more flexible approach to food production in open spaces than its current policy displays. Because urban agriculture can fulfill numerous municipal objectives, an argument can be made that private gains will achieve public purposes and therefore should be permitted.

Forty-three sites identified in the MacRae, Gallant, et al. (2010) study currently have commercial, institutional, and residential designations. Temporary use permits, minor variances, or interim control bylaws are possible tools to use for these sites, although the time and expense associated with putting them in place may prevent their use for agriculture. A coordinated and funded program by the city to lighten the burden on urban farmers and community organizations would make this a more useful approach. In the longer term, language to support community gardening and the planting of fruit trees across most zoning designations could be included in future official plans and zoning amendments.[6]

Long-term success would likely be facilitated by changes to the Official Plan and zoning designations to include an Urban Agricultural and Garden zoning designation, as exists in several U.S. cities, including Philadelphia (Caggiano et al. 2009) and Cleveland.[7] The ideal would be permanent protection of the agricultural status of certain lands. Montreal's Permanent Agricultural Zones (PAZ) are an example of this approach. Four percent of the city's lands are zoned under this category, including an experimental farm, an agricultural park, an eco-museum, and an arboretum (True Consulting Group 2007). Though the PAZ does not extend into the urban core, its existence on the

[5] Note that a related discussion about the potential sale of food produced in parks, through farm stands, and related marketing approaches, is also a priority.
[6] Conditional use permits allow agriculture in most land use designations in Oakland, California (McClintock and Cooper, 2009).
[7] See http://www.mayorsinnovation.org/pdf/Cleveland_CG_zoning_ord.pdf.

urban fringe keeps speculators at bay and by its permanence "permits farmers to risk investment" (McCallum, 2001, p. 3).

Agricultural Land Taxation

Land taxation is a key issue for urban agriculture on private land. Wekerle (2002) has argued previously that shifting tax burdens could encourage urban agriculture if small lots used for food production could be taxed at an agricultural rate

Although zoning is largely a city issue as it relates to land use, and although it is the city that collects and uses the property taxes, farm designation for property tax purposes is in provincial hands. To obtain a reduced property tax rate, a property must be taxed at agricultural rates. The Farm Property Class Tax Rate is offered through the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), and the Municipal Property Assessment Corporation (MPAC) is responsible for determining the property classification. Currently, to obtain a farm designation the property must be assessed as farmland. A landowner[8] must request a designation reconsideration by MPAC and an eligibility determination from OMAFRA and approval for the Farm Property Class Tax Rate. The owner must have a Farm Business Registration Number and the farm must generate at least C$7,000 in gross annual income. The owner is responsible for ensuring that any tenant who farms the land has a valid Farm Business Registration Number.

If the site receives this designation, its tax rates are reduced to 25% of residential property tax rates. The farm rate applies only on the part of the land under cultivation. There are farms within Toronto with a Farm Business Registration Number that are taxed at the agricultural rate. An urban location may not then, per se, be an obstacle to reduced tax rates. But small-scale urban farms may have more difficulty obtaining a Farm Business Registration Number. Exemptions from the normal requirements may be needed. OMAFRA should examine whether small-scale urban farms might need a different minimum gross annual income for eligibility[9] for a farm business registration number, and MPAC and OMAFRA should also study the implications of establishing a small-scale urban farm designation.

Following from the MacRae, Gallant, et al. (2010) analysis, the city finance department would need to study the tax revenue implications of permitting urban farm property tax reductions on the properties identified in the report. The implications for land owned or controlled by the provincial or federal governments or agencies are potentially problematic. For example, establishing production sites in hydroelectric corridors has tax revenue implications for the city of Toronto, since it results in a lower tax rate relative to the standard corridor rate (Danyluk, 2009).

Given these potential complexities, implementing land use designation and tax changes through a coordinating and facilitating body (see discussion of governance below) to help with the processing of applications could make the process more efficient and affordable for participating landowners.

Lease Arrangements

Urban farmers and growers often do not own the land they cultivate. Urban farming requires arrangements that provide security of tenure and suitable financial arrangements (if required) for all parties, cover insurance and liability issues, and include conditions of use that would support the city's multiple environmental and sociocultural objectives.

Depending on the nature of the food production, leases could be with individuals or organizations. Setting lease rates has already proven to be a challenge in some instances in Toronto. Setting rates is complex when having to determine "fair market value" for land with a limited set of private

[8] If the property is owned by a business that is a sole proprietorship, the owner must be a Canadian citizen or permanent resident.

[9] For example, the FoodShare production site grosses C$6,000/0.1 ha of land (Danyluk, 2009).

uses (e.g., hydroelectric corridors), or if it could potentially be used for housing development.

Landowners may have motives other than maximizing profit for offering land at reduced rate or even for free. They may want to see food production next to their residence, to support the local food movement, to gain environmental benefits (birds, bees, etc.), or to obtain a tax break by making land available to nonprofit or public groups. If the city creates incentives for developers to install food production sites, and disincentives if they fail to, it can shift market incentives toward allocating more land to such purposes (personal communication, W. Seccombe, Everdale Environmental Learning Centre, 2010).

Among the 312 parcels identified in the MacRae, Gallant, et al. (2010) analysis are a wide range of likely landowners and food production options. Given the need to coordinate production and distribution, and the expertise required to manage a complex set of arrangements, a coordinated leasing system will be needed. Interested landowners, including the municipal government, could contract with a third-party organization to manage lease arrangements based on templates established by the municipality. The third party would set up the lease arrangements with interested farmers, taking a small percentage of rents supplemented with revenues from the municipality and foundations to finance its coordination activities. If a third party is managing leases, there is some opportunity for pooled leasing rates for farmers and community organizations, with the leasing agency pooling revenue and then dispersing it differentially to landowners.

The use of such third-party arrangements, whereby governments subcontract to a nongovernmental organization (NGO), is increasingly common. Ontario NGOs are experimenting with such arrangements, with the partnership between FarmStart and the Toronto and Region Conservation Authority (TRCA) to run a farm incubator program being one example. Several Toronto private and nonprofit organizations are starting to explore innovative ways to establish agreements for accessing potential lands for production, including individual backyards.

In addition to setting out the rental and stewardship conditions for the land (e.g., organic production to respect pesticide use restrictions and greenhouse gas mitigation objectives, and respecting biodiversity enhancements), the leases would require that food is distributed to markets within the municipality in ways that minimize negative environmental impacts (e.g., short-haul trips, bicycle delivery where feasible, or coordinated trucking to aggregate loads).

Infrastructure for Rooftop Agriculture Development

A few Toronto rooftops are already food-growing spaces. Without significant interventions, aboveground food production (including on roofs) will likely continue to expand, but on a very small scale and on a noncommercial basis. Large-scale commercial rooftop agriculture is probably still years away from being practiced widely because the barriers are significant (e.g., existing rooftop designs, roof access issues, or unclear lease and liability issues).While individual examples of commercial rooftop farms such as the Eagle Street Rooftop Farm and Brooklyn Grange in New York do exist, they remain exceptional.

Rooftop food production can take many different forms, from intensive green roof gardens to container and raised-bed gardens, but most policy initiatives target green roofs rather than food production. No cities have specifically targeted rooftop production as part of an agricultural development strategy, but given the scarcity of land and competing uses, it is likely only a matter of time before rooftops are put to more intensive use.

MacRae, Gallant, et al. (2010) identified the need for 3,072.8 acres (1,243.5 ha) of rooftop growing space to meet the target of 10% of Toronto's fresh vegetable supply, or about 25% of the rooftop space theoretically identified as being appropriate for rooftop greening (Banting et al., 2005). Toronto is moving to take greater advantage of its rooftops with a new green roof bylaw. As of January 31, 2010, new residential, commercial, and

institutional buildings are required to have a certain percentage of green roof coverage.[10] This provision applies to all new construction with a gross floor area of 21,528 square feet (2,000m²) and over (and, for residential buildings, a height of 66 feet (20m) and over). The coverage required begins at 20% for smaller buildings, and increases to a maximum of 60% as the gross floor area increases to 215,278 square feet (20,000m²) and over. Industrial buildings were exempt until 2011, after which they are required to have approximately 10 percent coverage.

However, substantial changes would be required to the current bylaw to support food production. When initially proposed by the city, one of the stated goals of the bylaw was to "increase opportunities for urban food production" (City of Toronto, 2005), but the current bylaw is unlikely to accomplish this. It is focused on environmental benefits and aims to reduce the urban heat island effect (the higher temperatures found in urban areas caused by the sun reflecting off hard surfaces) and improve stormwater management (rainwater run-off from buildings). A policy that was meant to encourage rooftop food production would have to address a number of issues (Kaill-Vinish, 2009), including:

- Design elements: food production usually requires deeper soil than that required under the Toronto bylaw, and a substantial amount of rooftop production tends to be done in containers;
- Access to the roof: growers need daily access to the roof during the growing season and the capacity to readily move material up and down;
- Insurance: coverage for growers using the rooftop will be needed;
- Wider applicability: policies should encourage retrofitting existing roofs rather than just applying to new construction only, as in the Toronto example;
- Zoning: questions about zoning the land to allow for food production on the roof will need to be settled; and
- Construction code: some requirements may need to be adapted to the conditions of rooftop food production.

Various policy tools also have been used to encourage green roofs in other jurisdictions. These include bylaws, density bonuses, incentive programs, grants, fees, and levies (usually related to stormwater run-off from buildings). Some of these same policy tools potentially could be harnessed to target increased rooftop food production. Given Toronto's current policy and program infrastructure, the next challenge is to study how to modify existing instruments to promote food production. If modifying existing policies and programs proves too difficult, a specific food production bylaw, which includes attention to rooftop spaces, might have to be introduced.

Resources, Services, and Physical Infrastructure

"Physical infrastructure" covers all that is useful for the production, processing, and distribution of food in urban areas. When we asked urban growers about the resources on which they rely most to produce food in the city, the top three were (1) seeds, (2) land or space, and (3) compost. Ranked somewhat lower were water, soil, funding, and seedlings. When asked what resources they most lacked, the five top responses were (1) compost, (2) funding or capital, (3) land, (4) staff or volunteers, and (5) soil. The main explanations given for identifying certain tools and resources as particularly lacking were: (1) accessibility, (2) organic matter, (3) affordability and funding, (4) knowledge, and (5) tools.

Soil and Amendments

Toronto sits upon some of the most productive soil in Canada, so for some growers soil quality is not much of an issue, provided there has been no

[10] The bylaw was enacted 27 May 2009. See http://www.toronto.ca/legdocs/bylaws/2009/law0583.pdf.

extensive disturbance from urban processes. Yet access to soil and ways to improve its quality show up among the top issues for those involved in food growing. Most new sites where urban agriculture is feasible require testing and some transformation in a coordinated and environmentally sensitive way. Even where high-quality soil is available, it may be difficult to access or use, primarily due to real or perceived soil contamination. Part of the solution to soil contamination is technical (developing appropriate means for soil decontamination), but large-scale technical intervention goes beyond the capacity of many individual gardeners and producers. Toronto Public Health's Environmental Protection Office is currently developing a soil assessment protocol to assess the potential risks, to be used in the future for lands considered for urban agriculture.

A larger question is who will pay for soil remediation. Given the costs, urban agriculture will only occur on sites with minimal to moderate contamination that can be remediated with composting and phytoremediation (using plants themselves to absorb pollutants).

Soil is also needed for rooftop gardening.[11] The development and dissemination of appropriate, affordable, lightweight techniques for both soil-based and soil-less cultivation are needed. Local organizations, such as Alternatives and Earthbox, have developed appropriate growing media and containers, yet such approaches are rarely applied. A strategy is needed to promote the development and adoption of such growing approaches.

In urban areas, just as in rural ones, amendments are applied constantly to improve the soil, and pesticides are applied frequently to manage pests. In Toronto, however, what can be applied in gardens is increasingly restricted, notably due to the provincial ban on the sale and use of chemical pesticides for cosmetic purposes,[12] which supplanted the earlier ban by the city of Toronto.[13] At the same time, obtaining organic alternatives for fertilization and natural pest management is a challenge requiring attention from organizations and the municipal government.

Compost

Toronto has substantial amounts of viable organic materials at its disposal for composting because of its green bin and yard waste collection programs. Yet in our survey, compost tops the list of resources that are needed to expand urban agriculture. Most respondents recommended an improved compost distribution system, involving an expansion in local producers and the set-up of numerous locations for pick-up in the city. Other respondents suggested better information, including workshops, a public list of suppliers, and the streamlining of municipal assistance.

The problems start with the quality of what goes into Toronto's green bins and with its processing. In response to the shortage of local landfill sites, the city has placed a singular priority on landfill diversion, without coupling this goal with nutrient recycling. The solid waste department operates with neither a requirement nor a budget for ensuring that the end product is quality compost to be used in food growing (personal communication, Wally Seccombe, Everdale Environmental Learning Centre, 2010).

Moreover, current rules dictate that yard and leaf compost is available only to residents, not sold to businesses (City of Toronto, 2009). With limited

[11] Many examples of alternative forms of containers and stands for off-soil cultivation were featured in the Carrot City exhibit. See http://www.carrotcity.org, particularly the Products section.

[12] Regulation 63/09, made under the Pesticides Act, came into effect on Earth Day, April 22, 2009. It bans the use and sale of cosmetic pesticides across the province and supersedes any municipal bylaws or regulations on pesticides. Specifically the ban refers to usage on lawns, gardens, parks, and school yards. Some qualifications and exemptions exist, for example, agriculture, West Nile virus control, golf courses, and poisonous-to-touch plants, such as poison ivy. It remains unclear how the rules might affect commercial-scale urban production, but we presume that eliminating pesticide use would be preferable.

[13] See http://www.toronto.ca/health/pesticides/faq.htm.

supply, this makes sense; yet this product has acquired among community gardeners a reputation for poor quality (excessively high C:N ratio, too many contaminants), so it is underutilized. Were the city to bag and sell its compost, it would have to guarantee its quality for soil amendments for growing food, as happens already in some American cities.

Given that most urban farms occupy a very limited area and are uniquely plant-based operations (without access to sources of nitrogen needed for better quality compost, partly because of the municipal ban on raising farm animals in the city[14]), making quality compost based only on organic matter generated on site is usually not feasible. Currently, any operation importing materials for on-site composting requires approval by the Ontario Ministry of the Environment to operate as a waste disposal site — a difficult and expensive process. The ministry needs to develop a simplified and less expensive mechanism, while continuing to control the content and process of imported materials for on-site composting. Composting is even more challenging on rooftops, because of the difficulty of getting materials to and from the roof.

A co-operative group could take on the role of coordinating the purchase and distribution of the inputs for composting, as well as handle the associated approvals. Such an organization could be a bulk purchaser of compost materials and other inputs (see discussion below on an urban growers' cooperative). An alternative to large-scale composting are medium-scale composting facilities — centralized composting sites located within different communities. Medium-scale composting is at the heart of the mission of FoodCycles, a new organization that seeks to combine composting from and for the neighborhood with production, marketing, and education relating to food.

The medium-sized approach is very recent in Toronto and may develop significantly in the future,[15] but until that takes place, sufficient quality compost for an expanding urban agriculture will need to be generated through large-scale composting based on improvements in the green bin program (especially since it is in the process of expansion to apartment buildings[16]). There is thus a real need to accommodate a wider range of composting operations at all scales, and to change the rules to accommodate them, in order to ensure proper nutrient cycling while providing reliable local sources of compost for a thriving urban agriculture industry.

Water

A challenge for the city of Toronto is how to encourage the creation of gardens and cropping systems while reducing demand for water. This means mulching, using soils with good moisture-holding capacity, cultivating drought-resistant plant varieties, and incorporating plants that offer shade. The need for water will depend on the type and design of the operation.

If city hook-up is required, a crucial question is whether the farm operation must be connected to a drip irrigation system and metered. Most growers prefer drip irrigation systems with full coverage. Portland, Oregon, reported that it cost US$20,000 to US$30,000 just to meter sites for urban agriculture (Mendes, Balmer, Kaethler, & Rhoads, 2008), a substantial sum. Policy will need to address how to service urban farm sites with water, and who will bear those costs.

Of course, not all water for irrigation must be brought from off site. Over half of the respondents in the survey reused water, mostly from rain barrels. More advanced water-reuse systems such as cisterns and greywater recycling arrangements are almost non-existent in Toronto.[17] For those

[14] Note there is a movement in Toronto to overturn the ban on livestock, but it is not yet clear whether it will be successful.

[15] A new report (Vidoni, 2011) focuses on evaluating what it would take to initiate community composting projects in Toronto, looking at examples from elsewhere for lessons.

[16] See http://www.toronto.ca/garbage/multi/green_bin_program.htm.

[17] One exception is The Stop's Green Barn, where a greywater capture system was included as part of the retrofitting of a historic building. See http://thestop.org/green-barn.

who do not reuse water for irrigation, we asked what would encourage them to start reusing water. This question yielded two main responses: (1) guidance (through workshops and other forms of education) to navigate the process of getting a rain barrel or other system for using recycled water; and (2) financing.

These responses indicate a readiness to use alternative approaches and avoid reliance on domestic, treated municipal water. Other cities already have well established programs expanding water catchment facilities. GrowNYC has helped install rain barrel systems at over 60 community gardens in New York City.[18] The expansion of urban agriculture in Toronto will need to be tied in closely to the city's existing rain barrel initiative, but other strategies should also be investigated, including rain gardens, swales, and neighborhood-based rain storage (cisterns).

Power and Lighting

Power supply is often overlooked as a part of modern urban agriculture. Cultivation itself may not require electricity (one major exception being hydroponics), but many support functions do, from refrigeration to lighting for processing spaces, to ventilation of greenhouses in the summer, to record-keeping. Lighting may also be important for safety and security and for harvesting at dawn or dusk.

For many potential production sites, a power supply may already be nearby. Bringing power to rooftops is usually straightforward. However, a number of sites around Toronto do not have ready access to power. Ironically, electric transmission corridors, which are often used for cultivation, seldom have a supply of electricity on the ground.

Where power needs to be brought in, one question is whether permanent or temporary service is appropriate. The latter might seem to make sense if there is no off-season production between November and April. However, temporary hook-up rates can be higher than those for regular connections, and as many growers move towards season extension, permanent connections would be advisable.

As inexpensive, small-scale solar panels become increasingly common, solar energy may become a perfect fit for urban agriculture. Other power efficiency opportunities include integration of compost and fish farming into greenhouses to catch the heat released (as practised by Growing Power in Milwaukee, Wisconsin), the use of wasted energy from buildings, and improved greenhouse and cold storage design.

Seeds and Seedlings

Relative to many other cities, the production system for seeds and seedlings is relatively well developed in Toronto. The responses to our survey confirmed that there are many ways to obtain seeds and seedlings, including seed saving, retail stores, seed exchanges, and the Internet. For example, Urban Harvest, a small commercial producer of seeds and seedlings, serves the local market, growing most of its seeds and seedlings inside the city.

Yet beyond specific venues, such as some farmers' markets and seed exchange events, most producers do not have ready access to seeds and seedlings where and when they need them. What is available at neighborhood supply centers is typically a very narrow range of the most common herbs and a handful of vegetables. The seeds and seedlings for more specialized produce consumed by particular cultural groups are especially difficult to locate.

The space for producing seeds and seedlings within the city remains inadequate. Many growers cited a shortage of greenhouse space in the city, which is crucial for getting seedlings ready for planting season. Even established producers like Urban Harvest have to shift production sites frequently, as tenure insecurity and shortage of reliable growing space force them to move constantly and in many cases settle by necessity outside the city.

A systematic enhancement of the production and distribution of seeds and seedlings across the city

[18] See http://www.grownyc.org/openspace/rainwater.

will be necessary to scale up urban agriculture. Support for the producers of seeds and seedlings will range from enterprise development assistance to greenhouse provision or long-term leases on institutional land. On the distribution side, urban agriculture hubs (discussed below) could help make seeds and seedlings more readily available to city residents. At the same time, working with the owners of small, family-run neighborhood garden centers can provide an expanded range of choices for the small urban producer.

Production Equipment and Facilities

We asked about the tools that growers rely on to produce food in the city and about those that are needed but particularly lacking. The top responses were largely basic tools: hoses, wheelbarrows, pitchforks, shovels, composters, stakes, trellises, and rain barrels. The most sophisticated item mentioned was automated/drip irrigation.

Clearly, the need for basic tools cannot be underestimated in the spread of urban agriculture, especially for the many small plots identified in the MacRae, Gallant, et al. (2010) analysis. Food cultivation involves many different tools, and their cost can add up. At the same time, not all tools are needed simultaneously. Co-operative sharing arrangements could buy such equipment in bulk and make them available through travelling tool-lending libraries, including hand tools, rain barrels, fencing, protective meshing, irrigation lines, and packaging.[19] Sophisticated hand tools are also very useful for rooftop agriculture, where moving larger equipment can be quite difficult.

Security

Kaufman and Bailkey (2000) reported that urban farmers view the theft of food as primarily an irritant rather than deterrent. While theft may not be an issue on most sites, it does come up regularly as a top concern at gatherings of community gardeners (personal communication, Rhonda Teitel-Payne, The Stop Community Food Centre, 2010).[20] This is addressed by fencing, though the expenses and negative image associated with fencing may be a deterrent to its use. In many public park settings, fencing is simply not an option. Alternative measures such as the use of "living fences" (shrubs, berry bushes, etc.) can be quite effective.[21] A communication strategy and education campaign can also be helpful.

Although food production site often result in greater community safety (more eyes on the street), urban farmers have occasional concerns about personal security that are serious. A security survey would need to be carried out for many parcels and a prevention plan developed. Alarms and security fencing may be required in some cases; such measures should be considered part of the municipal investment in infrastructure. Operation Greenthumb, a unit of the city of New York, provides fencing for new community gardens.

Fencing is also needed for rooftop food production as a matter of liability. Regulations that govern the type, placement, and height requirements related to fencing, as well as who would use the area and when, how close to the edge of the roof a garden may extend, and what materials may be used, vary depending upon the site and ownership (e.g., school buildings have to follow rules set out by the local school board, whereas municipal buildings have a different set of regulations). Lack of knowledge of these requirements and the fear that they may be too burdensome appear to be holding back rooftop production in Toronto (Nasr et al., 2010).

Food-Chain Infrastructure

Given the city of Toronto's interest in urban agriculture as a greenhouse gas mitigation strategy,

[19] A new venture, Fresh City Farms, is making available such a collective resource to the franchise farmers who were to take part in this enterprise in summer 2011. Participating farmers would have access to a collection of tools that is shared between them.

[20] FoodCycles, for instance, had one instance of vandalism to its greenhouse in its first year of operation at Parc Downsview Park in Toronto. Since then, a recurring problem has been the theft of its produce rather than damage to its facilities.

[21] Such a strategy is being adopted in the design of the new park to be created at the heart of the redeveloped Regent Park neighborhood.

there is little advantage in taking markets away from existing regional producers, whose transportation of food typically contributes less to greenhouse gases than that of the dominant long-distance producers. Established farmers have traditionally opposed commercial urban agriculture because of worries, real or perceived, that it will cut into their markets. Given such concerns, it makes sense for urban production to focus on supplanting vegetables shipped long distance by truck. The potential environmental benefits of local production will be realized only with careful attention to minimizing transport with small vehicles, which emit more carbon dioxide per unit of food moved than large trucks, trains, or ships (Edward-Jones et al., 2008).Toronto is a major destination for California and Florida vegetables, most of them trucked. This means that a municipal and provincial strategy must intervene in supply-chain dynamics in ways that are not traditional for Canadian governments.

Import Substitution

Identifying import substitution opportunities is a significant challenge, given the current deficient state of market intelligence on the subject. We know from more general data that in 2001 Canada imported 86% of the fruit and 39% of the vegetables (excluding potatoes) it consumed.[22] In recent years Canada has been importing around 1.8 million U.S. tons (1.6 million tonnes) of fresh vegetables (excluding potatoes), with over 70% of that typically coming from the United States.[23] The top 10 imports by volume or value are typically lettuce, tomatoes, melons, peppers, carrots, onions, broccoli, celery, cauliflower, and gherkin cucumbers, accounting for 75%–85% of total fresh vegetable imports.[24] Some 55% of fresh vegetable imports to Canada come into Ontario. In a background analysis for the Food and Hunger Action Committee, City of Toronto (2001), MacRae used 1999 data to determine that for the top 10 vegetables, 38% arrived during Ontario's growing and early storage season (June–November), most of that coming from the U.S.[25] The import substitution target for Toronto production would, thus, be to replace 5% of fresh vegetable imports into Ontario during its prime growing and storage season,[26] a relatively modest import substitution target.

But not all the import substitution would be targeted to U.S. sources. For example, Ontario produced about 7% of Canadian potatoes on about 38,150 acres (15,440 ha) in 2006. MacRae, Gallant et al. (2010) calculated the need for 1,206 acres (488 ha) of potato production, which seems modest except that the planted area of potatoes has been in gradual decline since 2003,[27] likely due to changes in consumption patterns and national overproduction. Fresh potato imports measured 211,937 tons (192,266 tonnes), mainly in the May-to-July period, with 64% of those coming in from Washington and California (Agriculture and Agri-Food Canada (AAFC), 2007). It would be unlikely that Toronto potato production would substitute for the U.S. product, since the storage season does not usually extend into this period. Instead, it would likely compete with imports from other regions of Canada, particularly Prince Edward Island and New Brunswick, or could represent a new specialty organic potato market.

A more complicated question is posed by the relationship between conventional and organic markets, since promoting organic production[28] will be critical to meeting Toronto's greenhouse gas and pesticide reduction targets. These are not directly substitutable, as there are often price, quality and variety or breed considerations that determine whether a conventional buyer will shift

[22] Derived from Statistics Canada (2001).
[23] See http://www4.agr.gc.ca/resources/prod/doc/misb/hort/_sit/pdf/veg02_03_e.pdf.
[24] See http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1220616635495&lang=e#tab_3_10.
[25] Over 90% of it did for most of this period, and imports from Mexico and South America typically pick up in October and November.
[26] Calculated by taking 10% of the 38% and dividing by 75%.
[27] See http://www.omafra.gov.on.ca/english/stats/hort/potato.htm.
[28] For an overview of the benefits of organic vs. conventional production related to GHG emissions, see MacRae, Lynch, & Martin (2010).

to organic purchasing. Unfortunately, there is not much data on organic imports except that it is estimated that somewhere between 60% and 85% of Canadian organic consumption is imported largely from the U.S.[29] In contrast, only 30% of conventional foods to meet domestic requirements are imported (AAFC, 2008). A presumption of this study is that it will be feasible for organic vegetables to supplant conventional markets, but this will not occur without significant marketing efforts.[30] Providing more sophisticated market intelligence would be a critical task for a successful program, and it could be undertaken by an urban growers' marketing co-operative (see below).

Post-harvest Handling and Processing

For commercial growing operations, sophisticated post-harvest facilities and mechanisms for food packaging, processing, and distribution are needed. High quality, safe, appealing produce grown locally would likely foster market interest in Toronto production. It is now well recognized that the "middle" of the food chain (processing, storage, and distribution) represents the most significant bottleneck in developing alternative food systems.[31] Developing an array of such facilities is vital for supporting commercial-scale urban agriculture in Toronto. Yet the expansion of the "middle" in an urban context poses particular challenges.

Currently there are few post-harvest handling facilities in Toronto. Post-harvest facilities include cooling units to take the field heat out of produce, space and materials for packaging, and, in some cases, refrigerated transport. Fixed or mobile small- or medium-scale post-harvest handling facilities would save the costs of creating large centralized facilities, unless an existing partner provides access to them.

Neighborhood hubs for urban agriculture could make food processing possible at a financially viable scale. The link needs to be made between growers and certified commercial kitchens where food can be processed according to Public Health requirements. Processed food could be sold directly at farmers' markets, ensuring some cost recovery.

In addition to neighborhood hubs, larger facilities for processing locally grown food could ultimately be important. A well capitalized Toronto business incubator could stimulate local agricultural production and keep money in the Toronto economy. Existing infrastructure in schools, community centers, and churches could also be used in a more systematic manner to boost food processing.

Distribution Challenges

About 25% of U.S. greenhouse gas emissions related to food transport are associated with the delivery of food to consumers, and the percentage may be higher in Canada. These emissions are particularly problematic in the produce sector because of its reliance on trucks (Weber and Matthews, 2008). If small producers move their produce to market in small vehicles, emissions on a ton-mile/tonne-km basis will be dramatically higher than imported goods, and all the effects will be felt more in Toronto, even if emissions are reduced along the long-distance supply chain that local production has replaced. Other distribution models, thus, are needed.

Most of the land identified in the MacRae, Gallant et al. (2010) study is located some distance from food retailers, restaurants, and farmers' markets, largely in pockets identified by Lister (2007) as "food deserts" (areas in which very few retail outlets sell fresh food). Most commercial rooftop production would take place in industrial areas, often equally removed from retail locations outside

[29] Based on organic industry analysis and Nielson Company (2006).

[30] There is a legitimate question about the impacts of 5,725 acres (2317 ha) of organic vegetable production, should all Toronto acres be certified. Macey (2006) reported 1,166 acres (472 hectares) in organic vegetable production in 2005 for the entire province. So this would represent something like a fivefold expansion in organic acreage over a 10-year period. MacRae, Martin, Juhasz, & Langer (2009) concluded that with the proper policy and program supports, the Ontario area devoted to vegetable production could increase to 10% of total vegetable area or 15,790 acres (6390 ha) of organic production within 15 years. The Toronto program would represent about 36% of such an expansion.

[31] See for example reports at http://www.agofthemiddle.org/.

the downtown core, as the city's survey (Banting et al., 2005) identified primarily industrial and commercial rooftops as suitable locations (see these three articles for maps). Yet both of these spaces offer distribution possibilities. The larger farms in northeastern Scarborough, likely growing mainly late-season crops, offer opportunities to coordinate collection and distribution. Similarly, many of the small parcels and rooftops in Etobicoke would lend themselves to clustering for distribution purposes.

A sophisticated and multilayered distribution approach is required to account for the diversity of locations, types of production sites, and end-buyers. A key element of the strategy is to avoid, as much as possible, central distribution and packaging. The first layer of distribution would be neighborhood-based, designed to counter what appears to be a relatively recent urban trend of consumers travelling further within a city to obtain their food (Department for Environment, Food and Rural Affairs (DEFRA), 2005). Many land-based production sites in central and north Etobicoke are very accessible to residential areas. Community supported agriculture (CSA),[32] box schemes, and neighborhood markets may work very well in these areas, with short-haul bicycle[33] and taxi delivery to local shops and restaurants. Similarly, many potential rooftop sites are concentrated immediately west of the downtown core in districts zoned commercial (Banting et al., 2005), lending themselves to both neighborhood and short-haul distribution scenarios.

The mid-range distribution layer involves movement from larger and non-neighborhood sites into mid- and uptown locations, especially restaurants and independent retail, and the Ontario Food Terminal. The longer-range layer involves movement of food from the northwest and northeast into the downtown core. The mid- and long-range scenarios require distribution innovation. Clearly, moving away from the dominant model of large-unit distribution centers can reduce energy use in transport, but having small-scale producers deliver individually to a local distribution center will likely increase energy use relative to the current dominant model (Ministry of Agriculture, Food and Farming (MAFF), 2000).

A new distribution model is 100km Foods, which follows a relatively set route around the edge of the city, collecting small batches from different producers and selling to restaurants on different delivery days. This approach appear to reduce emissions relative to traditional methods of trucking.[34] It represents a promising piece among a whole set of innovations that will be needed to present an effective alternative to the current dominant long-distance distribution system.

Marketing

Most commercial production will likely be targeted to fresh-food markets, given the growing popularity of local and fresh food. This approach will help maximize market returns for producers. It is the experience of many organizations promoting local food that mainstream retailers or food service operations are not likely to buy Toronto produce.[35] The main sales opportunities include farm stands, farmers' markets, Good Food Markets, produce auctions, mobile produce carts, home-delivery box schemes, and CSAs. Some independent and co-operative retailers that have flexible vendor protocols and no requirements for central warehousing are also possible outlets.

[32] This is an arrangement where consumers prepurchase a share of a farm's produce, which comes in the form of a weekly delivery.

[33] The Growing Home project, based in Chicago, offers the services of West Town Bikes to deliver CSA shares to members via bicycle. West Town Bikes is a nonprofit organization whose missions are to promote bicycling in Chicago and to educate youth with a focus on underserved populations. They have a delivery fee on a weekly basis and also offer to pick up compost for a weekly fee. See the website at http://www.urbanhabitatchicago.org/blog/pedaltotable-bridging-the-gap-between-local-food-local-transportation/.

[34] Estimates on file with the corresponding author.

[35] This is the experience of Local Food Plus, for which the corresponding author is a consultant.

Independent restaurants, especially those that design their menus around seasonal food, may represent a major potential market, particularly if direct delivery is offered. There may also be opportunities for microprocessors working in small batch operations (including incubator kitchens).

Institutional procurement may be possible for city-run or city-managed operations. Toronto City Council adopted a Local Food Procurement Policy in 2008 in an attempt to reduce greenhouse gases caused by importing food from afar. To date, however, standards are not in place to describe precisely what "local" means, and shifting supply chains are proving challenging because of existing relations with distributors and the particular food requirements that exist in many cafeterias. In addition, linkages with potential urban growers are needed, which requires partnerships among NGOs, the city, and growers.

Planning, Coordination, Marketing, and Services
Kaufman and Bailkey (2000) identified the critical need for collaboration among urban farmers. Scaling up urban agriculture in a financially sustainable manner means increasing supply in a coordinated way to keep prices stable and build market confidence in urban suppliers. Although some individuals and organizations may successfully grow food for profit, working together in a co-operative manner is a more likely path to success in Toronto. Land requirements, the dispersion of small parcels across wide areas of the city, and market specialization are all factors that lend themselves to people working together. An urban growers' co-operative could be a step forward. Although a full feasibility study, including what co-op model to employ, will be required,[36] we suggest a co-op would need to do the following:

- Purchase inputs and equipment and distribute products. The challenges of post-harvest handling might also be addressed, including the provision of field-chilling facilities (fixed or mobile), supports for packaging, and scheduling of transport.

- Identify opportunities for import substitution or new markets not currently served by existing Ontario producers, and coordinating supply to serve those markets.

- Engage in certain retail functions. For example, it could employ the approach used by the Niagara Food Co-operative, a self-described "virtual farmers' market" where members order food and pay online, picking up their purchases at a central location.

- Develop a "Grown in Toronto" label.[37] Clearly, detailed market research would be needed before any label is developed. Buy-in from growers, institutional purchasers, and retail outlets would also be required. However, a co-op could learn from the example of Local Food Plus (LFP), a certifying body for sustainably produced local food.

- Educate consumers about the value of local products.

Knowledge Infrastructure

Training Initiatives
Toronto has a growing number of students and researchers focusing on urban agriculture, and there are strong links among individuals in its postsecondary institutions. However, dissemination of the knowledge generated by researchers to practitioners is much weaker. Dozens of studies have been undertaken, but most urban farmers are not aware of or do not know how to find them. Internships, sponsored research, and regular presentations can strengthen the links between researchers and growers.

Much knowledge diffusion takes place through training provided by the NGO sector. Still, training

[36] This can be co-financed by co-operative development funds available at the provincial and federal levels.

[37] Such a label has been created successfully in Detroit, for instance.

of potential urban growers can be enhanced through such means as the successful Toronto Community Food Animators program, facilitated by the city of Toronto. Its functions can be expanded to new parts of the city and to help build community urban agriculture hubs.

Another opportunity lies in adapting the successful Collaborative Regional Alliance for Farmer Training (CRAFT) program for training new farmers across Ontario. An "urban CRAFT" program could support new urban farmers — both young, Canada-born, usually urban-bred individuals, and also recent immigrants who are seeking to make use of their roots in farming but require knowledge to adapt to their new agricultural conditions. A new initiative to coordinate trainers based in the civil society sector and postsecondary educators may soon be launched in Toronto.

The creation of positions for urban agricultural extension specialists, as exist in the departments of agriculture in several U.S. states, is worth considering in Ontario. For example, Penn State University and Cornell University provide agricultural extension agents in Philadelphia and New York City, respectively, offering support to urban community gardens and commercial start-up farms on the cities' peripheries. Toronto city and civil society staff members would need to explore with the Ontario Ministry of Agriculture, Food and Rural Affairs how to develop this capacity for the long term.

MacRae et al. (2009) proposed an organic transition advisory service, modeled on existing Ontario NGO initiatives and successful programs from Europe. Personal assistance from trained experts (often farmers and former organic inspectors) is needed to help farmers explore problems and possible options of which they might otherwise not be aware. U.S. surveys have found that a strong majority of farmers believe that farm planning requires more information than most farmers have at their fingertips, and that advisory services help farmers explore problems and unfamiliar options. MacRae et al. (2009) proposed that the province invest significantly in organic advisory services, sharing the cost among farmers themselves. Should this not come to pass, it would fall on the municipality to finance this function, the most efficient scenario being engagement of an existing third-party organization with expertise to deliver the program. Costs would be relatively low given our estimate that up to 1,596 acres (646 ha) would be targeted for the transition: 311 acres (126 ha) currently in conventional vegetables and up to 1,285 acres (520 ha) in corn, soybeans and small grains.[38]

Urban Agriculture Virtual Clearinghouse and Learning Centres

MetroAg – Alliance for Urban Agriculture (MetroAg), a new North American organization, is currently constructing a clearinghouse on urban agriculture information across Canada and the United States. Sustain Ontario, fast emerging as a key node for improving the province's food and farming systems, recently launched its knowledge platform for the local food movement across Ontario. Toronto is well positioned to develop a Toronto-focused clearinghouse on urban agriculture that would partly interact with the platforms of MetroAg and Sustain Ontario. This would seek to facilitate knowledge sharing among Torontonians and with other urban growers across Ontario and North America. The proposed Toronto clearinghouse would be a systematic source of information on who is doing what in urban agriculture in and around Toronto, including inventories of available lands potentially usable for food production. City regulations as they pertain to local food production and related activities such as composting will form another information set expected to be housed on this site.

Complementing such a digital knowledge clearinghouse, MetroAg and FoodShare have recently created a physical hub within the city, in order to develop and disseminate knowledge about urban agriculture. The Toronto Urban Food and Agri-

[38] Because of data confidentiality provisions in Statistics Canada data, we were not able to cross-reference census farms with our mapping (see MacRae, Gallant, et al., 2010). Projected converting hectares may actually be lower than estimated.

Table 2. Models for Municipal Urban Agriculture Development

Model	Characteristics	Example	Strengths	Limitations for Toronto
Political level coordination	Mayor's office or council advocate	Homegrown Minneapolis[a] (initiative of the mayor, 2009)	Clear political champion	Not historically an interest of the mayor's office; not a strong mayor system
Interdepartmental committee (IDC)	Representatives from key implementing departments	Philadelphia[b]	Coordinates actions across civil service	IDC exists[c] but cannot integrate with external actors
Leading NGO	NGO central to policy and programming in community	Southside Community Land Trust, Providence, RI[d]	Strong program delivery model	No Toronto NGO has urban agriculture as its main activity
Coalition	NGOs and other actors working collaboratively	Milwaukee UA Network[e]	Brings together diverse array of actors	Toronto Urban Growers lacks resources and depends fully on volunteers

[a] http://www.minneapolismn.gov/health/homegrown/index.htm.
[b] http://www.leadershipforhealthycommunities.org/images/stories/philadelphia_food_charter1.pdf.
[c] The committee includes representatives from City Planning; Economic Development, Culture and Tourism; Parks, Forestry and Recreation; Social Development, Finance and Administration; Toronto Community Housing Corporation; and the Toronto Environment Office.
[d] http://southsideclt.org/.
[e] http://www.mkeurbanag.org/Main/AboutMUAN.

culture Learning Centre is intended to serve researchers, practitioners, advocates, and others through a hub that would include a physical and digital library that builds on the collections of The Urban Agriculture Network (TUAN),[39] meeting spaces, and work space.

In addition to a central focal point for knowledge storage and sharing, a series of smaller-scale neighborhood hubs for urban agriculture are needed. Such centers would offer training sessions on urban agriculture, a small library, and a forum for innovation and dissemination of advances. The intention would be to combine such hubs with tool lending and material storage (see the section on physical infrastructure). Neighborhood hubs could be linked to emerging neighborhood food center proposals, which are part of the city's Food Strategy discussions (Toronto Public Health, 2010).

[39] MetroAg has secured control of the library that was assembled by TUAN, a nonprofit organization based in Washington, D.C., and has shipped it to Toronto. This collection contains publications, books, articles, papers, computer files, photographs, and recordings.

Governance, Coordination and Financial Support Infrastructure

Complex policy and program environments, such as those related to urban agriculture, are challenging to govern. A governance structure must express and refine a shared vision and enhance long-term plans for implementation. It must aggregate resources for implementing urban agriculture across numerous complementary and competing actions and actors.

Since urban agriculture, especially its commercial expression, is not particularly common in Canadian cities, many of the rules governing its operations have yet to be determined. Gaps in jurisdictional and regulatory frameworks can create governance challenges. The range of landowners and building owners and the geographic dispersion of production and distribution further complicate the governance environment.

Several models for governing this kind of work were investigated and assessed using organizational ecology frames (table 2 and Nasr et al., 2010). We concluded that none of them was appropriate

given Toronto's current realities. Instead, we turned to the model of a multistakeholder steering body with staffing from a funded agency. From our survey of urban agriculture development in North American cities, no other jurisdiction has completely pursued this model, although a Toronto food-related initiative has used this approach for more than 10 years. The Toronto Partners for Student Nutrition coordinates the implementation of student nutrition programs for 125,000 children daily in Toronto schools. The partnership involves all the major funders and implementers of student nutrition programs, with staff support provided by the Toronto District School Board.

In this model, overall governance and policy development would be provided by a steering body representing all the main governmental and nongovernmental actors engaged in the sector and the proposed urban growers' marketing cooperative. Staffing support would be provided from the city of Toronto, likely by staff who sit on the existing urban agriculture interdepartmental committee. The steering body would have an allocations committee that aggregates resources — land, finances, inputs, expertise — and distributes them to projects based on one funding application. The allocation committee's members would include representatives from government, funding agencies, private donors, and program delivery agencies.

Currently, funding for urban agriculture in Toronto largely comes from three sources: foundations (funding NGOs), corporations, and two funding programs of the city of Toronto.[40] Toronto does not have a funding stream dedicated solely to urban agriculture. Other jurisdictions around the world have such streams, on a permanent or one-time basis, for grants to jump-start the sector. London has instituted Capital Growth, an ambitious project related to the 2012 Olympic Games, which has a goal of creating 2,012 new food-growing spaces by 2012. This citywide program is being supported within various boroughs by local governments. For instance, the Edible Islington program makes small grants of C$300 to C$5,000 to fund projects that will "provide a community benefit."[41]

The survey of entrepreneurial agricultural projects by Kaufman and Bailkey (2000) legitimately raised questions about the financial viability of such initiatives. Although a full financial analysis was beyond the scope of this study, clearly a mix of market and nonmarket revenue sources will be required, particularly in the start-up phases. The municipality will have a significant role to play in enabling and providing grants and loans for start-up. Urban farmers will need to tap into existing OMAFRA grant programs for business planning and environmental stewardship assistance, and to press for a dedicated stream focused on their specific needs for the long term. The Co-operative Development Initiative (a federal grant program accessed through the Canadian Co-operative Association and Ontario Co-operative Association) provides grants for co-operative start-up, and local sustainable food initiatives are one of its priorities. Extension support will be critical. The municipality will have a substantial role in trying to keep costs reasonable, especially land and input costs. Agricultural land taxation rates will probably be essential. Land leasing costs will likely have to remain below fair market value. The proposed Toronto Urban Farmers Marketing Cooperative will play a key role in marketing and distribution, taking some of that burden off individual farmers. But ultimately, farmers will have to survive financially by relying primarily on sales of their produce to create a sustainable food production scenario.

Conclusion

The potential for urban agriculture is nowhere near being fully realized, but Toronto is ripe for greater urban agricultural activity. Suitable growing spaces may not be the major limiting factor to reach the goal of producing 10% of Toronto's current fresh vegetable intake. Much of the current activity is small in scale and not necessarily targeted to

[40] The two primary funding programs are Live Green Toronto and the Community Services Partnerships (CSP) program.

[41] See http://www.capitalgrowth.org/.

Toronto markets. Considerable barriers to scaling up have been identified, and a coherent, coordinated and multi-actor set of policy and program initiatives will be required.

We have proposed a program with five key pillars: infrastructure for accessing spaces for production; resources, services and physical infrastructure; food-chain infrastructure; knowledge infrastructure; and governance, coordination and financial support infrastructure. These five pillars build on existing initiatives and will require a high level of collaboration between multiple actors. The co-operative organizational approach, consistent with organizational ecology frameworks, provides a well proven democratic governance model. The plan involves progressive implementation over a 10-year period, focuses on import substitution to minimize competition with Ontario producers, actively facilitates demand-supply coordination, and meets other municipal objectives regarding environmental improvement, a livable city, and employment opportunities. The primary role of the state is to reshape the conditions of the market to account for the public benefits that should flow from an urban food production system.

Although designed specifically for the Toronto context, many of the program elements elaborated here are likely to be pertinent to other municipalities, and many planning-related instruments that can be brought to bear on policy and program implementation (Oswald, 2009) are applicable in other jurisdictions. Many other cities in North America are similarly poised to implement commercial urban agriculture programs on a comprehensive scale (see for example, Quinn, 2010, and Stringer, 2010, on New York City). Foodshed thinking increasingly informs this municipal interest, and urban planners are increasingly attentive to issues related to food production. There would appear, as a result, to be great opportunities for widespread scaling-up of food production in cities, including Toronto, if this proposed program were implemented.

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The feasibility of regional food systems in metropolitan areas: An investigation of Philadelphia's foodshed

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Abstract

A rapidly globalizing food system raises important questions of environmental sustainability, food security, public health, and nutrition. The local food movement has been arguing for localization and regionalization of the food system as an effective strategy to counteract the risks of a globalized food system and promote sustainability. However, confusion abounds about what constitutes a local food system, and to date little evidence exists regarding the capacity of local food systems to support major metropolitan areas in the global North. This paper quantifies the ability of the Philadelphia region to support the dietary requirements of that city's population. Food production data for three foodshed scenarios in the Philadelphia region is analyzed and compared to the dietary requirements of the population based on federal dietary guidelines and current consumption patterns in the metropolitan region.

Keywords

local food systems, regional food systems, foodshed, Philadelphia

Introduction

In today's fast developing research on local and regional food systems, one enduring difficulty is the question of capacity of localities and regions to

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produce enough food to support their dietary requirements. It is often assumed that the capacity to feed urbanized regions in the developed world, and increasingly in the developing world, by utilizing resources within a region is a thing of the past. Still, the systematic study of local food systems is in its infancy, and in general, the feasibility of local food systems in terms of production capacity has not been the primary focus of food system studies (Martinez, S. W., Hand, M., Da Pra, M., Pollack, S., Ralston, K., Smith, T.,…Newman, C., 2010; Risku-Norja, Ketomaki, Hietala, Helenius, & Virtanen, 2008). In a fundamental way, much like Berry (1990) suggests in his renowned quote that "eating is an agricultural act," the connection between what we eat and what we grow is (or at least ought to be) a direct one. However, the study and practice of agriculture, particularly in the United States, have been generally disconnected from the study of nutrition and dietary requirements (Peters, Fick, & Wilkens, 2003).

In this study, we evaluate agricultural production in the agricultural hinterland of the Philadelphia food system. Three foodshed regions are defined and compared. These foodshed regions represent regions that emerged from previous research and the local food systems literature. A "current foodshed" includes 37 counties that were documented as currently supplying food to the local food system in the city. A "50-mile (80.5 km) foodshed" comprising 25 counties represents the average distance that farmers who supply local food markets travel to Philadelphia (Kremer, 2011; Kremer & DeLiberty, 2011). Finally, a "100-mile (160.9 km) foodshed" comprising 69 counties represents the popular radius that is often used as a reference to local food systems in the literature (see for example Smith & MacKinnon, 2008).

To contribute to the developing study of local and regional food systems, data on current agricultural production under these different definitions of foodshed regions are analyzed and compared to dietary requirements of the population based on the federal Dietary Guidelines for Americans (DGA) and current food consumption of four food groups: fruits, vegetables, meat, and dairy.

Foodsheds, Regions, and the Question of Capacity

An early attempt to make a connection between food production and dietary requirements used USDA food availability data to compare between actual consumption of food and federal dietary recommendations (Kantor, 1999). Although the stated purpose of the study was a time series evaluation of consumption patterns and the prediction of future dietary trends, the study appears to be the first to use the newly created 1995 loss-adjusted food availability dataset to evaluate the adequacy of food availability in the U.S. and its capacity to meet the dietary requirement of its population. The study concludes that food availability in the U.S. falls short of supplying federal dietary recommendations to the population in several important categories, including vegetables, fruit, dairy, and lean meats, while providing a large excess of added fats and sugars, a trend that is predicted to continue well into the future. Further breakdown of these categories into different types of fruits, vegetables, dairy products, and meats presented an even more perplexing picture, where the most nutritious foods were the least available. The study results were used to draw attention to deficits in the American diet, but could also be used to draw attention to deficits in farming practices that underlie food availability. In essence, these results indicate that American farms and agriculture policy fail to deliver the quality of foods needed for a balanced diet, and total caloric intake is often achieved through undesirable added fats and sugars.

In another chapter of the same publication, Young and Kantor (1999) offer a view of the types of changes American agriculture needs to make to supply an adequate diet to the U.S. population. They indicate that production of certain vegetables such as leafy greens, beans, and lentils would need to be increased by 200% to 300%, while other foods, such as potatoes, would decrease by 30% to 40%. Fruit production should increase by more than 100% and added fats and sugars decreased by 36% and 68%, respectively. Calculating the overall required changes in agricultural land, the authors estimate that over 5 million acres (over 2 million

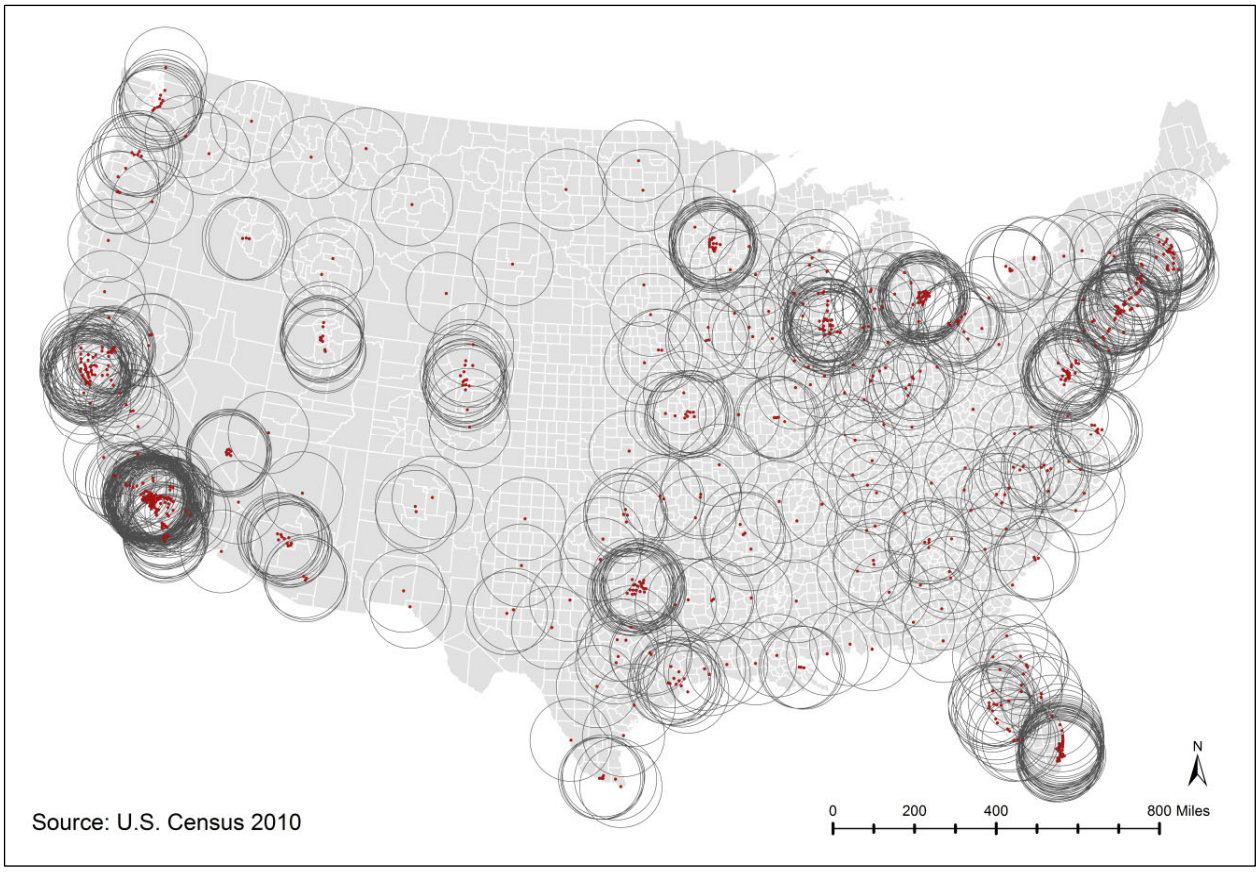
hectars) would need to be added to production, mostly for fruits and vegetables, while other acres would need changes in their production patterns. While the study is highly aggregated, this approach sets the stage for a more refined understanding of the relationships between production and consumption of agricultural products in the U.S., an essential step for approaching the question of food systems as a question of sustainability. Addressing the direct connection between actual agricultural production and needed nutritional requirements opens new opportunities to set policies that encourage agricultural production for adequate nutrition (as defined by the DGA), such as promoting land use change toward producing nutritionally favorable crops (Peters et al., 2003; Young & Kantor, 1999).

In a recent study, Peters, Wilkins, and Fick (2007) build on this approach and compare land use requirements for different diets and the availability of land to supply these requirements in New York State. They calculate the number of people who could be fed using the land resources in the state by constructing various dietary scenarios and find up to a fivefold difference between vegetarian and meat-based diets. The per capita land requirement to supply the different diets ranged between 0.45 acre per capita (0.18 ha per capita) for a vegetarian diet and 2.13 acres per capita (0.86 ha per capita) for a diet heavily based on meat. They concluded that with moderate meat consumption, the land base in New York state can feed about 21% of the state's population. Additional research addressed a spatial conceptualization of localized food systems by estimating the potential for lowering the distance that food travels in New York state (Peters, Bills, Lembo, & Wilkins, 2009). This study, comparing food production potential and food requirements in population centers in the state, used aggregations of agricultural potential and human dietary requirements and represented a major step forward in spatial analysis of local foodsheds. Its findings suggest that smaller urban centers in New York might be able to support their dietary requirements, using food produced locally, and that up to 98% of their food requirements could be produced within an average of 30.5 miles (49 km). However, as is often the case with large metropolitan regions, New York City is largely left out of this food system, with 2.2% of its food requirement potentially being met by local production with an average of 165 miles (265 km) traveled (Peters et al., 2009).

Using an average diet from the studies discussed above as a reference, the Delaware Valley Regional Planning Commission (DVRPC, 2010) chose an average of 1.23 acres (0.50 hectare) per capita to represent the amount of land required to supply an appropriate diet to the Philadelphia region population. They concluded that the DVRPC's nine-county region can produce about 5% of its own food, and a 100-mile radius region around Philadelphia can produce about 11% of its food. However, when discussing a foodshed, a 100-miles radius is better understood as the production base for the DVRPC region. Viewed from this perspective, the region's capacity to provide the same diet just for Philadelphia residents is around 60% (Clancy & Ruhf, 2010).

The results of these studies reflect the limitations in understanding local food systems in major urban areas. One major issue when attempting to capture the concept of local food systems is the issue of scale and definition of a region. In the New York State study, the state is defined as the unit of analysis, although the state's foodshed may extend beyond the political boundaries of the state, and portions of the state may also be part of other regional foodsheds. Moreover, much confusion arises over the definition of a region for the purpose of foodshed analysis. In Philadelphia, for example, a 100-mile radius includes the population of both New York City and Baltimore in Philadelphia's foodshed, encompassing over 38 million people (or 13% of the entire U.S. population). As figure 1 demonstrates, the designation of a 100-mile radius around any large city is bound to overlap with foodsheds of other cities. New York City's 100-mile foodshed, for example, includes portions of New Jersey, Pennsylvania, Connecticut, and Massachusetts, and overlaps with the foodsheds of other large cities. In such cases, theoretical calculations of food production capacity fall short of the actual realities of food pathways. In fact,

Figure 1. Local Foodsheds Delineated by a 100 Mile Radius Around U.S. Cities with Population Larger than 50,000



very few 100-mile circles around large cities do not overlap with other adjacent circles, and few of these circles are fully bound by the political boundaries of a single state. In addition, the geographic characteristics of a region do not always comply with the radius definition. In the case of Philadelphia, as in many other coastal cities, a significant portion of the 100-mile radius is occupied by the ocean. Of course, a 100-mile radius is used here as an arbitrary example for visualization, but the same exercise could be repeated using other radii.

Narrowing the analysis to the issue of food miles, as suggested by Peters et al. (2009), by exclusively optimizing the distance traveled by raw foods from the field to the adjacent population center, ignores a complicated reality of food systems infrastructure, such as processing capacity and distribution networks, and the economic reality that local food may travel toward higher-income areas. This situation makes NYC a more likely recipient of food produced in that state than most other urban centers. Referring to the relationship between Pennsylvania and New Jersey agriculture and New York City markets, DVRPC (2010) cites this particular point as one of the barriers to widening the local food system in the Philadelphia region.

Another recent study that assesses the local food system potential in the Willamette Valley region in Oregon captures some of these complexities. Giombolini, Chambers, Schlegel and Dunne (2011) use state agricultural production data and USDA dietary recommendations to evaluate the capacity of that region to feed its own population. The region, as defined by the geography of the valley, comprises 10 counties and approximately 2.5 million people and is a major agricultural production region that caters to the largest cities in the state (Giombolini et al., 2011). Using current

production data, they provide detail and insight into the different foods available in the region, thus enhancing the understanding of what is in fact possible locally. They find that for all the food groups, the valley does not produce enough food to support its population. Grain production was found sufficient to supply up to 73% of the dietary requirements, and dairy, up to 60%. Vegetables and fruit presented a much grimmer picture, with 30% and 24%, respectively. The authors also make the point that in reality 92% of wheat grain is exported to Asian markets, although they do not provide information about what portion wheat is of all grains, or about the actual destinations of any of the other crops.

In Finland, a study of the capacity and environmental impacts of localizing the food system in a rural area compared primary production capacity against a current diet and three constructed dietary scenarios that included 24 basic foods (Risku-Norja et al., 2008). The researchers found that while the region, a rural area with little population, was well capable of producing its own food, there were still major differences in food production capacity, depending on meat-based or vegetarian dietary choice. They also argue that both dietary choice and agricultural method can significantly influence the environmental impacts of the food system, suggesting that localization alone is insufficient to determine the full environmental impacts of the food system.

In sum, in the developing discussion about the capacity of localities and regions to supply their own food, the conclusion is often that self-sufficiency is rarely feasible, but that in principle, some capacity for self-sufficiency does exist. However, major questions remain regarding the definition of local and regional food systems and especially the capacity of different foodshed regions to feed major metropolitan areas. Building on the body of literature discussed so far and in order to further the study of local and regional food systems and foodsheds as they relate to large metropolitan areas, we define three foodshed regions around the city of Philadelphia and examine their capacity to produce the dietary requirements of the city and the different foodshed regions.

Philadelphia Metropolitan Region as a Foodshed

A particularly difficult issue when evaluating a local food system is the ability to define the different components of the system (infrastructure, participants, types of food outlets, and food production), the system's physical extent, as well as its social and economic characteristics. Geographic definitions used in this paper are partly derived from an analysis of the Philadelphia local food system discussed elsewhere (Kremer et al., 2011; Kremer, DeLiberty, & Schreuder, forthcoming) and supported by the literature on local food systems. In the analysis of the foodshed regions, the county is used as the unit of analysis, as it is the smallest scale for which detailed agriculture statistics are available. To explore how different definitions of the foodshed affect the capacity of the food system, a regional analysis was performed for the following three foodshed scenarios:

1. Current local foodshed: This region includes all counties that currently participate in the local food system in Philadelphia. They include farms that are sending their produce to farmers' markets, specialty stores, or other retail and institutional outlets in the city, or offer a CSA to city residents (Kremer, 2011; Kremer et al., 2011). It is the only foodshed that solely includes counties currently supplying local food to the city and the only one that is not spatially continuous. This foodshed includes 37 counties.

2. 50-mile (80.5 km) foodshed: This region represents the average distance currently traveled by farmers supplying local food markets to the city (Kremer et al., 2011) and is the smallest foodshed, of 25 counties.

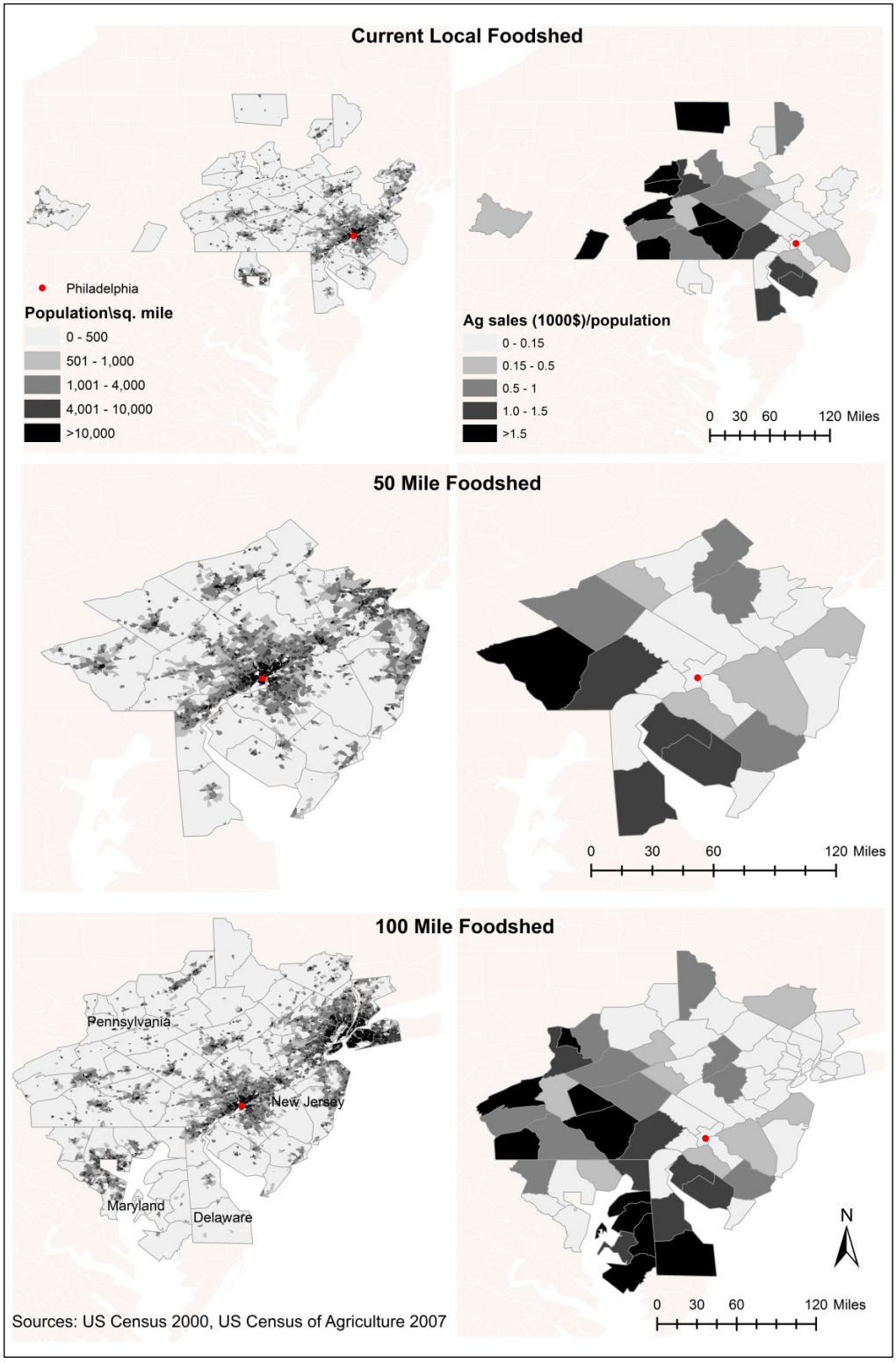
3. 100-mile (160.9 km) foodshed: A radius widely used in the discussion of local food systems and one of the most popular icons for the local food movement. This foodshed includes 69 counties.

Counties from five states, Pennsylvania, New Jersey, Delaware, Maryland, and New York, are represented in different combinations in this analysis. County demographic data was retrieved from the 2000 Census, and agriculture data was acquired using the USDA Census of Agriculture 2007 Desktop Dataquery Tool (USDA-NASS, 2007). The participating counties in each of the defined foodshed regions are mapped in figure 2, and the population density within each foodshed region is presented alongside per capita sales of agricultural products. Table 1 summarizes the key population and agricultural land-use characteristics of the three foodshed regions.

As shown in Table 1, the population in

Figure 2. Three Defined Foodshed Regions

On the left: Population density in the study area. On the right: Per capita sales of agricultural products.



Philadelphia represents a small portion of the total population of the region under all foodshed definitions, its portion ranging from 14% in the case of the 50-mile foodshed to 5% in the case of the 100-mile foodshed (which itself contains about 10% of the total U.S. population). While the focus of this analysis is on the foodsheds' capacity to feed Philadelphia, the fact that the city is part of the most densely populated region in the United States and has an immediate proximity to other significant metropolitan areas, such as New York and Baltimore, introduces complications and subtleties to the regional analysis that require further attention and will be discussed in some detail later in this paper.

Some counties within the region, such as Philadelphia itself, New York City, and Ocean County, New Jersey, have little agricultural production reflected in the USDA statistics. However, most counties do have major agricultural output, and some are even primarily agriculture counties, such as Lancaster and Berks counties in Pennsylvania and Sussex County in Delaware. Figure 3 presents the distribution of sales for all agricultural product groups in the three defined foodshed regions. Figure 4 displays agricultural products sales by major agriculture food groups (produce, grains, meat, poultry, and dairy). In general terms, closer to the coast where population density is usually higher, agricultural production tends to be mixed and includes a higher percentage of fruits, vegetables, and nursery crops. As population density drops (to the west in Pennsylvania and the south in Delaware), agricultural production concentrates on grain, milk, and livestock. Overall, the region is characterized by relatively small farm size, with the average in most counties being smaller than 100 acres (40 hectares).

Methodology

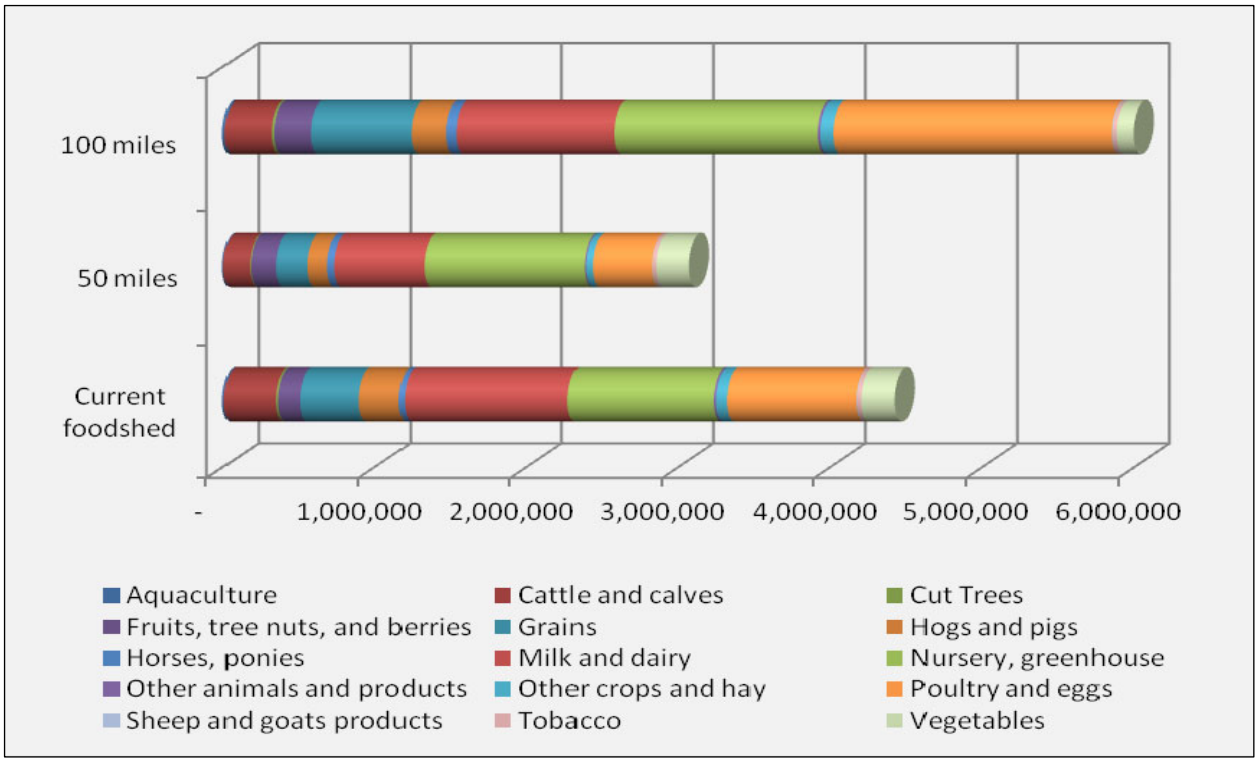
The methodology used in this paper builds on previous studies that compared food production (Giombolini et al., 2011; Kantor, 1999; Risku-Norja et al., 2008), or potential food production (Peters, Wilkens, & Fick, 2007) to dietary requirements of a defined population. Here, we chose to use the current agricultural production in the designated region as the basis for analysis because it enables a more realistic and specified picture of the regional current situation and may be more indicative of the types of changes necessary to build a successful localized food system. While other studies adopted a similar approach (see Giombolini et al., 2011; Risku-Norja et al., 2008), our study reflects a more complicated situation,

Table 1. Summary of Land Use and Agricultural Production in Three Foodshed Regions

Variable	Current Foodshed	50 mile	100 mile
Population	12,058,140	11,049,429	31,211,500
Philadelphia city population share of region (%)	13%	14%	5%
Agriculture acres per person	0.26	0.15	0.13
Agriculture acres per Philadelphia person	2.06	1.06	2.70
Agriculture land use (acres, 2007)			
Crop—pasture or grazing	162,473	78,775	193,936
Crop—harvested cropland	2,468,727	1,325,689	3,333,042
Crop- other cropland	222,472	73,123	256,460
Permanent pasture and rangeland	297,235	142,803	342,399
Woodland not pastured	552,369	203,546	698,848
Woodland pastured	42,331	17,760	48,338
Total land in agriculture	3,193,238	1,638,150	4,174,175

Compiled from 2007 Census of Agriculture (USDA-NASS, 2007; USDA, 2007), 2000 Census of Population (U.S. Census Bureau, 2000)

Figure 3. Agricultural Production Sales (in US$1,000) by Region and Product Group



namely that of a metropolitan area. The major challenge in constructing a regional analysis for this study is in integrating scarce and fragmented data of county agriculture land use into a model that can calculate estimated agriculture yields for different foods and then categorize them into USDA nutrition guidelines food groups. This methodology covers most food groups: vegetables, fruit, poultry and eggs, and meat and dairy. However, it was not feasible to determine the amount of crops in the region used for the production of oils. It is reasonable to assume that a portion of the corn and soy production in the region is used for oils; however, we had no reliable way to estimate this portion or the amount of oils produced from those crops. Other oil crops are not grown in significant quantity in the region. For this reason, the food group of oils was not included in our analysis.

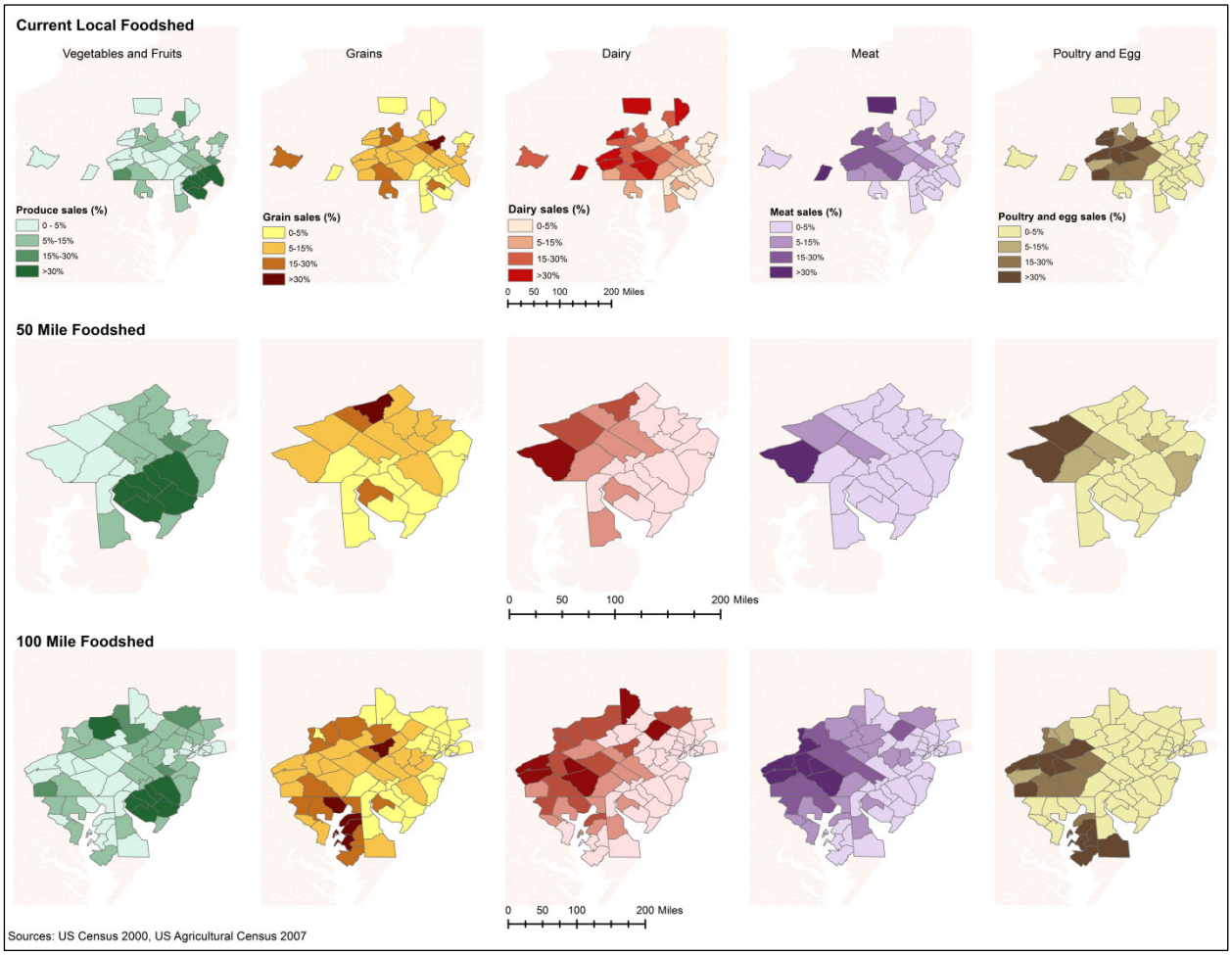
Agricultural Production

The baseline agriculture data was acquired from the 2007 census of agriculture for each of the counties using the USDA Census of Agriculture 2007 Desktop Dataquery Tool (USDA-NASS, 2007). With this tool, all counties were selected for each data point. All data was queried and aggregated into tables of data points by county within the relevant foodshed. Using ESRI ArcGIS 10, geographic attributes of census county data were joined to tables containing agriculture census data, enabling the spatial representation of the agriculture statistics.

Within the food groups, data appeared in different formats for different foods. Fruit and vegetable data was available only as the number of cultivated acres per county. This data was then multiplied by national average yield, in pounds per acre, calculated from total production and cultivated acres published in the most recently available Vegetables and Melons Yearbook (USDA-ERS, 2009b) and the Fruit and Tree Nut Yearbook (USDA-ERS, 2009a) published annually by USDA Economic Research Service. To most accurately fit the regional data available, yields for 2007 are used.

Figure 4. Agriculture Sales in Three Foodshed Regions by Product Group

Maps represent percent of total sales for each agricultural product group within each county.



Grain data was available in the form of production of bushel per acre and converted to pounds of relevant commodities such as wheat flour and cornmeal. Meat and poultry data is available as the number of animals sold for slaughter in each county. These number were converted to pounds of meat using the national Livestock Slaughter, and Poultry-Production and Value, annual reports (USDA-NASS, 2009a; USDA-NASS, 2009b). Milk production data was available as the number of milk cows residing in each county. Statistics of milk production are collected continuously by USDA from a sample of 23 states across the country (personal email correspondence with Roger Hoskin of USDA-ERS, June 25, 2010). In this case, average milk production per cow was based on 11 counties that are included in the region of this study and are part of the national sample was used to calculate milk production. Data about egg production was available as the number of dozens of eggs produced in 2007.

Dietary Requirements

To estimate the dietary requirements for the population of the city of Philadelphia and the foodshed regions, federal Dietary Guidelines for Americans (DGA) are employed (USDA & USDHHS, 2010). Dietary guidelines are represented by six food groups: fruit, vegetables, grains, dairy, protein foods, and oils. Further recommendations within these groups exist, such as the classification of vegetables into groups that distinguish between

green, leafy, and starchy vegetables, but for simplification here, we addressed only the above mentioned groups. Table 2 presents the dietary recommendations for different age groups by gender. The DGA are also divided by a recommended calorie intake for each age-gender group, and the amount recommended is then represented by standardized units of consumption — cups, ounce equivalents, or grams.

Similarly to Giombolini et al. (2011), this study uses dietary guidelines for moderately active persons, as data on the activity levels of the population in the study area is limited. Moderate activity represents an average level of activity that lies between sedentary and highly active persons. Using population data from the 2000 Census, grouped by age according to the divisions in the dietary guidelines, enabled the calculation of total dietary requirements, by food group, for the study population.

An additional parameter often used to estimate average food consumption in the U.S. is the USDA's Economic Research Service Per Capita Food Availability dataset (USDA-ERS, n.d.). This dataset estimates the availability of specific food products by calculating total production, imports, and exports normalized for the population. The data is often used as a proxy for current food consumption trends in the population and is used here as a comparative indicator for the capacity of the food system. Average annual per capita consumption of food by food group is summarized in Table 4.

Results

Dietary Requirements of Philadelphia and the Foodshed Populations

Dietary requirements of the Philadelphia population were calculated using the DGA (USDA & USDHSS, 2010). DGA differ by age group, gender and activity level. It was not possible to delineate population groups by activity level for this research, so the dietary guidelines for moderately active persons, and an average activity level, were used for all population groups. Population data was acquired from the 2000 Census of Population (U.S. Census Bureau, 2000). Data was downloaded for all ages (0–110) for Philadelphia as well as all the

Table 2. Dietary Guidelines by Age and Gender for Moderately Active Persons by Food Group (daily consumption)

Gender	Age	Moderately Active Calories	Fruits (cups)	Vegetables (cups)	Grains (oz eq)	Lean Meat and Beans (oz eq)	Dairy (cups)	Oils (g)
Children	2–3	1,000–1,400	1.50	1.50	5.00	4.00	2.50	7
Female	4–8	1,400–1,600	1.50	2.00	5.00	5.00	3.00	2
	9–13	1,600–2,000	2.00	2.50	6.00	5.50	3.00	7
	14–18	2,000	2.00	2.50	6.00	5.50	3.00	7
	19–30	2,000–2,200	2.00	3.00	7.00	6.00	3.00	9
	31–50	2,000	2.00	2.50	6.00	5.50	3.00	7
	51+	1,800	1.50	2.50	6.00	5.00	3.00	4
Male	4–8	1,400–1600	1.50	2.00	5.00	5.00	3.00	2
	9–13	1,800–2,200	2.00	3.00	7.00	6.00	3.00	9
	14–18	2,400–2,800	2.50	3.50	10.00	7.00	3.00	6
	19–30	2,600–2,800	2.50	3.50	10.00	7.00	3.00	6
	31–50	2,400–2,600	2.00	3.50	9.00	6.50	3.00	4
	51+	2,200–2,400	2.00	3.00	8.00	6.50	3.00	1

Compiled from: Dietary Guidelines for Americans 2010 (USDA & USDHHS, 2010)

Table 3. Total Food Requirements of the Philadelphia Population by Age Group According to the DGA

Gender	Age (years)	Calories[1]	Fruits[2]	Vegetables[2]	Grains (ton)	Meat[2]	Milk[3]	Oils (ton)
Child	2–3	1000-1400	21.68	21.68	1,024.46	28.91	14.45	122.87
Female	4–8	1400-1600	58.67	78.22	2,771.96	97.78	58.67	430.22
	9–13	1,600–2,000	82.61	103.26	3,512.86	113.59	61.96	557.61
	14–18	2000	76.91	96.14	3,270.54	105.75	57.68	519.14
	19–30	2,000–2,200	216.20	324.31	10,726.25	324.31	162.15	1,567.48
	31–50	2000	326.30	407.87	13,875.66	448.66	244.72	2,202.52
	51+	1800	262.71	437.84	14,895.17	437.84	262.71	2,101.65
Male	4–8	1400-1600	60.56	80.74	2,861.21	100.93	60.56	444.08
	9–13	1,800–2,200	85.35	128.02	4,234.29	128.02	64.01	618.78
	14–18	2,400–2,800	96.56	135.19	5,475.01	135.19	57.94	695.25
	19–30	2,600–2,800	245.59	343.82	13,924.53	343.82	147.35	1,768.22
	31–50	2,400–2,600	290.08	507.64	18,503.17	471.38	217.56	2,465.68
	51+	2,200–2,400	241.62	362.43	13,699.53	392.63	181.21	1,872.54

[1] Number of daily calories recommended for Moderately Active persons; [2] million servings; [3] million cups

Table 4. Food Availability by Food Group (annual kg/capita)

Food Group	Average Consumption (2007, kg/capita)
Vegetables	124.9
Fruit	118.2
Milk and Dairy	121.0
Grains	89.5
Poultry and eggs	48.0
Meat	91.1

Compiled from: USDA Economic Research Service- Food Availability (Per Capita) Data System (USDA-ERS, n.d.)

counties in the three defined foodshed regions. Population was then grouped into age groups corresponding to the gender and age groups used in the dietary guidelines. Babies under two years are not included in the calculations because they are not included in the dietary guidelines. All children between 2 and 3 years old are grouped together because the guidelines are gender neutral at this age group. The rest of the age groups, 4–8, 9–13, 14–18, 19–30, 31–50, and 51 and over, are aggregated by gender.

The DGA, as presented in Table 2, suggest the number of servings necessary for appropriate nourishment from each food group. Servings are an abstract unit that may contain differing quantities in different foods. For example, one serving of fruits or vegetables is measured as half a cup, which can mean 28 grams of lettuce, 50 grams of cauliflower, 90 grams of tomato, and so on. One serving of dairy is equivalent to one cup (244 grams) of milk, and one serving of meat is equivalent to one ounce (28 grams). An egg, for example, is considered equivalent to one ounce of meat and one serving in the meat, poultry, and eggs group. The calculations in this study are based on the number of servings required by the population for each food group. Daily recommended servings are multiplied by the number of persons in the corresponding age-gender group and then converted to annual consumption. The result is the total annual number of servings required to feed the different population groups. Table 3 summarizes the amount of servings required to appropriately feed the population of Philadelphia by gender and age group for each food group, assuming a moderately active lifestyle. Table 5 summarizes the number of servings required to appropriately feed the entire population within each defined foodshed region.

Table 5. Total Food Requirements in Philadelphia and the Three Foodshed Regions According to the DGA

Foodshed Region	Fruits[1]	Vegetables[1]	Grains (ton)	Meat[1]	Milk[2]	Oils (ton)
Philadelphia	2,0645	3,027	108,775	3,129	1,591	15,366
Current foodshed	15,119	22,159	801,352	22,983	11,572	112,834
50 mile	14,381	21,063	761,7667	21,850	11,001	107,272
100 mile	41,156	60,277	2,181,361	62,493	31,416	306,932

[1] million servings; [2] million cups

Table 6. Food Consumption in Philadelphia and Three Foodshed Regions According to ERS Food Availability Data

Foodshed Region	Fruits (ton)	Vegetables (ton)	Grains (ton)	Meat, Poultry and Eggs (ton)	Dairy (ton)
Philadelphia	172,460	182,353	130,678	202,968	176,592
Current foodshed	1,259,427	1,331,674	954,303	1,482,216	1,289,603
50 mile	1,197,710	1,266,416	907,538	1,409,580	1,226,407
100 mile	3,420,652	3,616,876	2,591,923	4,025,753	3,502,611

The second method applied here to estimate the food requirements of a population is based on food availability data collected by the Economic Research Service of USDA (USDA-ERS, n.d.). This data, an average estimate of the total food available to a population, is widely used as a proxy for food consumption by the population. The data represents the types of food that people actually eat rather than what is considered good for them to eat (per the DGA). We use this data, grouped to match the food groups in the DGA, as a comparative measure of the region's capacity to supply its food requirements. We use average annual consumption of food in the different groups, as presented in Table 4, multiplied by the population in the city and the three defined foodshed regions. The method used to derive this dataset does not allow for age and gender specification, and thus the results represent an overall average of current consumption. Table 6 presents the total food consumption in the different food groups calculated using this method.

Food Requirements for Animal Feed

Since meat and dairy make up significant parts of food consumption in the United States, calculating a population's dietary requirements needs to account for the food necessary to feed the animals that provide milk, eggs, and meat. To include the food requirements of animals that provide milk, eggs, and meat to the population of the region and avoid overcounting grain production for human food products, grains were divided into two groups: grains used directly for human consumption and grains used as animal feed. This way it is possible to estimate the region's capacity to provide animal feed as well as food for direct human consumption. It is difficult to estimate food requirements of animals because they vary greatly with geography and production methods. Here, we used consumption factors calculated as U.S. average grain consumption per kilogram of meat production for the different products: beef, pork, eggs, milk, broilers, and turkeys (Pimentel &

Table 7. Feed Grain Requirements for Philadelphia and Three Foodshed Regions

Foodshed Region	Feed grain required (ton)
Philadelphia	379,560
Current foodshed	14,445,213
50 mile	7,472,399
100 mile	17,529,073

Pimentel, 2008). Total production for each of these groups is multiplied by the consumption factors. The total grain requirements presumed needed for animal feed are summarized in table 7.

Food Production in the Foodshed

Total regional food production is presented here for all the food groups and foodshed regions as defined above. In term of sales, as presented in Figure 3, the largest food sectors are poultry, eggs, and dairy, while in terms of actual production, grains are by far the largest crop of the region, followed by dairy. Meat, poultry, and eggs represent the third largest food group in all the defined foodshed regions except for the 50-mile foodshed, where vegetable production is greater. A comparison of food production by food group and foodshed region is presented in Figure 5.

For the purpose of comparing food production and food requirements, the calculated food production dataset was converted into units of food requirements. For the federal dietary guidelines, food production was converted into units of servings (vegetables, fruits, and meat), cups (milk), and grams (grains). Serving sizes and weights of different foods are based on data available from the USDA and in the literature (Giombolini et al., 2011; Kantor, 1998; USDA-ERS, n.d.; USDA-FNS, 2009). Table 8 summarizes the total food production for the defined foodshed regions.

Comparing Food Requirements and Food Production

Having estimated the production of food in the defined foodshed regions and the food requirements in the city and the foodshed regions, it is now possible to compare them. However, the comparison will not indicate the current reality because little regional food production can be currently attributed to local food consumption. Nonetheless, the analysis sheds light on the

Figure 5. Food Production by Food Group

The proportion of food produced in each food group for three foodshed regions. Percentages based on production (in tons) out of total production in each foodshed. Numbers inside the bars represent actual production in 1,000 tons.

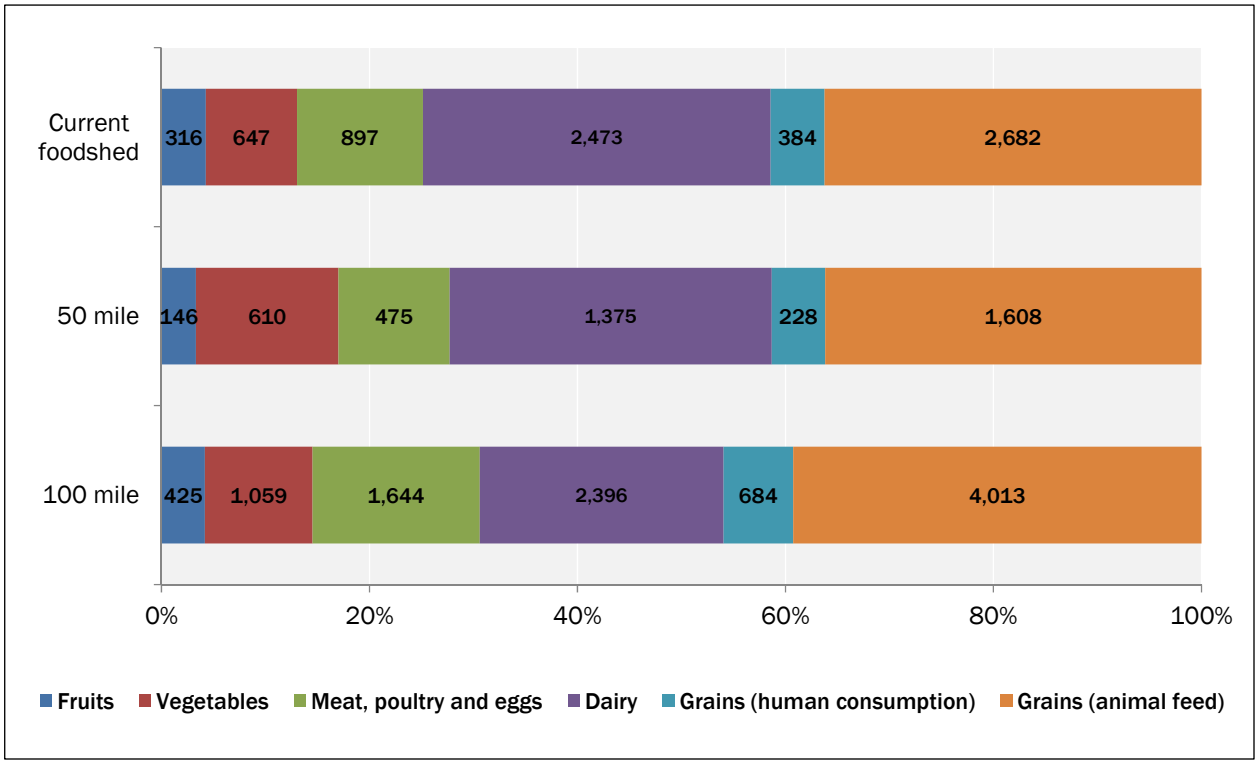


Table 8. Food Production Converted to DGA Units in Three Foodshed Regions

Foodshed region	Fruits[1]	Vegetables[1]	Grains (ton)	Meat[1]	Milk[2]
Current foodshed	2,634	9,080	383,930	31,598	10,126
50 mile	1,476	8,780	228,071	16,723	5,632
100 mile	3,925	14,595	683,415	57,945	9,811

[1] million servings; [2] million cups

Table 9. Proportion of Food Produced in the Three Foodsheds That Is Consumed by Philadelphia*

Foodshed region	Fruits	Vegetables	Grains	Meat	Milk
Current foodshed	78%	33%	28%	10%	16%
50 mile	140%	34%	48%	19%	28%
100 mile	53%	21%	16%	5%	16%

* Calculated as Philadelphia's total food requirements for each food group divided by total production for each food group within each foodshed region

Table 10. Proportion of Produced Food Consumed by Each Foodhsed's Entire Population*

Foodshed region	Fruits	Vegetables	Grains	Meat Eaten	Milk
Current foodshed	574%	244%	209%	73%	114%
50 miles	975%	240%	334%	131%	195%
100 miles	1048%	413%	319%	108%	320%

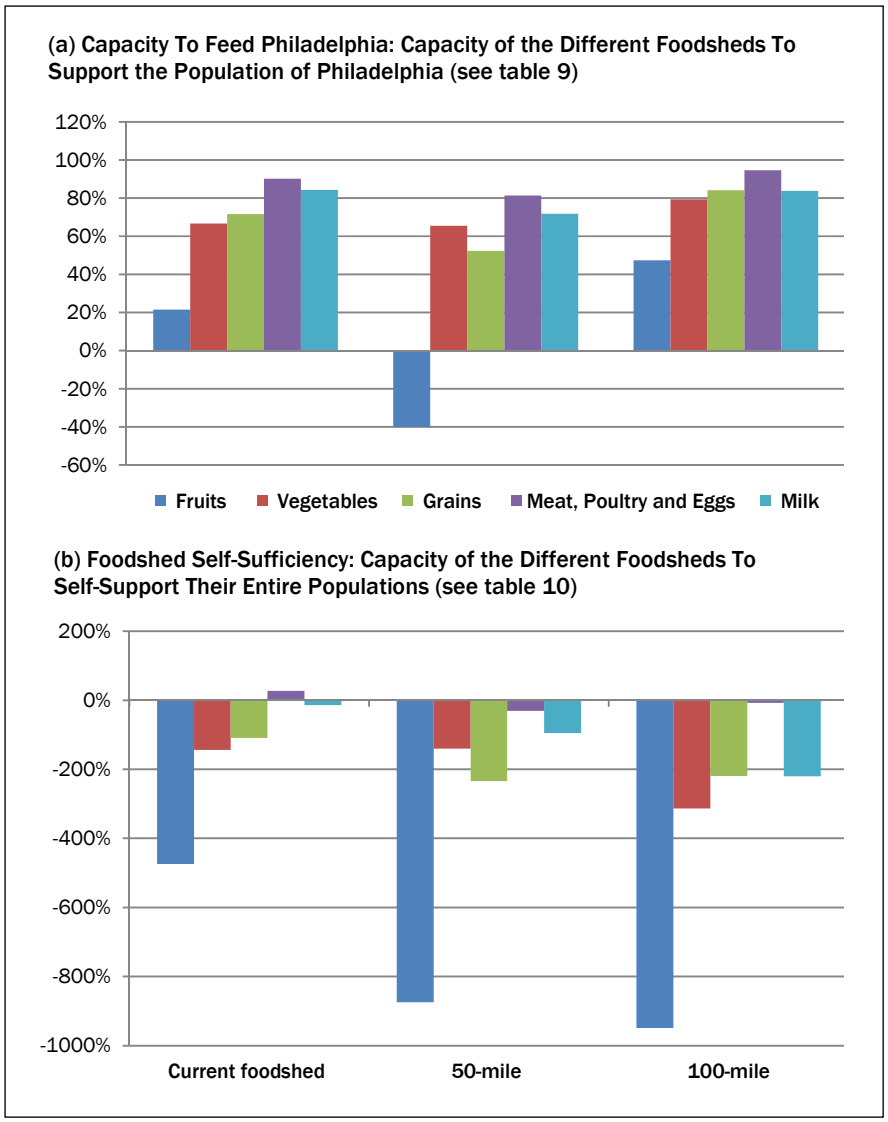
* Calculated as total food requirements of the population in all counties included in each foodshed region for all food groups, divided by total production in each food group within each foodshed region

potential and capacity in the region to produce food and can be used to focus attention on barriers and opportunities for the development of a more localized food system.

Using the calculated datasets of production and requirements, we first evaluate how much of the regional food production under the different foodshed definitions would be consumed by Philadelphia's population based on the DGA. Second, we calculate the capacity of the different regions to supply the dietary requirements of their full populations. Table 9 and 10 summarize the capacity of the three foodshed regions to support Philadelphia's food requirements and the self-sufficiency capacity of the foodshed regions. Percentages in the tables represent the portion of produced food that would be consumed by the defined population. Hence, any number under 100% represents sufficient capacity to feed the population, while numbers above 100% represent a deficiency. This two-step calculation was then repeated using estimated actual food consumption data based on the USDA ERS food availability dataset to compare the findings of the foodshed capacity based on the dietary guidelines to a foodshed capacity based on current consumption patterns. Figure 6 visualizes these results by representing the ratio between food production and food requirements, by food group, as either a shortage or surplus of food, first for Philadelphia and then for all foodshed regions. Figure 7 illustrates similar results utilizing USDA-ERS food availability data.

Figure 6. The Capacity To Support Food Requirements Based on the DGA

The regional capacity to support food requirements under federal food guidelines in three foodshed regions. Zero in the graphs represents 100% of food requirements.



Using a similar methodology, calculating the sufficiency of grain production for animal feed reveals similar results. While most of the regions provide enough food to support animal feed for Philadelphia's dietary requirements, the foodshed regions lacked the ability to provide enough animal feed to support their entire populations. Figure 8 presents the regional capacity to produce the feed grains required to feed animals in support of food requirements in Philadelphia and also each of the defined foodshed regions.

Discussion

Supplying Philadelphia's Dietary Requirements

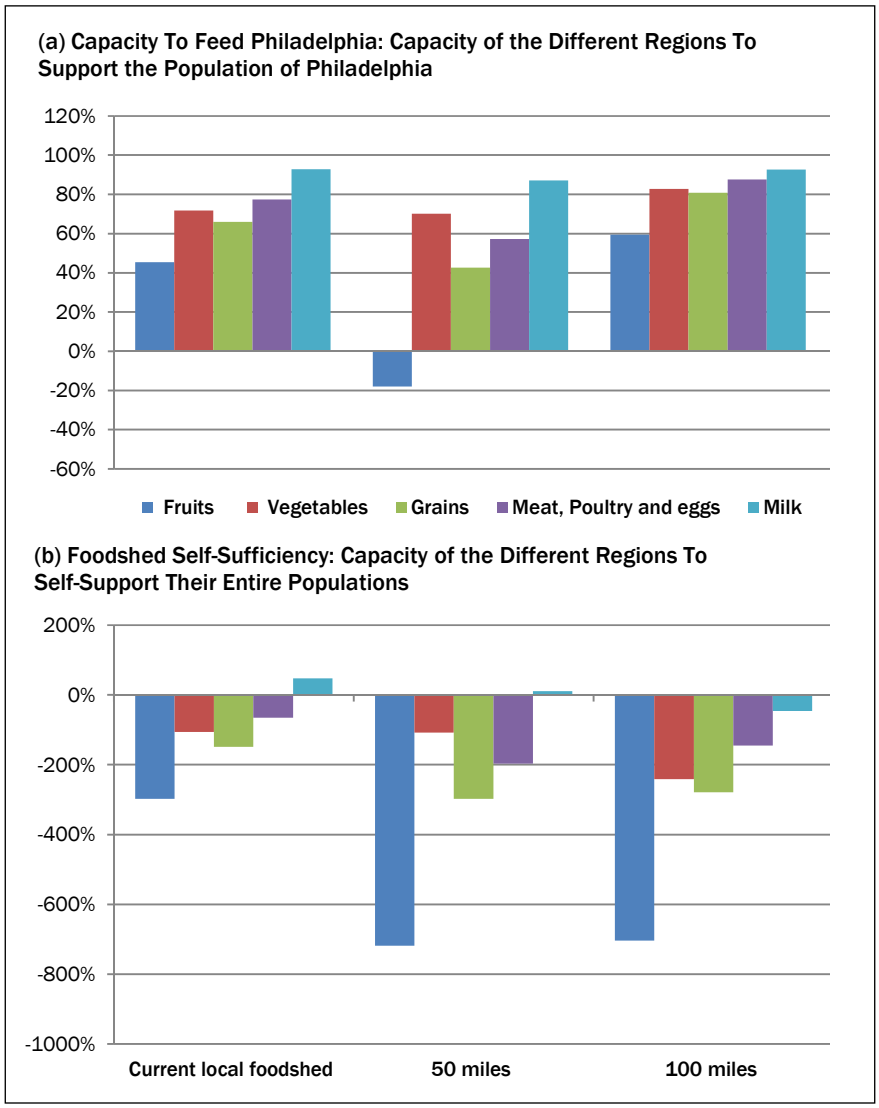
Studying the extent to which food production can supply the dietary requirements of the population of the city of Philadelphia, we analyzed data for current agricultural production under the different definitions of foodshed regions for Philadelphia and compared it to the DGA requirements and current food consumption of four food groups: fruits, vegetables, meat, and dairy. The results indicate that the amount of food produced in most of the defined foodshed regions easily meets the dietary requirements of Philadelphia, using both the DGA and the ERS food availability dataset. An exception is the fruit group, in which a shortage of 40% (by the DGA) and 18% (by the ERS dataset) occurred in the 50-mile foodshed. The reason for this shortage is that some of the most intensive fruit-producing counties that traditionally supply fruit to Philadelphia and the region, such as Adams and York counties in Pennsylvania, fall outside the 50-mile foodshed, but are included in all other foodshed regions. The 50-mile foodshed also lacks feed grain for animals by 4%. All regions except for the 50-mile foodshed produced grain for animal feed in sufficient quantity to supply Philadelphia's meat, poultry, and dairy requirements.

In the100-mile foodshed, Philadelphia's consumption represents between 5% (meat) to 53% (fruit)

of total production. In the 50-mile foodshed, Philadelphia's population requires 19% of the region's meat production, while its demand for fruits is underserved by 40%. On average, for all the food groups, Philadelphia's food requirements represent between 21% (in the case of the largest region, including all counties) and 51% (in the case of the 50-mile foodshed) of total regional production.

Figure 7. Capacity To Support Food Requirements Based on Current Food Consumption

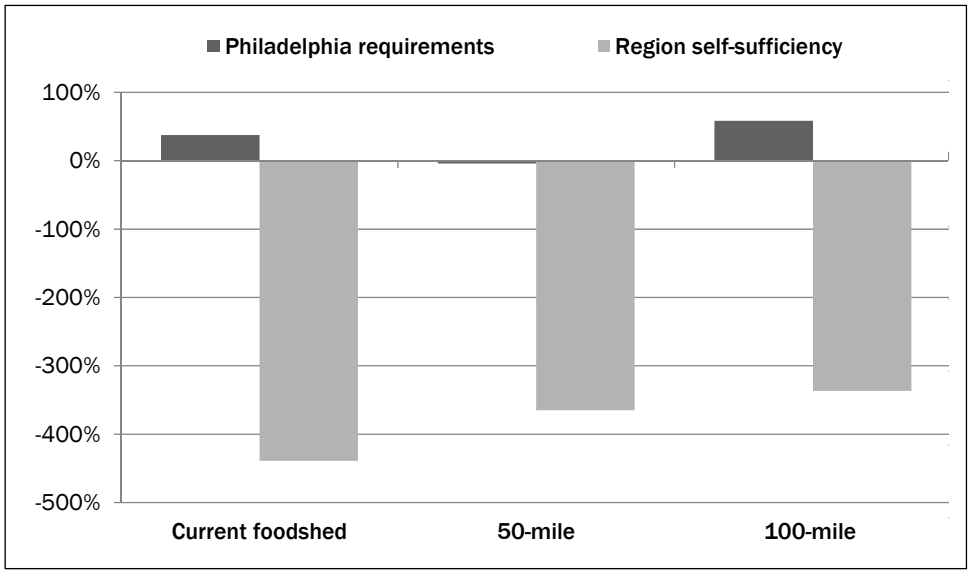
The regional capacity to support food requirements under USDA ERS food availability data in three foodshed regions. Zero in the graphs represents 100% of food requirements.



One of the interesting issues that emerge from this analysis is the difference in the results when considering the DGA and current consumption according to the food availability database. While the general trend is similar, differences appear in the total shortage or surplus for different food groups. For example, for vegetables and milk, a larger surplus occurs using the ERS food availability data, and in the case of meat, a larger surplus appears when using the DGA. Analyzing the difference in the results for DGA and current food consumption reveals that a change from current consumption to federal guidelines would result in a larger consumption of the regions' fruits, vegetables, and dairy and a lower consumption of the regions' grains, meat, poultry, and eggs. Together with the literature arguing that dietary choices have a significant impact on the resources and energy required for food production and that meat-intensive diets requires more resources in terms of land and energy (Gerbens-Leenes, 2006; Peters et al., 2007; Pimentel & Pimentel, 2008; Risku-Norja et al., 2008), these results suggest that encouraging consumption based on the DGA guidelines may have many positive impacts on the environment in addition to positive health impacts.

It is important to note here that using food groups as representative of total food requirements can be misleading. One example is the vegetables group, where five varieties (potatoes, sweet corn, tomatoes, cucumbers, and pumpkins) account for over 60% of total production. This concentration of

Figure 8. The Regional Capacity To Support Animal Grain Feed Production for Consumption of Meat, Poultry, Eggs, and Milk by the Philadelphia Population and the Entire Population of Each Defined Foodshed Region



production means that if the population were to rely on the region's produce, only a limited diet currently would be possible. In the case of vegetables and grains, a shift toward a more diverse representation of crops in agriculture practices is possible since the region's the soil and weather conditions enable the production of most grains and vegetables. In the case of fruits, the choice is more limited. Some fruits, such as citrus and tropical varieties, are obviously not suitable for the study region, and thus without imports, these varieties would be completely absent from the population's diet. This point is one important weakness of any analysis that generalizes land use and production potential and indeed underscores the fact that fundamental changes in land use, agricultural decisions, and consumption patterns are necessary for even a partial localization and regionalization of the Philadelphia region food system.

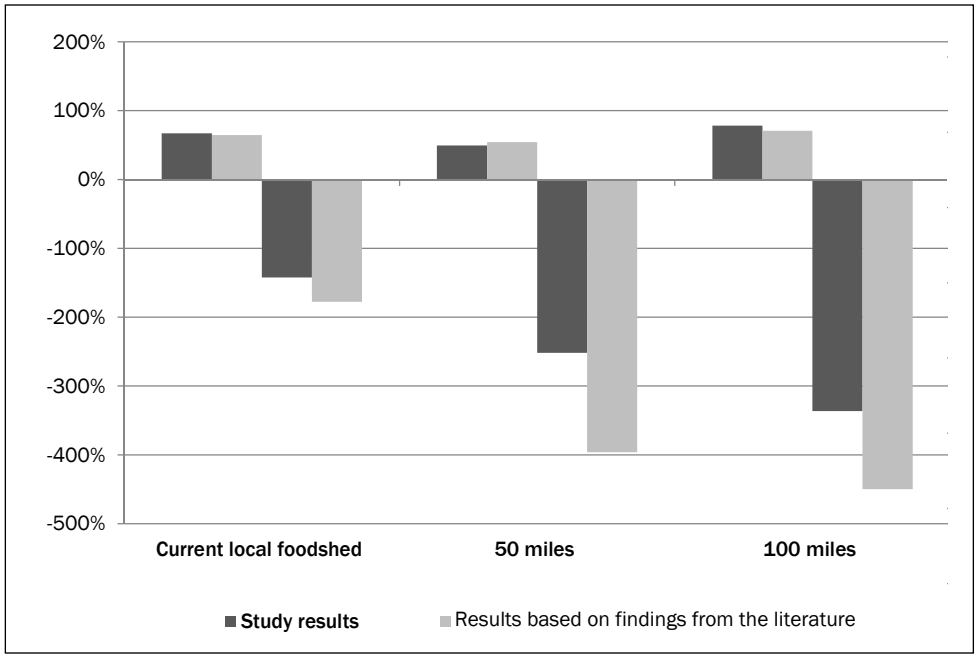
Foodsheds and Regional Self-sufficiency

We performed a second set of food requirements and food consumption calculations to include the total population of the foodshed regions and then compared this to the food production of the corresponding regions (as represented in figures 6-b and 7-b). The results indicate that in all the foodshed regions, the quantity of food grown is not sufficient to support the population of those regions. Fruits and vegetables are in large deficit in all the foodshed regions, using both dietary requirements evaluation methods. The largest deficit is in fruits, which is almost 950% short in the two largest foodsheds. Vegetables exhibit shortages up to triple the amount available. In the case of meat and poultry, consumption based on dietary guidelines results in a close match between production and requirements. However, for current consumption as represented by ERS food availability, a shortage exists in all foodshed regions. Using current food consumption trends, milk is produced in a sufficient quantity to meet the consumption demand in the current foodshed as well as the 50-mile foodshed. None of the foodshed regions produces enough feed grains to support meat and dairy consumption fully.

On average, for all the food groups, the shortage in food production ranged between 143% in the current local foodshed to 342% in the 100-mile foodshed region. The steepest shortages were for fruits, followed by vegetables at 420%. Thus, supplying the entire population of these regions with an adequate diet based on both the DGA and current consumption patterns would require enlarging the foodshed or including food supplies imported from other, more distant regions.

We compared the results of this study with a calculation using an average number of acres per person required to provide an average diet that meets the DGA (adjusted from Peters et al., 2007), and found similarities in the general trends of the data, although the total deficiencies in the different regions vary greatly (up to 50% in the case of the 50-mile region). A comparison of the results for all the foodshed regions, for the Philadelphia population, and for the self-sufficiency of each region is presented in Figure 9.

Figure 9. A comparison of the results of this study and results using literature data (from Peters et al., 2007) for the defined foodshed regions' capacity to support food requirements of the Philadelphia population (all bars above zero) and the three foodshed regions (all bars below zero).



Overlapping Foodsheds in Urbanized Regions

The results of this regional foodshed analysis exemplify the importance of the issue illustrated in figure 1, that when discussing foodsheds as self-containing regions, issues arise of overlapping populations and competition for food resources. The notion of a foodshed implies directionality in the flow of food from agricultural areas with lower population concentrations to more densely populated areas and large cities. The highly concentrated populations in metropolitan areas along the East Coast, which include Philadelphia, New York, Baltimore, and Washington, D.C., means that the foodsheds for these cities are bound to overlap. Philadelphia is located at the center of the most densely populated region in the United States. Its 100-mile foodshed contains about 10% of the total U.S. population and overlaps with foodsheds for New York City and Baltimore. The 50-mile foodshed does not include any of these metropolitan areas, but still is home to over 11 million people living in smaller cities around Philadelphia, such as Camden, New Jersey, and Wilmington, Delaware.

Nonetheless, as the definition of foodshed widens, the overlap declines. While the foodshed of Camden may be very similar to that of Philadelphia,[1] New York City can reach to upstate New York counties and even some New England counties for dairy products and fruit and into New Jersey for vegetables. A central question this situation raises is the likelihood of food that is produced within the foodshed region, even in a

[1] This definition only pertains to arbitrarily defined foodsheds of specific radii. As we show elsewhere (Kremer et al., forthcoming), there are administrative, political, and cultural issues that affect the shape of a foodshed. In the case of Camden, NJ, we can expect more food coming to that city from the agricultural counties of New Jersey than we see in Philadelphia's local food system. Thus, although the cities are physically adjacent in terms of their locations and are separated only by the Delaware River and the state line, they develop and experience different local foodshed structures.

localized food system, reaching Philadelphia rather than other population centers in the region. It was beyond the scope of this study to measure these overlaps and estimate the extent of the resulting competition over local food resources between these cities and their economic implications. Still, it is clearly an issue for participants in the local food system in Philadelphia, who often suggest that the city is disadvantaged by its proximity to the more lucrative New York City market (DVRPC, 2010; Kremer et al., forthcoming). More research is thus needed to address these issues.

Conclusion

In this study we analyzed the statistical data on land use and agricultural production and compared that data to current dietary requirements as represented in consumption practices and federal dietary guidelines, to evaluate the potential for a semi-open regional food system that can satisfy the dietary requirements of the city of Philadelphia. In addition, we evaluated the ability of three defined foodshed regions around Philadelphia to produce enough food to support their entire populations. The results show that while the agricultural hinterland in most of the defined foodshed regions may produce enough food to satisfy the dietary requirements of the city, issues of overlapping foodsheds and competition over local food resources may complicate the development of a localized food system around major metropolitan areas. Finally, we would like to point out the effectiveness of the current local foodshed. The local foodshed is defined as the area that includes all counties currently supplying local food to the city's farmers' markets, retail markets, and institutions. In all, 37 counties are included in the current local foodshed (in comparison to the 69 counties included in the 100-mile foodshed), which is not geographically continuous. Nonetheless, this foodshed is almost as effective as larger foodshed regions in addressing the dietary requirements of the city's population. Since this is a self-organized region,[2] namely a region defined by the self-organization of the current local food system, it is possible that the city attracts more agriculture counties and creates a spatial structure that can be interpreted as a foodshed that best fits its needs. This finding indicates that there is still much to learn about emerging local food systems, and that their patterns of development can offer considerable insight into the future of food system localization and regionalization.

While this study begins the discussion about the capacity and potential of food system localization in major metropolitan regions, much research is still needed. Major areas for further research identified in this paper include:

- Addressing demographic and socioeconomic characteristics and their interaction with market forces that contribute to actual food pathways;
- Addressing the question of overlapping foodsheds; and
- Incorporating in the analysis the impact of variation in dietary choices on foodshed capacity.

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[2] As explained elsewhere (Kremer, 2011), farmers selling in farmers' markets are not limited by travel distance, but do have to see traveling to the city to sell their products as economically cost efficient.

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Welcoming animals back to the city: Navigating the tensions of urban livestock through municipal ordinances

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Abstract

Since the Industrial Revolution, livestock has been driven out of urban and semi-urban areas in the United States. Recently, calls for localizing the food system have led to a rise in urban agriculture, and livestock is finding its way back into the city. The return of livestock to urban areas is rife with tensions, including concerns about public health and challenges to dominant perspectives about the separation of urban from rural life. Through an analysis of municipal codes, this paper identifies how some communities have navigated challenges associated with welcoming livestock back into the city. Specifically, the paper analyzes how codes regulate livestock through prohibitions of certain types of animals, zoning to establish where in the municipality livestock can be kept, site-level restrictions that define property characteristics required to keep productive animals, and requirements for managing livestock and their accessory structures on the property. The analysis demonstrates that no two municipalities approach the urban livestock question in the same way; however, each seeks to place limits on raising livestock in urban areas through some combination of regulatory land use tools. The paper concludes with a broader discussion of how the regulations address key tensions associated with our understanding of the urban-rural divide and competing claims on public health.

Keywords

animal control, food systems planning, land use regulations, public health, urban livestock, zoning

Introduction

> Sure, my chickens lay eggs — but the flock has spawned an occasional rooster that crowed loudly and often, starting at 4 a.m. Bees do result in honey and wax and better pollination — but they have also stung

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> people from time to time. The garden: verdant cornucopia on one hand, rodent-attracting breeding ground on the other. (Carpenter, 2009, p. 5)

In describing her efforts to establish a small urban farm in Oakland, California, Novella Carpenter (2009) eloquently and succinctly captures the tensions that arise with raising livestock in urban environments. Ironically, Carpenter, a well-known advocate of local food and urban farming, engaged in some of her own agricultural activities illegally until recently, when she raised the funds to obtain a conditional use permit for her garden, animals, and associated enterprise (Kuruvila, 2011). Since then, officials in Oakland have decided to take up the question of urban agriculture more comprehensively and develop ordinances that will "tackle the full dimensions of the urban food movement, which is animals and vegetables" according to the city's planning director (as quoted in Kuruvila, 2011, para. 7).

Oakland is not alone in revisiting animal control and land use ordinances in order to respond to a growing demand for producing food in urban and suburban backyards and vacant lots. In the last decade, many municipalities have revised plans and ordinances in order to allow livestock raising within urbanized areas. A new articulation of an old concern arises with this return of agricultural production to urban and semi-urban[1] environments. While urban livestock can be the source of high quality, local, and arguably tastier protein, the potential for disease, pestilence, odor, and noise nuisance from husbandry activities has not gone away. This paper explores how cities have responded to the growing demand for small-scale animal husbandry in urban and semi-urban areas while navigating the tensions associated with our understanding of urban and rural space and livelihoods as well as competing claims regarding public health.

[1] See Meeus and Gulinck (2008) for a review of semi-urban areas loosely defined as landscapes between urban and rural characteristics.

The paper begins with a literature review that briefly explores the history of animals in the city. This review focuses on both technological advancements and regulatory approaches that led to the relatively recent expulsion of livestock, and then outlines various reasons why some urban dwellers are advocating their return. An explanation of the methods used for collecting and analyzing municipal ordinances follows. Then, the analysis describes how municipal codes regulate livestock through prohibitions of certain types of livestock, through zoning to establish where in the municipality livestock can be kept, through site-level restrictions that define property characteristics required to keep livestock, and through a specification of livestock-keeping practices for managing both livestock and their accessory structures on the property. The discussion and implications section reflects on how the ordinances address some of the inherent challenges associated with livestock keeping in urban and semi-urban environments. In particular, it suggests that the tensions associated with the urban-rural divide and public health will be core challenges that will face planners and advocates who seek to expand opportunities for urban livestock keeping. The conclusion touches on some of the broader implications of this movement to allow livestock back into the city and ways in which municipalities seek to navigate the potential discord associated with the blurring of urban and rural life.

Literature Review

Moving Livestock out of the City

For centuries, cities were planned in ways that would ensure the protection of and direct access to agriculturally productive lands. The urban population lived and died by the food that was produced nearby, and much of early city administration aimed to ensure an adequate supply of food (Diamond, 2005; Smit, Nasr, & Ratta, 2001; Steel, 2009). Until the advent of long-term preservation and efficient long-distance transportation, people needed to live close to where their food was grown or husbanded. While imported grain has sustained basic food needs in cities at least since ancient Rome, other foods, such as fruits, vegetables, milk,

and meat, were often too perishable to travel far. In order to have access to animal-based protein, pre-industrial city dwellers put up with the nuisances of livestock. Noise, odors, pestilence, and disease were widespread as animals (and their wastes) were integral to life in the city (Steel, 2009).

With technological advancements in transportation during the latter half of the nineteenth century, the dependence on proximal sources of food began to wane in industrializing countries. Agriculture and its ancillary processes began moving out of town, or at least as far as the new railroads reached. While the transition was neither immediate nor totalizing, a great majority of both large- and small-scale farming activities moved into the hinterlands, keeping their ties to urban consumers via a burgeoning network of railroads (Cronon, 1991; Steel, 2009).

Following World War II, several factors led to further movement of livestock operations away from cities. Urban consumers began to move out to suburbs in increasing numbers, leading to the conversion of farmland to development and reducing the available land near cities on which to farm (Kaufman, 2004; Mendes, Balmer, Kaethler, & Rhoads, 2008; Randolph, 2012). Moreover, refrigerated storage systems on transport and, later, in homes, meant that animal products, including fresh meat and milk, could be shipped long distances and kept for extended periods of time (Cronon, 1991; Pothukuchi & Kaufman, 1999).

Meanwhile, with increasing industrialization of food production and experimentation in concentrated animal production facilities, more and more livestock began to be raised in concentrated animal feeding operations (CAFOs). CAFOs increased efficiencies by reducing the amount of land necessary for raising each animal. However, to maximize economies of scale, these facilities needed large land areas to house hundreds or thousands of animals at each facility. What had been a land-intensive agricultural practice on a per-unit basis slowly became a medical and industrial process undertaken in the hinterlands on concentrated feedlots, with animals fed grains laced with antibiotic cocktails and growth hormones as they lived on plantless plots until slaughter (Pollan, 2006). Factory farming and industrial food processing increased economies of scale, reduced prices, and facilitated a transition toward an urban diet heavily based on meat (Nestle, 2006; Schlosser, 2001; Steel, 2009). Furthermore, it reinforced the exodus of urban livestock as urban farmers could not compete with the prices of their industrial competitors.

Finally, supermarkets took control of the food distribution system, linking customers with an increasingly globalized food market and concentrating a variety of food products under one roof (Dunkley, Helling, & Sawicki, 2004; Hodgson, Campbell, & Bailey, 2011; Pothukuchi & Kaufman, 1999; Steel, 2009). With their global distribution chains, supermarkets could bring animal products to market from hundreds or even thousands of miles away. The need for a local cattle herd or chicken yard effectively had become obsolete.

In the latter half of the twentieth century, a global industrial food system emerged, and consumers were introduced to a whole new relationship with food. Fast food, processed foods, year-round vegetables and fruits, and increased variety from exotic locales became the norm for urban consumers throughout the developed world (Nestle, 2006; Schlosser, 2001; Steel, 2009). Abundance and convenience defined the new era. The modern industrial food system had overcome the necessity of proximity, in many ways liberating people from local social-ecological constraints in the production of food and eliminating the need for animal husbandry within city limits.

Municipal Codes and Urban Livestock

As with regulations of other land use activities, regulation of urban livestock is multilayered. As permitted under state enabling legislation, municipalities can use a variety of regulatory tools to guide social and economic activity in urban environments. Municipal codes usually incorporate zoning ordinances, animal control ordinances, and public health ordinances to provide guidance on whether, where, and how all sorts of animals, including livestock, can be kept in the city.

In the case of urban livestock, planners and other officials were complicit in the exodus of animals from the city, utilizing municipal regulations to push agricultural activities beyond urban boundaries. Early on, the justification for moving animals out of the city was based largely on public health concerns, and thus the regulation of animal-keeping is often incorporated into municipal health codes. New York City serves as an instructive example. The city's groundbreaking Metropolitan Health Bill of 1866 established a regulatory framework for dealing with health and sanitation problems to enhance quality of life and prevent the spread of disease. In 1877 the city's relatively new Health Board banned chickens and other fowl due to public health concerns associated, at least in part, with poultry slaughtering. City dwellers had to obtain a special permit from the city's Health Department to set the conditions under which birds could be kept and killed in city limits (Orbach & Sjoberg, 2011a). According to Orbach and Sjoberg (2011a), many cities followed suit and began to ban urban livestock of various types due to concerns over public health.

Over time, regulating urban livestock became more than just a question of public health. Urban dwellers began to view city life as distinct and separated from rural life (Blecha, 2007; Cronon, 1991; Gaynor, 1999, 2007; Schiere, Thys, Matthys, Rischkowsky, & Schiere, 2006). Andrea Gaynor (2007, p. 29) pegs the decline of productive animal keeping in Australian cities on "an imaginative geography, in which productive animals were deemed inappropriate occupants of urban spaces." Instead, urban dwellers, particularly those of the middle and upper classes, began to prioritize "amenity, privacy, order, and the protection of real property values" (Gaynor, 2007, p. 29), a perspective which did not allow for animal keeping in urban and semi-urban areas. They effectively lobbied for local government regulations to support this agenda and urban dwellers in industrialized countries around the world came to support a perspective of a clean, orderly, and animal-free city (Blecha, 2007; Gaynor, 1999, 2007).

Traditional zoning practice effectively accomplished the desired separation. Zoning codes segregated rural from urban life, only minimally allowing urban agriculture activities (Pothukuchi & Kaufman, 1999). These zoning restrictions relied on the segregation of uses modeled in Euclidean zoning, which seeks to ensure that the "right thing" does not end up in the "wrong place, such as a pig in the parlor instead of the barnyard" ("Village of Euclid v. Ambler Realty Co.," 1926). Generally prohibitive of many livestock activities or at a minimum relegating livestock to large lots on the periphery (Blecha, 2007; Gaynor, 1999, 2007), these new controls essentially banned all farming in towns and put it in the hands of those in the countryside (Steel, 2009).

Bringing Livestock Back to the City

Although raising productive animals in urban environments has been fraught with contradictions since the first cities were constructed, livestock has never been fully extirpated from cities. Since industrialization, much livestock keeping has been undertaken behind the scenes, quietly, invisibly (Gaynor, 1999). Immigrant populations have long brought their practices of livestock keeping and slaughtering to cities in the United States (Blecha, 2007; Schiere & Hoek, 2001; Schiere et al., 2006). The urban poor and others who seek self-reliance have continuously kept some livestock in cities (Gaynor, 1999, 2007; Steel, 2009). And, during periods of societal transition such as economic depression or war, support for urban animal keeping reemerges and government programs and campaigns are launched to encourage urban farm activities (Blecha, 2007; Smit et al., 2001). The Depression of 1893, World Wars I and II, and the Great Depression each led to a short-term resurgence of livestock raising in and around cities in industrialized nations. Similarly, a resurgence of urban livestock often accompanies a coincident growth in other urban agricultural activities, such as urban gardening and community gardens. During World War II, for example, victory gardens were often accompanied by the raising of chickens, rabbits, and hogs to support the urban diet (Blecha, 2007).

The most recent resurgence of support for urban livestock raising in industrialized nations has been linked to the local foods movement. Combining desires for healthier dietary practices, community sustainability and resilience, and greater access to safe and healthy food options, among others, a vibrant movement promoting local foods has grown in popularity and influence over the last decade and a half (Born & Purcell, 2006; Campbell, 2004; Delind, 2011; Wekerle, 2004). The local foods movement in its various articulations has become a powerful advocating force to expand urban agriculture in cities throughout the country (Delind, 2011; Gaynor, 2007). Just as in previous eras when urban farming gained popularity, the new era is dominated by the production of fruits and vegetables in backyard and community gardens. However, urban livestock is also reemerging in earnest, with egg-laying hens and honey-making bees leading the way (Blecha, 2007; Orbach & Sjoberg, 2011a; Salkin, 2011).

Despite ongoing debates about whether localizing the food system is either possible or desirable (Born & Purcell, 2006; Glaeser, 2011), the push for locally produced or locally sourced foods has gained traction throughout the United States, leading to a rise in urban agriculture and related activities. Planners have found a new role to play in this emergent context. Instead of seeking ways to separate city life from rural life, they are increasingly drawn to incorporate urban agriculture, community gardens, and farmers' markets into comprehensive plans, zoning and subdivision ordinances, and urban revitalization efforts (Hodgson, et al., 2011). Farmers' markets are on the rise, increasing from under 2,000 markets in 1994 to more than 6,000 in 2010 (U.S. Department of Agriculture (USDA) Agricultural Marketing Service, 2011). Community supported agriculture, community gardens, school gardens, food cooperatives, community kitchens, and other urban agricultural activities to support local food systems are springing up throughout the country (Hodgson et al., 2011; Vallianatos, Gottlieb, & Haase, 2004). Local governments, nonprofits, and voluntary associations have developed partnerships and programs to enhance gardening opportunities and to educate interested members of the public who want to get involved. Numerous U. S. cities have developed sustainability plans, comprehensive plans, and zoning ordinances to reflect policies related to food systems (Goldstein, Bellis, Morse, Myers, & Ura, 2012; Hodgson, et al., 2011). Some cities, such as Minneapolis, Minnesota, have developed standalone urban agriculture plans to supplement their comprehensive land use plans (City of Minneapolis Community Planning and Economic Development Department, 2011).

Even with the building momentum toward locally produced or sourced foods and a revival of urban agriculture, raising livestock in urban and semi-urban environments remains a thornier issue than urban gardens. Dominant perspectives about what it means to live in the city are not easily overturned. Although advocates argue that local food can promote public health and sustainability, the public health reasons that drove animals out in the first place have not been resolved. Concerns about disease and pestilence remain when livestock and people live in close proximity.

Municipal codes specifying regulations for urban livestock seek to mitigate the potential negative impacts of small-scale animal husbandry in urban and semi-urban areas by setting the conditions under which this practice can be undertaken. Over the last decade, numerous municipalities have reviewed and revised their ordinances as this issue has gained policy salience (Blecha, 2007; Gaynor, 1999; Goldstein et al. 2012; Hodgson et al., 2011; LaBadie, 2008; Orbach & Sjoberg, 2011b; Salkin, 2011). Blecha (2007) and Gaynor (1999, 2007) provide useful theoretical interpretations about how changing livestock regulations have coincided with an emergent blurring of understandings and experiences of urban and rural life. The analyses by Salkin (2011) and Orbach and Sjoberg (2011a; 2011b) provide a strong foundation in legal trends associated with backyard chickens. To my knowledge there has been no similar analysis performed on ordinances addressing urban livestock beyond chickens. Hodgson et al. (2011) and Goldstein et al. (2012) offer excellent overviews of urban agriculture trends in general, although small scale

urban livestock policies are only cursorily treated. While thousands of municipalities across the country have animal control ordinances, and many allowing urban livestock have been on the books for decades, a number of localities have taken up this issue in recent years to revise their ordinances, often at the behest of local food advocates (Orbach & Sjoberg, 2011a; Salkin, 2011; Hodgson et al., 2011). A few have chosen to go against the tide and prohibit urban livestock activities (Salkin, 2011); however, an increasing number seek to balance the tension between calls for increased urban livestock husbandry and continued resistance to animals in the city. Through an analysis of municipal codes addressing urban livestock issues, this paper aims to provide guidance to planners and advocates as well as to chart a course for further research in this area as public officials face the thorny challenge of determining the extent to which and how to welcome livestock back into the city.

Methods

For this study, the author selected 22 U.S. municipalities that have recently revised their animal control ordinances and/or zoning codes to allow for urban livestock (see appendix for the list of localities and sources for ordinances included in the analysis). This sample includes municipalities that recently have taken up food systems planning issues in general and urban livestock in particular, as identified by stories in recent news media, legal studies of ordinances allowing backyard chickens (LaBadie, 2008; Orbach & Sjoberg, 2011a; Salkin, 2011), and food systems planning literature, especially the urban agriculture edition of the American Planning Association's Planning Advisory Service (Hodgson, et al., 2011). The municipalities range from small towns such as South Portland, Maine, and Morgan Hill, California, with populations less than 40,000, to large metropolitan centers such as Charlotte, North Carolina (population over 700,000) and San Antonio, Texas (population over 1.3 million). The sample was purposive to emphasize variability in terms of regional representation and population size as well as approaches to managing urban livestock. The study includes only municipalities that allow urban livestock activities to some extent, as the aim of this paper is to examine how cities navigate challenges associated with welcoming livestock back to urban areas through their municipal ordinances.

To analyze the ordinances, the author and his research assistants downloaded municipal codes available online and isolated sections of the code associated with livestock keeping. In general, livestock keeping is addressed in zoning, animal control, and public health sections of the codes. After collecting the codes, the author reviewed the pertinent sections of each ordinance for language related to the regulation of livestock keeping. The ordinance analysis required cross referencing between sections to interpret the intent of the code. In some cases, inconsistencies emerged between different sections of the code. When possible and applicable, we sought to double-check our interpretations of the code with local officials. However, there are grey areas in some of these codes, and enforcement of different sections is often the responsibility of different agencies. The results section points to some of these complexities of interpretation.

The research process incorporated a standard qualitative data analysis approach that begins by developing analytical categories. In this case, the categories aligned with a multilayered view of municipal regulations. At the broadest level, municipalities set limits on what livestock are allowable within their boundaries by prohibiting certain types outright. At the next level, localities designate certain uses as allowable in specified zones. Within those allowable zones, municipalities regulate at the site level, designating minimum lot sizes, setbacks, and number limits on the animals. And, in terms of individual practices, municipalities regulate various aspects of animal keeping, ranging from what types of accessory structures are allowed or required to where to keep animal feed and how animals are to be treated. Once these categories were defined, the analysis proceeded by linking ordinance sections to each category in the analytical framework and developing new codes and categories to sort and describe the data (Charmaz, 2006; Miles & Huberman, 1994).

Results

The analysis of municipal ordinances is divided into four sections. The first section, animal type prohibitions and nuisance conditions, specifies how localities prohibit certain animal types from municipal boundaries or clarify nuisance. The second section on district or zone limits explains how municipal codes address urban livestock through zoning and categorizes each locality based on how restrictive or permissible the zoning code is. The section on site-level restrictions examines how codes specify lot sizes, setbacks, and number of animals to regulate urban livestock keeping at the property level. The site-level analysis examines one of the more complex components of the codes as the specifications within these regulations tend to vary greatly across different municipalities and animal types. Therefore, the section includes a synthesis analysis across the municipalities using one animal type (chickens) as an example. Finally, the section on regulating livestock-keeping practices examines how the codes regulate individual practices by establishing permitting requirements, technical specifications, and administrative oversight.

Animal Type Prohibitions and Nuisance Conditions

People live in close proximity in urban areas, so in order to protect public health, safety, and welfare, municipalities can choose to prohibit certain uses outright. In the case of animal husbandry, the issues of nuisance related to odor, noise, pestilence, and waste as well as associated public health impacts are the primary concerns that lead to animals being prohibited from urbanized areas. Not all animals pose a significant risk to health or nuisance, but those animals that are identified as particularly problematic can be prohibited.

Most likely due to the high potential for noise nuisance, few communities allow roosters without significant restrictions. Eight of the municipalities included in this study prohibit roosters outright: Seattle, Washington; Fort Collins, Colorado; Bloomington, Indiana; Baltimore, Maryland; Mobile, Alabama; Ann Arbor, Michigan; Rogers, Arkansas; and South Portland, Maine (see table 1). In other localities, roosters are allowed under limited conditions. Many localities allow roosters only in agricultural or large lot residential zones, or have stringent setbacks of 100 feet (30 meters) or more from neighboring residences or property lines. Others specify conditions which would constitute a nuisance. For example, Cleveland, Ohio, allows roosters, but the code specifies that "it shall be unlawful for any person or other party operating or occupying any building or premises to keep or allow to be kept any animal or bird that makes noise so as to habitually disturb the peace and quiet of any person in the vicinity of the premises." Similarly, Stamford, Connecticut, allows roosters but specifies that "no person shall keep any rooster in such location that the crowing thereof shall be annoying to any person occupying premises in the vicinity. Upon complaint of any such person so annoyed, the Director of Health shall have authority to order the owner of such rooster to remove the same so that such annoyance shall cease." Although not summarily prohibited, these codes specify that it is the owner's responsibility to avoid noise nuisance issues.

Many codes specify types of prohibited animals beyond roosters. Some narrowly specify certain types, such as Cleveland, Ohio, where the only animals prohibited outright are Africanized bees; Chattanooga, Tennessee, where the code prohibits peacocks; or San Antonio, Texas, which does not allow swine. Along with roosters, Seattle does not allow swine except for miniature potbelly pigs. Others have broader prohibitions. Ann Arbor does not allow domestic fowl other than chickens. The Baltimore health code lists 19 categories of prohibited animals including all bovine (cattle), porcine (pigs) except Vietnamese potbellied pigs, even-toed ungulates (sheep, goats, etc.), and odd-toed ungulates except for domesticated horses in the arabber[2] and carriage trades. In the end, the only allowable animal types for food production purposes in Baltimore are chicken hens and bees. All others are banned.

[2] An arabber is "a street merchant who sells fruits and vegetables from a colorful, horse-drawn cart" (http://en.wikipedia.org/wiki/Arabber)

Table 1. Livestock Type Prohibitions in Sample
(P=prohibited, A=allowable, S=some in category allowed, blank=none specified or unclear)

Municipality	State	Population	Chickens	Roosters	Other fowl*	Honey bees	Small animals*	Medium animals*	Large animals*
Ann Arbor	Michigan	112,920	A	P	P	A	A	P	P
Baltimore	Maryland	637,418	A	P	P	A	P	P	P
Bloomington	Indiana	71,939	A	P	A		A	A	A
Charlotte	North Carolina	704,422	A	A	A	A	A	A	A
Chattanooga	Tennessee	171,350	A	A	A	A	A	A	A
Cleveland	Ohio	431,369	A	A	A	A	A	A	A
Fort Collins	Colorado	138,733	A	P		A			
Kansas City	Missouri	482,299	A	A	A	A	A	A	A
Longmont	Colorado	88,425	A	A	A	A	A	A	A
Madison	Wisconsin	235,419	A	A	A		A	S	A
Missoula	Montana	68,876	A	A	A	A	A	A	A
Mobile	Alabama	193,205	A	P	A			S	A
Morgan Hill	California	38,547	A		A	A	A	A	A
Mountain View	California	72,222	A	A	A		A	A	A
Rogers	Arkansas	59,017	A	P	A		A	S	A
Round Rock	Texas	105,424	A		A		A	A	A
San Antonio	Texas	1,373,668	A		A		A	S	A
Santa Clara	California	111,997	A	A	A		A	A	A
Seattle	Washington	608,660	A	P	A	A	A	S	A
South Portland	Maine	23,976	A	P		A			
Stamford	Connecticut	121,026	A	A	A		A	A	A
Tallahassee	Florida	172,574	A	A	A		P	P	S

* Other fowl includes turkey, geese, ducks, etc. Small animals include rabbits. Medium animals include goats, pigs, sheep, etc. Large animals include cows, horses, alpacas, llamas, etc.

Table 1 provides a summary across all municipalities on the question of animal type prohibitions. Among the municipalities in this study, prohibiting certain livestock outright is used by around half of the ordinances. However, all of the ordinances allow chickens and a great majority allows other fowl, small, medium, and large animals at least somewhere within municipal boundaries. In the end, prohibiting animals outright is used rather minimally by these localities.

District or Zone Limits

Many localities use zoning regulations to restrict or permit *where* in the urban environment livestock can be raised. Most localities specify where agricultural uses are allowable within their zoning regulations. In a few cases, the animal control ordinance clarifies zones in which livestock animals can be kept. Tentative efforts have been made in some cities where nearly all livestock keeping is allowable only in agricultural zones. Other local governments have more permissible zoning regulations, allowing most types of livestock in almost all residential zones, subject to specific site-level restrictions. Between these two extremes are municipalities that allow urban livestock in certain residential zones either as an outright use or as an accessory or conditional use. The analysis categorizes zone or district limits as highly limited (livestock in agriculture zones only with the exception of chickens and

bees), moderately limited (includes allowing small animals or other fowl in residential zones), and widely permitted (some medium and/or large animals allowable in residential zones) (see table 2).

Highly limited

Most communities still maintain highly restrictive zoning for urban livestock. The municipalities in this category limit livestock keeping to agricultural zones with the exception of chickens and/or bees, which are permissible in residential zones. Cities in this category include Longmont, Mobile, Rogers, Santa Clara, and Ann Arbor, among others (see table 2). In the end, over half (12) of the municipalities in this study have zoning restrictions that limit livestock except chickens and/or bees to agricultural zones.

In some of these localities, the zoning code limits all livestock keeping to nonresidential zones. Santa Clara only allows livestock keeping in agricultural zones. San Antonio allows small produce farms in residential areas, but only allows livestock in the Mixed Light Industrial or Farm and Ranch zones. In most cases, communities continue to limit livestock keeping to agricultural zones with the exception of chickens or bees which are allowed in some residential districts. Mobile's city code permits the keeping of all livestock in Residential Agricultural zoning districts, which are sparsely populated single-family residential areas of the city. The city code also permits livestock feedlots and wholesale operations in the highly intensive industrial zone. Livestock keeping in all other parts of the city is prohibited, with the exception of chickens. For chickens, the code specifies that up to 25 chickens can be kept in all residential zones. Longmont and Fort Collins allow chicken hens in all residential zones, but other livestock are relegated to agricultural zones in these cities. Ann Arbor allows chickens and bees in low-density residential areas where the use on site is either single- or two-family dwellings. Madison allows the keeping of up to four chickens in medium and low density residential zones, but other livestock keeping is relegated to agricultural zones. Rogers allows up to four chicken hens at single-family residences in all zones, but no other livestock outside the agricultural zone. The proposed zoning code draft for Baltimore allows urban livestock as a conditional use in most residential districts, several commercial zones, and office residential zones as long as there is a management plan for minimizing the risk of nuisance conflicts. However, as in the case of Ann Arbor, only chickens and bees are allowed in the animal control ordinance.

Moderately limited

Municipalities with moderately limited zoning restrictions for livestock keeping include those that allow small animals and/or other fowl as well as chickens and bees in some residential areas, but relegate most medium and all large animals to agricultural zones. Mountain View, Morgan Hill, Cleveland, Chattanooga, and Round Rock fall into this category.

In Morgan Hill, small animals and chickens are allowable in most residential zones. Other livestock, up to two large and four medium animals on the first 40,000 square feet (3,700 square meters), may be kept in residential estate zones with the exception of swine and bees, which are confined to agricultural zones. Cleveland allows fowl, small animals, and some medium animals such as goats in residential districts, subject to certain conditions. However, larger animals are relegated to agricultural zones. Mountain View allows up to four small animals, including chickens, rabbits, geese, ducks, and other fowl in all residential zones. Round Rock allows livestock raising in Agricultural zones and the Single Family Rural zone, which has a minimum lot size of 2 acres (0.8 hectare). The animal control ordinance further specifies the requirements (such as a minimum lot size of 1 acre or 0.4 hectare) necessary for animals to be kept within city limits that are not in those two zoning districts. Chattanooga established a new urban agriculture zoning district (A-1) in city limits with code revisions in 2001. The code only allows urban livestock to be kept on lots of 20 or more acres (8 or more hectares) in this zone unless the agricultural use is incorporated into a Planned Unit Development. According to Chapter 7 of the municipal code revised in January, 2008, however, fowl, swine, goats, and chickens (including roosters) can be kept

in all other zones of the city as long as lot sizes are at least 5 acres (2 hectares). Thus, while the lot size limitations are stringent, the actual zones in which animals can be kept are only moderately limited given that some medium-sized animals can be kept in all zones.

Widely permitted

In some municipalities, zoning regulations do not significantly limit where urban livestock keeping takes place. Ordinances that are within this category allow most animal types, including some large animal livestock, in residential areas as well as other zones within the municipality. Kansas City, Seattle, Stamford, Missoula and Charlotte fall into this category. Seattle permits outright "the keeping of small animals, farm animals, domestic fowl and bees…in all zones as an accessory use to any principal use…" Missoula limits livestock keeping to residential zones that have minimum lot sizes of 1 acre, but the city allows all types of animals in those zones. Chickens can be kept in all residential zones regardless of lot size. In Kansas City there are no district limits for animal husbandry activities. Similarly, in Stamford, farm uses are widely permitted and allowable in all districts as an incidental and auxiliary use. In residential districts in particular, the code allows "the keeping of livestock incidental to the domestic establishment of a residential use of the parcel of land on which such livestock are kept." In Charlotte, farms and all farming activities allowable elsewhere in the code are permitted outright in all zoning districts. Table 2 categorizes each city on the scale of district or zone limits.

Site-Level Restrictions

At the site level, regulations for urban livestock vary and include lot size, setbacks, and number of animals. Most ordinances use a graduated approach to clarify lot size and setback restrictions based on animal type or numbers. In short, larger animals tend to require larger lot sizes and more extensive setback requirements. Numbers limits tend to be higher for smaller animals and more stringent for larger animals. However, there is great variability across municipalities. This section outlines some of the key characteristics of site-level restrictions in these three categories and then provides a summary analysis across the municipalities using chickens as the example.

Lot sizes

A few municipalities set overall minimum lot sizes before the keeping of livestock is an allowable use. Chattanooga, for example, sets an overall minimum

Table 2. District or Zone Limits

Municipality	State	Highly limited	Moderately limited	Widely permitted
Ann Arbor	Michigan	X		
Baltimore	Maryland	X		
Bloomington	Indiana	X		
Charlotte	North Carolina			X
Chattanooga	Tennessee		X	
Cleveland	Ohio		X	
Fort Collins	Colorado	X		
Kansas City	Missouri			X
Longmont	Colorado	X		
Madison	Wisconsin	X		
Missoula	Montana			X
Mobile	Alabama	X		
Morgan Hill	California		X	
Mountain View	California		X	
Rogers	Arkansas	X		
Round Rock	Texas		X	
San Antonio	Texas	X		
Santa Clara	California	X		
Seattle	Washington			X
South Portland	Maine	X		
Stamford	Connecticut			X
Tallahassee	Florida	X		

for swine, goats, chickens and roosters, which can only be kept in city limits on lots that are 5 contiguous acres (2 hectares) in size. Others tend to use a graduated approach and set lot size requirements based on the relative space requirements of each animal type. Seattle serves as an instructive example. Three small animals are permitted as "accessory to each business establishment…or dwelling unit on a lot." Up to eight domestic fowl can be kept in addition to small animals on any lot. Four small animals can be kept on lots of at least 20,000 square feet (1,860 meters) with single-family homes. The code permits one additional small animal on single family residential lots "for each 5,000 square feet [460 square meters] in excess of 20,000 square feet [1,860 square meters]." Larger animals (e.g. cows, horses, and sheep) can only be kept on lots larger than 20,000 square feet (1,860 square meters) but residents can keep one such animal per 10,000 square feet (930 square meters) on the lot. Cleveland also uses the graduated approach and specifies minimum lot sizes for medium-sized animals at 14,400 square feet (1,340 square meters) (about one-quarter acre or 0.1 hectare) in nonresidential areas and 24,000 square feet (2,230 square meters) (a little more than half an acre or 0.2 hectare) in residential areas. Small animals including chickens, geese and ducks require a minimum lot size of 800 square feet (74 square meters) in residential areas.

Other codes specify fewer categories but still use a graduated approach. In Bloomington, a minimum lot size of 5 acres (2 hectares) or 300 feet (91 meters) of width is required to keep large animals, while chickens can be kept on lots of two or more acres (0.8 hectare). Tallahassee requires 5 contiguous acres (2 hectares) for horses and fowl (besides chickens) and 15 acres (6 hectares) for all other livestock in the city. In Round Rock, minimum lot size is set at 1 acre (0.4 hectare) for all medium and large livestock types, but no lot size restrictions are placed on the keeping of fowl.

Either in conjunction with or in lieu of overall lot size, some municipalities regulate the size of land for the animal's use, which effectively sets minimum lot size requirements. Missoula requires a half acre (0.2 hectare) of land for the animal's sole use for medium and large animals. Similarly, Chattanooga requires one-quarter acre (0.1 hectare) of pasturage for small and medium animals and 1 acre (0.4 hectare) of pasturage for each large animal. San Antonio requires a minimum of 400 square feet (37 square meters) of pen for each bovine or equine species and 200 square feet (19 square meters) for each goat or sheep. Bloomington limits livestock to one animal unit per acre (0.4 hectare) of land used as pasture with large animals counting as one unit, medium animals as 0.5 units and fowl as 0.2 units. Charlotte requires a minimum of 2 acres (0.8 hectare) of pasturage for cows and other large livestock excluding horses and one-quarter acre (0.1 hectare) for each goat, sheep, or other medium sized livestock.

Setbacks

Used alternatively or in conjunction with lot sizes, setbacks ensure a minimum distance from neighboring property lines or structures. The use of setbacks is particularly prevalent in animal control ordinances in relation to residential properties and structures. Many municipalities use setbacks as a central tool to separate nearby residences from animals that might cause nuisance.

Where not prohibited, roosters tend to have strict setbacks. Santa Clara specifies that "no person shall keep any rooster which crows, or is capable of crowing within one hundred (100) feet [30 meters] of any dwelling unit other than the dwelling unit of the person owning or in possession of such rooster, unless proof is presented to the housing coordinator that successful treatment to prevent crowing has been performed." Cleveland also uses 100 feet (30 meter) setbacks for coops and enclosures that house roosters.

Beyond roosters, setbacks tend to be relatively strict for large animals and less stringent for chickens and small animals. Mountain View requires setbacks of 25 feet (8 meters) from neighboring residences for fowl and 200 feet (61 meters) for other livestock. In Round Rock, fowl must be enclosed and kept at least 25 feet (8 meters) away from neighboring residences. If more than 50 feet

(16 meters) away, the allowable number of birds doubles from five to 10. For other livestock, setbacks from neighboring residences must be 50 feet (16 meters) for grazing and 150 feet (46 meters) for enclosures. In Kansas City, livestock must be kept at least 200 feet (61 meters) away from any building used by humans other than the owner, and small animals must be kept at least 100 feet (30 meters) from such buildings and 25 feet (8 meters) from the property line. San Antonio requires livestock to be enclosed at least 100 feet (30 meters) from any dwelling or business other than the owner's. Chickens must be kept 25 feet (8 meters) from neighboring residences in Baltimore, 10 feet (3 meters) from the property line and 40 feet (12 meters) from residences in Ann Arbor, and 20 feet (6 meters) from neighboring dwellings in Tallahassee.

Number of animals

Some municipalities also limit the total number of animals allowed on each parcel. Ann Arbor only allows four chickens and two hives of bees per property owner. Baltimore allows no more than four chickens and 125 pigeons. The Kansas City ordinance limits adult chickens and other domestic fowl to 15, adult rabbits to 10, and larger livestock animals to two. Missoula and South Portland allow six chickens in residential areas, while Madison and Rogers allow four.

Many municipalities have graduated limits of numbers of animals tied to lot sizes and setbacks. For example, Fort Collins limits the number of beehives to two on lots that are less than one-quarter acre (0.1 hectare) in size and gradually increases the number to eight hives on one acre (0.4 hectare). There are no limits to the number of hives wherever the apiary can be situated 200 feet (61 meters) in any direction from all property lines (effectively setting a minimum lot size of about three acres or 1.2 hectares). Seattle allows up to three small animals and eight domestic fowl on all lots, but allows more animals and larger animals on lot sizes larger than a half acre (0.2 hectare). For medium and large animals, Missoula specifies allowable numbers per acre with maximum numbers set at three horses, mules, goats or donkeys; five sheep; or two cows or llamas. The Round Rock code states that "no more than one unit of livestock [can be kept] for the first acre [0.4 hectare] of land" with an additional unit for each additional half acre (0.2 hectare). Some livestock are equivalent to one unit, such as bovine and equine species. Swine are considered half units. Sheep, goats, and emus, among others, are considered one-fifth units.

Site-level restriction synthesis

One of the more popular animals for the urban environment is the chicken. Public pressure in support of backyard chickens has led many municipalities to develop ordinances to accommodate demand or deal with conflicts associated with chicken keeping (Blecha, 2007; LaBadie, 2008; Orbach & Sjoberg, 2011a, 2011b; Salkin, 2011). For this reason, and because all of the municipal ordinances in this study addressed chickens, the analysis of how the codes treat chickens provides a sense of how different municipalities use site-level restrictions to regulate urban livestock.

In regulating backyard chickens, municipalities rely almost exclusively on setbacks and number limitations. Setbacks pertain to enclosures required to keep chickens and are established based on distance from property lines or neighboring residences or both. In some cases, setback restrictions can be relaxed with notification and approval of neighboring landowners. Number limits frequently establish a maximum allowance for hen keeping. However, in some cases, number limits are graduated based on lot sizes—the larger the lot, the more chickens the landowner can keep. Only two of the municipalities in this study, Chattanooga (5 acres or 2 hectares) and Bloomington (2 acres or 0.8 hectare), identified minimum lot size restrictions for chickens. The other localities either had no lot size restrictions or implied lot sizes based on zoning district limitations. Table 3 (next page) provides data on setbacks and number limitations for each municipality in the study.

As the table reveals, all of the municipalities manage urban chickens with one or more site-level tools. Depending on lot size, more than half of the municipalities have set limits of fewer than eight

chickens and only four localities do not use number limits to regulate chickens. Eighteen of the 22 municipalities ensure that there is relatively substantial separation from the chickens and neighbors, establishing setbacks of at least 20 feet (6 meters) from neighboring residences. This table maps reasonably well onto other animal types in that municipalities tend to use at least one site-level restriction to control where urban livestock can be kept on individual parcels within allowable zones. One distinction is that lot sizes are more frequently used for medium and large sized animals in conjunction with setbacks and number limitations than for chickens. In general, the larger the animal, the more restrictive the number limits, the larger the lot size requirements, and/or the more expansive the setbacks.

Regulating the Practice of Livestock Keeping

To regulate livestock keeping practices, municipalities tend to specify conditions under which livestock can be husbanded under the public health or animal control chapters of municipal codes. These regulations generally describe how animals are to be treated, outline specifications of enclosures and confinements, identify agency or organizational oversight for inspections, and list other procedural and technical conditions that must be met before livestock keeping is allowed in specified areas of each locality. In many cases, localities also describe a process through which a permit can be obtained, along with associated fees.

Permitting

Most of the localities in this study utilize permitting or licensing programs to ensure that the specifica-

Table 3. Site-Level Restrictions (Chickens Only)

Municipality	State	Property line setback	Neighboring residence setback	Number limit
Ann Arbor	Michigan	10 ft (3 m)	40 ft (12 m)	4
Baltimore	Maryland		25 ft (8 m)	4
Bloomington	Indiana		20 ft (6 m)	5/acre
Charlotte	North Carolina	25 ft (8 m)		20/acre
Chattanooga	Tennessee	25-150 ft (8-46 m)		20/acre
Cleveland	Ohio	5 ft (1.5 m)		1/800 ft^2
Fort Collins	Colorado	15 ft (4.5 m)		6
Kansas City	Missouri	25 ft (8 m)		15
Longmont	Colorado	6 ft (2 m)	6 ft (2 m)	4
Madison	Wisconsin		25 ft (8 m)	4
Missoula	Montana		20 ft (6 m)	6
Mobile	Alabama	20 ft (6 m)	40 ft (12 m)	25
Morgan Hill	California	5 ft (1.5 m)	20 ft (6 m)	n/a
Mountain View	California		25 ft (8 m)	4
Rogers	Arkansas		25 ft (8 m)	4
Round Rock	Texas		25-50 ft (8-15 m)	5-10
San Antonio	Texas		100 ft (30 m)	3
Santa Clara	California		50 ft (15 m)	n/a
Seattle	Washington		10 ft (3 m)	8+
South Portland	Maine	20 ft (6 m)		6
Stamford	Connecticut	50 ft (15 m)		n/a
Tallahassee	Florida		20 ft (6 m)	n/a

tions for livestock keeping practice will be met prior to a landowner engaging in animal husbandry. Only two cities, Chattanooga[3] and Round Rock, did not specify a permitting program for livestock animals in their ordinances. In these cities, the requirements for livestock keeping are as specific as in most other municipalities, and livestock keepers are just as subject to inspections as their counterparts in other cities. The major difference is that livestock keepers do not have to obtain a permit prior to engaging in the practice. All other localities in this study used some sort of permitting process for at least one, if not all, allowable animal types. In essence, to receive a permit, the applicant must demonstrate, either through a paper application or a property inspection, that he or she will be able to meet the specifications for livestock keeping outlined in the code. In some cases, such as in Bloomington and Ann Arbor, permits will be granted only after a waiver is obtained from all adjacent property owners indicating that they do not object to the keeping of the animals.

Management specifications

Seventeen of the 22 animal control ordinances reviewed in this study provided specific guidelines for animal husbandry practices in order to receive a permit or to engage in the practice if a permit is not required. Guidelines clarify whether or not an enclosure is required, the design specifications for the enclosure, and setback requirements from neighboring properties as well as the owner's residence. They also tend to outline cleaning requirements, including the frequency and acceptable techniques for cleaning enclosures and disposing of animal wastes. There are usually care requirements, such as ensuring that there is adequate water, food, and space for each animal. There is a wide range of variability in the specifics, but in general, these provisions outline standards for the treatment and care of animals and ways to reduce potential public health concerns or nuisances.

The animal control ordinance in Missoula serves as an example of the types of requirements owners must adhere to in order to receive a permit and to avoid being in violation of the code. For animals kept on one acre (0.4 hectare) of property or more, there are few restrictions. For chicken hens kept in residential zones, the animals must be kept in a "covered, predator-proof chicken house that is thoroughly ventilated, of sufficient size to admit free movement of the chickens, designed to be easily accessed, cleaned and maintained by the owners and be at least 2 square feet [0.2 square meter] per chicken in size." The chicken coop must be 20 feet (6 meters) away from neighboring residences. The birds have to be shut into the chicken house from sunset to sunrise and fenced in a predator-proof enclosure during daylight hours. Feed has to be stored in containers that can be kept free of rodents and predators. And, even after all of these conditions are met, "it is unlawful for the owner, custodian, or keeper of any chicken to allow the animal(s) to be a nuisance to any neighbors." Animal control officers determine nuisance violations on a case-by-case basis.

Charlotte serves as another example. For domestic fowl and rabbits, Charlotte's code requires that the animals be enclosed in a well ventilated structure of at least 18 inches (0.5 meter) in height that provides 4 square feet (0.4 square meter) of space for each bird or rabbit. It also specifies that "the coop, fowl house or hutch shall be kept clean, sanitary and free from accumulation of animal excrement and objectionable odors. It shall be cleaned daily, and all droppings and body excretion shall be placed in a flyproof container and double-bagged in plastic bags." It limits the number of animals to 20 per maintained acre (0.4 hectare) and specifies setbacks of 25 feet (8 meters) from property lines. For larger livestock animals, the code requires sheltered enclosures "adequate…to protect them from the elements" which are kept clean and sanitary and set back from property lines 25 to 75 feet (8 to 23 meters), depending upon the animal size.

The remaining five municipalities in this study (Baltimore, Cleveland, Madison, Stamford, and Morgan Hill) demur on this level of specificity.

[3] The Chattanooga code does require a permit for keeping goats to use for kudzu control. However, the purpose of keeping the animals is not to yield agricultural outputs.

Instead, they provide a level of administrative discretion to determine whether the proposed use is appropriate to the specific conditions of the site. In Baltimore, for example, the proposed revision of the zoning code specifies that landowners wishing to engage in animal husbandry and other intensive agricultural activities "must prepare a management plan that addresses how the activities will be managed to avoid impacts on surrounding land uses and natural systems." In Stamford landowners are required to keep animal enclosures in a "reasonably clean and sanitary condition," while the director of health can order the owner to clean the enclosure when "in his judgment conditions therein are unsanitary." In Morgan Hill the code specifies that the location of enclosures for livestock will be reviewed and approved based on criteria including "type and size of animals, existing land use and structures on site, adjacent land uses and structures, possibility of noise and odor impacts on neighbors, topography, relationship to streets and alleys, applicable fence location and height regulations, and protection of fences between the property and adjacent lots." The language in these codes provides administrative discretion to the officers charged with enforcing the code while also providing a level of flexibility to landowners to come up with ways to minimize nuisance or public health concerns.

Administrative oversight

Many ordinances specify administrative oversight to manage the permitting program and to conduct inspections to identify code violations. Municipalities rely on a variety of departments such as those responsible for health, animal control, land development and building, or their equivalents to administer the permitting program. In general, codes clarify that a permit will be issued once the administrative department has ensured that all the provisions of the code have been met by the applicant.

In many cases, public health officers administer the program. For example, the Mobile code states that "it shall be unlawful for any person to keep or maintain any chickens within the city without first obtaining a permit from the health officer. The health officer shall issue a permit when there has been full compliance with the provisions of this division [of the code]." Anyone proposing to keep farm animals or bees in Cleveland must apply to the department of health for a license that must be renewed every two years. The application includes property specifications, number and types of animals, site plans, a feces removal plan, and neighbor addresses. Once the director of public health determines that nuisances will be mitigated and neighbor concerns are addressed, the application is approved and submitted to the building department for final review. In the case of Cleveland, involving the health department in code enforcement and development may have facilitated the passage of the ordinances allowing urban livestock. When urban agriculture advocates and the city planning staff began drafting ordinance language for urban livestock keeping, they worked with the city's department of public health to address health risks and nuisances. The involvement of the department "eased public and political concern about potential nuisance issues and contributed to quick approval…by city council" (Hodgson et al., 2011, p. 76).

In many municipalities, several public officers can serve as inspectors. For example, in Missoula the health officer, animal control officer, or city police department can be involved in inspections to ensure that enclosures are kept clean. If not clean, the health officer can submit that the conditions warrant a public health nuisance and the owner either has to comply with the code or suspend the use. Meantime, animal control officers determine whether noise or smells constitute a nuisance, and police officers can enforce any aspect of the code. Similarly, South Portland relies on a variety of officials for enforcement. For example, once bee keeping is permitted, the code specifies that "the City Health Officer, the Animal Control Officer, the Code Enforcement Officer and/or the State Bee Inspector shall have the right to inspect any apiary. Where practicable, prior notice shall be given to the beekeeper."

In some cases, state agricultural department officials are notified and often provide licenses or

permits for certain animal types. For example, the Seattle and South Portland codes require bees to be registered with the respective state departments of agriculture. In Baltimore, chickens must be registered with the Maryland Department of Agriculture, Domestic Poultry and Exotic Bird Registration Division.

In one outlier, the Fort Collins code relies on a nongovernmental organization to manage training and permitting. The ordinance specifies that "any person keeping chicken hens pursuant to this provision must first have been issued a permit by the Larimer Humane Society and have received such information or training pertaining to the keeping of chicken hens as the director of said agency deems appropriate." This is a particularly interesting example, as a regulatory function is handled by a private entity rather than public officials.

Discussion and Implications

Local governments throughout the United States are facing increasing pressure to incorporate food system issues into their planning and policy-making. The questions of whether and how to allow urban livestock keeping have risen alongside this emergent focus on food systems planning and the call for local food. This turn toward urban livestock is fraught with tensions. On the one hand, a common understanding of urban and rural divisions is being called into question. Farmers may no longer be relegated only to the hinterlands, as many urban residents are taking up various agricultural activities and choosing to label themselves "urban farmers" (Carpenter, 2009). Secondly, in an ironic twist, part of the motivation for bringing livestock back to the city is grounded in a public health argument. The rise of diabetes and an obesity epidemic have served as fruitful fodder for local food advocates, who argue that healthier eating can be promoted alongside urban agriculture activities that include raising livestock. And yet the primary reason that livestock were expelled from cities more than a century ago was likewise grounded in a public health argument. Navigating these two tensions and the social conflicts that can ensue is one of the core challenges that planners and public officials face as they incorporate food systems planning into their practice. Municipal officials have turned to traditional means to regulate urban livestock, allowing the return of animals to urban environments in deference to local food, sustainability, and other advocates, while maintaining restrictions on what types, where, and how such livestock can be raised within city limits.

Regulating the Urban-Rural Divide

Traditional land use codes separate uses, segregating homes from workplaces, urban activities from rural, and industries from shopping centers. Over the last century and a half, many urbanized municipalities sought to prohibit livestock keeping or at least to confine livestock to large-lot agricultural zones. In many of the municipal codes analyzed here, the lines are beginning to blur. More cities are beginning to allow livestock keeping in more densely urbanized areas.

One can think of this regulatory framework as a series of layers through which localities define the extent to which and how urban livestock keeping can be undertaken within municipal boundaries. The first layer operates at the level of the municipal boundary itself. Some animals are summarily prohibited. The second layer sorts animals into allowable zones, designating in what sections of the city the permissible animals can be kept. The next layer, those regulating site-level restrictions, delineate which parcels (lot size restrictions), where on a particular parcel (setbacks), and at what level of intensity (number limits) within the allowable zones livestock keeping can be undertaken. The final layer specifies how to engage in responsible livestock keeping practices by outlining requirements for the treatment, care, maintenance, accessory structures, confinement, and minimum space for each animal. This layer also outlines the responsible parties for permitting, oversight, and enforcement of the code.

These approaches to regulating land uses in the urbanized environment are not new. They are modeled on Euclidean zoning and putting "right things" in their "right places" and specifying how to conduct activities on the land that have minimal negative impacts on the users of neighboring prop-

erties. What appears to be changing, at least at the margins, is our understanding of what "right things" and "right places" might be. All of the localities in this analysis are opening their boundaries to urban livestock to a certain extent, most are allowing some livestock keeping in residential areas, and a few are allowing some animals in relatively densely populated sections of the urban environment. This regulatory resorting of the urban environment inherently is fraught with tensions. It calls into question a widely accepted understanding of the separation of urban and rural life (Blecha, 2007; Gaynor, 2007). The more permissible the code, the greater the chances that a conflict among neighbors with differing perspectives on urbanism will ensue.

And yet, in most cases, this experimentation only marginally pushes the boundaries of the urban-rural delineation. Twelve of the 22 cities included in this study use highly restrictive zoning, all of the municipalities use at least one relatively stringent site-level restriction, and language concerning nuisance often puts the onus on the livestock keeper to avoid potential conflicts with surrounding land uses. It is rare to find a municipality that is widely permissive in all aspects of urban livestock keeping. Even in the case of chickens, which are allowed in every municipality in this study, the keeping of fowl in residential areas is highly regulated with setbacks, number limits, permitting processes, and detailed management specifications. Nonetheless, these steps, while tentative, are bringing old arguments about defining life in town versus life in the country back to the surface. A resorting of the urban environment is beginning in some U.S. municipalities.

Urban Livestock and Public Health

In some ways, the tentativeness can be explained by a more fundamental challenge in welcoming livestock back to the city. The rural-urban divide was created not simply because city dwellers thought it would be nicer that way, but rather because public officials sought to reduce incidence of disease and unsanitary living conditions that could accompany agricultural activities in densely populated urban areas (Blecha, 2007; Gaynor, 2007; Orbach & Sjoberg, 2011a). As gardens and livestock grow in popularity and return to the city, old tensions resurface. As one of the reviewers of this paper commented, "As a public health nurse involved in urban agriculture, I often feel torn between wanting to encourage growing of local foods and raising animals in the city and potential health risks. We are as healthy as we are in part due to the separation of animals and people" (personal communication from anonymous manuscript reviewer, September 22, 2011). This is a core concern that municipalities seek to address in municipal codes that regulate livestock keeping in urbanized areas.

Municipalities wishing to avoid public health concerns and social conflict associated with urban livestock altogether can choose to simply prohibit certain animal types from city limits. However, based on the ordinances in this study, animal type prohibitions were used as much or more for reducing social conflict from other types of nuisance, such as those associated with noise or odors, as they were for public health concerns. A frequently prohibited animal, the rooster, poses no more public health threat than chickens, which are widely allowed. Zoning and site-level restrictions may have been developed with an eye toward public health concerns as well as nuisance. However, code language most directly addresses public health in outlining management specifications for animal keeping practices in the public health or animal control sections of the code.

At the level of livestock keeping practices, the municipalities in this study approached dealing with public health concerns in one of two ways. The most widely used approach provides very explicit and detailed language about how the animals are to be kept, how wastes are to be handled, and what pest control measures should be in place. The codes in this study frequently utilize provisions such as keeping feed covered in coyote- or rat-proof containers, disposing of wastes in ways to minimize odors and contamination of waterways, and destroying diseased animals. Many of the codes prohibit the slaughter of animals on site. Codes also clarify the involvement of health departments

or other code enforcement officials in determining when health or animal treatment concerns need to be addressed.

In the second approach, the codes specify the enforcement official and use vague language to describe what constitutes a nuisance or health violation. In these cases, urban livestock keepers have little specific guidance on what they should do to meet the provisions of the code. Instead, the code allows for some flexibility, providing a level of discretion to the administrative overseer and the urban farmer to work out how to best manage urban livestock on a specific piece of land.

The difference between these two approaches is striking. In the first case, clarity and predictability is high, but where specifications are overly stringent, cost prohibitive or inapplicable on a particular plot, some individuals will be unable to engage in the practice of livestock keeping where they live. In the second case, the flexibility of the ordinance allows for creativity as landowners work with public officials to determine the best ways to minimize nuisance and health concerns based on the specific conditions of the proposed urban livestock activity. Such flexibility also could lead to inconsistent application of the intent of the law which could be construed as unfair or capricious.

One approach is not inherently more or less likely to achieve public health goals or minimize the risk of nuisance in relation to urban livestock keeping. Each sets up a process through which urban livestock keepers and administrative overseers will proceed before the practice will be allowed or terminated. In the end, the practices of administrators and urban farmers will determine the extent to which public health concerns are effectively mitigated. However, these concerns can be addressed through careful crafting and enforcement of ordinances, along with the effective identification of instances of health problems. The more public health conflicts can be curtailed through these ordinances and their enforcement, the more likely the practice of urban livestock keeping will expand to other communities.

Conclusion

Municipal governments and planners are likely to face increasing pressure to address the question of urban livestock. As they do so, they will have to figure out how to navigate the inherent tensions that come with animal husbandry in urban and semi-urban environments and determine whether and how to allow the return of livestock animals to the city.

The return of livestock to the city calls into question the dominant perspective that separates urban life from rural life and brings up concerns about public health impacts of urban livestock. The separation of urban and rural is being challenged by those who choose to keep animals in urban and semi-urban areas (Blecha, 2007) as well as by municipalities that have chosen to allow and enable such activities (Gaynor, 1999, 2007). The underlying narrative of what it means to be an urban dweller has the potential to be reshaped with a new focus on self-reliance, urban resilience, and food production. This transition will only happen in places where municipal officials choose to develop ordinances where urban livestock is permissible and where livestock keeping is undertaken in ways that result in minimal social conflict and public health impacts. Codes will have to address public health concerns related to animal wastes, contaminated stormwater runoff, pestilence and diseases related to all of these.

There is no simple answer to these concerns. Each of the municipal codes analyzed here navigates this complex terrain differently. Some set such restrictive zoning, large lot sizes, and/or expansive setbacks that only residents on the periphery are likely to engage in livestock keeping, unless large undeveloped plots remain (or reemerge, in the case of shrinking cities) in more urbanized areas. Others provide strict guidelines for animal confinement, care, and facilities maintenance while remaining relatively permissive on type, lot size, setback, and number limitations. Still others provide guidelines and set limits, but allow landowners and officials to take into account the particularities of the animals, site conditions, and surroundings and make a judgment about the appropriateness of animal hus-

bandry on a case-by-case basis. There is no single approach, but every locality in this study incorporated some level of administrative oversight and legal restrictions on livestock activities within municipal boundaries, primarily to address issues of public health and nuisance concerns. Taken together, these ordinances offer a variety of options that municipal officials can draw on as they seek to determine whether and how to welcome animals back to the city.

These efforts inherently are shaped by local and regional social, political, and economic realities. The call for local food may be harmonious, but the responses are necessarily cacophonic. As these experiments in urban livestock play out, it will be instructive to watch which places navigate the challenges of welcoming livestock back into the city most effectively, simultaneously allowing urban livestock keeping while minimizing nuisance and public health conflicts. The success or failure of these early experiments will determine how widespread the practice of urban livestock keeping is likely to become and the extent to which municipalities will welcome animals back into the urban environment. 

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Appendix. Sources for Ordinances

Municipality	State	Source for Ordinance
Ann Arbor	Michigan	Ann Arbor Code of Ordinances Title IX, Ch. 107, Sec. 9.38-39, 9.42 Adopted October 4, 2010 http://library.municode.com/index.aspx?clientId=11782&stateId=22&stateName=Michigan
Baltimore	Maryland	Baltimore Zoning Code Draft 2010 Title 14-2, Sec. 14-305, 14-327 http://www.rewritebaltimore.org/home.html Baltimore City Health Code Title 2, Sec. 2-106, Title 10, Subtitles 1, 3, 6, Sec. 10-106 Effective October 6, 2007 http://www.baltimorehealth.org/press/2007_02_02_AnimalRegs.pdf
Bloomington	Indiana	Bloomington Municipal Code Title 20, Chapter 20.05, Sec. 20.05.089-095 Passed December 15, 2010 http://bloomington.in.gov/code/
Charlotte	North Carolina	Code of Ordinances, Charlotte, NC Part II, Chapter 3, Article IV, Sec. 3-102 Updated December 13, 2004 Appendix A, Chapter 9, Part 1 Updated most recently, September 20, 2010 http://library.municode.com/index.aspx?clientId=19970&stateId=33&stateName=North Carolina
Chattanooga	Tennessee	Chattanooga City Code Appendix B, Article V, Sec. 1600-1604 January 2009 http://www.chattanooga.gov/City_Council/110_Code.asp
Cleveland	Ohio	The Code, City of Cleveland Part 3, Title VII, Ch. 347, Sec. 347.02 Adopted June 30, 2010 http://planning.city.cleveland.oh.us/zoning/pdf/34702FarmAnimalsandBees.pdf
Detroit	Michigan	Detroit City Code Part III, Ch. 6, Art. 1, Sec. 6-1-3 Enacted November 23, 2010 http://library.municode.com/index.aspx?clientId=10649&stateId=22&stateName=Michigan
Fort Collins	Colorado	Fort Collins Municipal Code Ch. 4, Art. II, Div. 6, Sec. 4.116-117, Art. III, Div. 2, Sec. 4.226-236 Includes ordinances through December 21, 2010 http://www.colocode.com/ftcollins/municipal/begin2.htm#toc

Municipality	State	Source for Ordinance
Kansas City	Missouri	Code of Ordinances, City of Kansas City Part II, Chapter 14, Sec. 14-12 through 14-15, Ch. 34, Sec. 34-21 Enacted March 10, 2011 http://library.municode.com/index.aspx?clientId=10156&stateId=25&stateName=Missouri
Longmont	Colorado	Municipal Code f City of Longmont Title 7, Sec. 7.04.130, Title 9, Sec. 9.04.020 Adopted February 8, 2011 http://library.municode.com/index.aspx?clientId=14590&stateId=6&stateName=Colorado
Madison	Wisconsin	Madison Code of Ordinances Ch. 7, Sec. 7.29, Ch. 9, Sec 9.52, Ch. 23, Sec. 23-31 No date specified http://library.municode.com/index.aspx?clientId=50000&stateId=49&stateName=Wisconsin
Missoula	Montana	Missoula Municipal Code Title 6, Sec. 6.12.010-030 This chapter updated July 9, 2008 http://www.ci.missoula.mt.us/index.aspx?nid=268
Mobile	Alabama	Code of Ordinances, City of Mobile Ch. 7, Art. IV, Div. 1, Sec. 7.81-95, Div. 2, Sec. 7.101-113, Ch. 64, Sec. 64.1-11 Enacted January 18, 2011 http://library.municode.com/index.aspx?clientId=11265&stateId=1&stateName=Alabama
Morgan Hill	California	Morgan Hill Municipal Code Title 6, Ch. 6.36, Sec. 6.36.040-6.36.180, 6.36.270-6.36.280 Passed November 17, 2010 http://library.municode.com/index.aspx?clientId=16502&stateId=5&stateName=California
Mountain View	California	Mountain View City Code Part II, Ch. 5, Div. 2, Art. II, Sec. 5.46-59, Ch. 36, Art. XII, Sec. A.36.10-20 Passed March 1, 2011 http://library.municode.com/index.aspx?clientId=16508&stateId=5&stateName=California
Rogers	Arkansas	Code of Ordinances, City of Rogers Ch. 6, Art. V, Sec. 6-228 through 6-230, Art. VI, Div. 1, Sec. 6-254 through 6-256, Div. 2, Sec. 6-276 through 6-270, Ch. 14, Art. VI, Div. 2, Sec. 14-696 through 14-734 Enacted July 27, 2010 http://library.municode.com/index.aspx?clientId=14712&stateId=4&stateName=Arkansas
Round Rock	Texas	Code of Ordinances, City of Round Rock Part II, Ch. 8, Art. 1, Sec. 8-5, 8-6, Art II, Sec. 8-31 Enacted January 27, 2011 http://library.municode.com/index.aspx?clientId=14610&stateId=43&stateName=Texas

Municipality	State	Source for Ordinance
San Antonio	Texas	Code of Ordinances, City of San Antonio Part II, Ch. 5, Art. III, Sec. 5.50-5.52, Art. V, Sec. 5.109, 5.114 Enacted January 20, 2011 http://library.municode.com/index.aspx?clientId=11508&stateId=43&stateName=Texas
Santa Clara	California	Santa Clara City Code Title 6, Ch. 6.15, Sec. 6.15.010-060, Title 8, Ch. 18.04, Sec. 18.04.010-040 http://www.codepublishing.com/ca/santaclara/frameless/
Seattle	Washington	Seattle Municipal Code Title 23, Subtitle III, Chapter 23.42, Sec. 23.42.052 Includes amendments passed through December 2010. http://library.municode.com/index.aspx?clientId=13857
South Portland	Maine	South Portland Code of Ordinance Ch. 3, Art. II, Sec. 3-52 through 3-67, Art. III, Sec. 3-71 through 3-93 Include amendments passed through December 2010 http://www.southportland.org/index.asp?Type=B_LIST&SEC={93286E1E-9FF8-40D2-AC30-8840DEB23A29}
Stamford	Connecticut	City of Stamford, Zoning Regulations, Section 5-1, http://www.cityofstamford.org/filestorage/25/52/138/164/204/Stamford_Zoning_Regulations_9-17-10.pdf Stamford Connecticut, Code of Ordinances, Chapter 111, Sec. 111-2 through 11-6 http://library.municode.com/index.aspx?clientId=13324&stateId=7&stateName=Connecticut

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Assessing access to local food system initiatives in Fairbanks, Alaska

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Abstract

Local food system initiatives are an increasingly popular attempt to address environmental and social-equity problems that seem to be inherent in the conventional global food system. However, relatively few studies have been undertaken to assess the ability of local food system initiatives to ameliorate these concerns. This study focuses on a community with food system vulnerabilities related to geographic isolation and a marginal agricultural climate that limits local food production. The study seeks to develop tools to test hypotheses important to this community and others: whether local foods can be as physically and economically accessible as conventional foods. Using spatial analysis and quantitative price comparisons, the study concludes that at this time, locally grown foods in Fairbanks, Alaska, are not as accessible as conventional foods. The tools applied in this study could be used elsewhere to develop a more robust literature on the impact of local food system initiatives on urban food systems.

Keywords

Alaska, food systems planning, geographic information systems (GIS), local food access

Introduction

The availability of food in a particular region or community does not guarantee food security for the people of that community (Sen, 1981). If access to food is not equitable, some sector of the population is likely to experience food insecurity. Access to food requires that food be physically accessible, affordable, and culturally or personally acceptable

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(Ericksen, 2008). As interest grows in increasing the amount of food grown within communities to feed community residents, in other words creating local food systems, it is important to assess whether local food system initiatives such as small-scale farms, farmers' markets, and community-supported agriculture enterprises can provide the equitable access required to create a functional food system. Localization presents opportunities to address serious weaknesses in the conventional global food system (GFS), which relies on industrial food production techniques and functions at a global spatial scale. But, without rigorous assessments of nascent local food system (LFS) initiatives, we run the risk of replicating inequities or introducing new vulnerabilities in alternative food systems. Tools developed to assess food access and health issues, particularly among vulnerable populations, can be adapted to help LFS planners and practitioners better understand the current and potential role locally grown foods could play in food systems that achieve food access, nutritional security, and food security.

Using both spatial analysis and quantitative price comparisons, this study compares access (both physical and economic) to local and nonlocal vegetables in the current food system of Fairbanks, Alaska. This study hypothesized that locally grown foods are not as physically or economically accessible to lower-income residents as they are to higher-income residents. The study found that physical access to locally grown foods is lower for all Fairbanks residents, regardless of household income, but that higher prices for locally grown foods are likely to reduce economic access for lower-income households. By assessing the state of nascent LFS initiatives in one community, this study tests the use of food access assessment tools as applied to locally grown foods, identifies several challenges to making local food access equitable across all socioeconomic groups, and highlights areas where future research might uncover solutions to these challenges.

Food System Scales and Choices

While the popularity and viability of LFS initiatives have increased in recent years, their specific role in building comprehensive, functional food systems has yet to be fully examined. The goals of food system localization are often summarized as reducing food miles and associated energy use and pollution (Pirog & Benjamin, 2003); providing food that has not been subject to long-distance shipping (Kloppenburg Jr., Hendrickson, & Stevenson, 1996); building community relationships (Feenstra, 2002); increasing use of sustainable agricultural methods (Feenstra, 2002; Kloppenburg Jr., et al., 1996); supporting local economies (Feenstra, 2002); and improving food access by creating direct links between consumers and food production sites (Feenstra, 2002).

LFSs are not inherently sustainable, environmentally sound, or socially equitable — although they may make contributions to one or more of these objectives. LFSs have weaknesses, as does the more conventional GFS (Hendrickson & Heffernan, 2002), including susceptibility to local disease, climate, and disturbance patterns (Sundkvist, Milestad, & Jansson, 2005); overstressing of local resources (Sundkvist et al., 2005); and lack of social equity (Allen, 1999; Guthman, Morris, & Allen, 2006; Hinrichs, 2003).

LFS initiatives have now been in place in enough communities for sufficient time to begin the process of evaluating their impacts, identifying their strengths and weaknesses, and developing a set of best practices that emerge from the process of assessment. To date there are relatively few studies that assess LFS initiatives' contribution to food security in developed countries and cities. Most research has focused on a lack of social equity in participation in LFS initiatives (see: Allen, 1999; Guthman, 2008; Hinrichs, 2003; Hinrichs & Kremer, 2002; Macias, 2008). A smaller set of studies has examined the contribution of LFS initiatives, particularly gardening, to nutritional outcomes for participants. Blair, Giesecke, and Sherman (1991) and Alaimo, Packnett, Miles, and Kruger (2008) each found that community gardeners consume fruits and vegetables at higher rates than nongardeners. McCormack, Laska, Larson, and Story (2010) note the potential for both farmers' markets and community gardens to

increase access to fruits and vegetables, yet stress that there is limited research assessing the specific health benefits of either type of LFS initiative.

Several LFS studies have noted the lack of assessment tools in this field (Grey, 2000; Hinrichs, Kloppenburg Jr, Stevenson, Lexberg, Hendrickson, and DeMaster, 1998; McCormack, et al., 2010). However, tools developed to assess general food access and the relationship between food access and health outcomes may be useful in assessing the state of LFS initiatives. Presence or absence of different types of food retailers in a particular geographic or demographic area is one indicator of access to food (Alwitt & Donley, 1997; Bodor, Rose, Farley, Swalm, & Scott, 2007; Guy & David, 2004; Lee, Darcy, Leonard, Groos, Stubbs, Lowson, Dunn, Coyne, & Riley, 2002; Morland, Wing, Diez Roux, & Poole, 2002). Availability of certain types of foods, often fruits, vegetables, and low-fat dairy, in different types of stores and geographic areas has been used to determine whether local residents have access to healthful foods (Hendrickson, Smith, & Eikenberry, 2006) and how food access affects health outcomes (Inagami, Cohen, Finch, & Asch, 2006; Lane, Keefe, Rubinstein, Levandowski, Webster, Cibula, Boahene, Dele-Michael, Carter, Jones, Wojtowycz, & Brill, 2008; Wang, Kim, Gonzalez, MacLeod, & Winkleby, 2007), with the general finding that the type of store most available in a given neighborhood affects residents' body mass index. Costs of a selection of foods, usually a predetermined "healthy food basket," have also been compared by geographic or demographic area (Donkin, Dowler, Stevenson, & Turner, 2000; Guy & David, 2004; Lee, et al., 2002), demonstrating that food costs and availability often vary within one community depending on the neighborhood. One of the most complete approaches to assessing food access is to determine how far, and by what method, consumers must travel to reach particular types of food by mapping the distance from either individual residence (Algert, Agrawal, & Lewis, 2006) or neighborhood (Sharkey, Horel, & Dean, 2010) to a variety of food sources such as supermarkets, small markets, and convenience stores. Some food access studies have included farmers' markets in their assessments, but have focused on markets as a source of fresh produce without considering their status as purveyors of local foods (Bader, Purciel, Yousefzadeh, & Neckerman, 2010; Larsen & Gilliland, 2009).

This study applies several of these methods of measuring general food access to the question of access to locally grown foods in order to assess the role local foods currently play in one community's food system. Presence or absence of types of stores, presence or absence of locally grown foods in those stores, price comparisons between locally grown and nonlocal vegetables, and proximity of local and nonlocal food outlets to population centers are all examined in order to assess access to locally grown foods.

These are not new tools, as is clear by the literature cited above. However, they are used in this study for two specific reasons: (1) they have not yet been applied to LFS-specific questions such as equitable access to local food resources, and this study provides an opportunity to test their efficacy in this context; and (2) in our efforts to build our knowledge base about LFS strengths, weaknesses, and best practices, we should use established, successful, and replicable methods capable of producing comparable data both within and across a variety of communities.

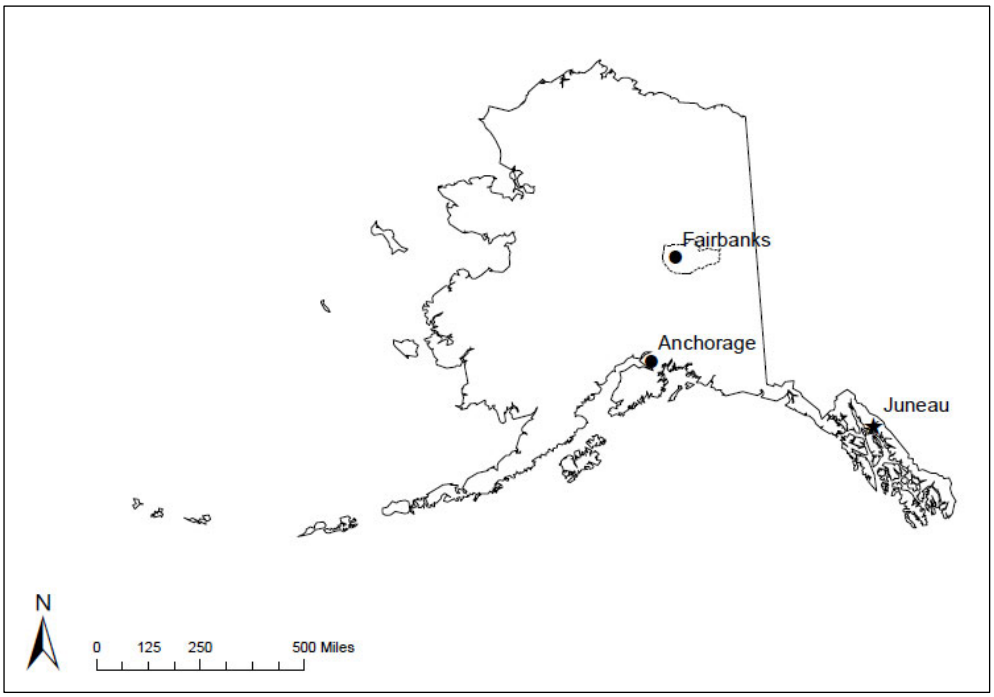
If we wish to design food systems that meet community needs through the incorporation of more local production, we must explore the specific outcomes of LFS initiatives on individuals and communities. Fairbanks, as well as many other North American cities, is engaged in the process of building local capacity and it is important, early in the process, to identify existing community needs and the role of nascent LFS initiatives in addressing those needs.

The Fairbanks Food System

This research took place in Fairbanks, Alaska, primarily during the summers of 2006 and 2007 and describes the community food system as it existed at that time. Assessments such as those conducted in this study must be repeated periodi-

cally in order to track changes in the community, such as population shifts that might affect the food system and changes in the food system, such as increases or decreases in local production, that might affect the community.

Figure 1. The State of Alaska, Fairbanks North Star Borough, and Urban Centers



Located at 64° north latitude, Fairbanks is the urban hub of Interior Alaska (see figure1). The region is subarctic, with average temperatures that range from -9.7° F (-23.2º C) in January to + 62.4° F (16.9º C) in July. Fairbanks averages 10 days per year below -40° F (-40º C) and 13 days above +80° F (26.7º C) (Alaska Climate Research Center, 2008a). There are fewer than 4 hours of daylight at the winter solstice in December and more than 22 hours at the summer solstice in June (Alaska Climate Research Center, 2008b). Fairbanks receives an average of 10.56 inches (26.82 cm) of precipitation annually (National Agricultural Statistics Service - Alaska Field Office, 2006). The average growing season for Fairbanks is 115 days (Alaska Climate Research Center, 2008c). In the Fairbanks area, 16,834 acres (6,812 hec) of cropland were harvested in 2007; however, only 340 acres (138 hec) of those were vegetables (United States Department of Agriculture, 2009). Agricultural capacity in Fairbanks is somewhat limited due to both climate and soils. There are no Class 1 soils, identified by the USDA as best for agriculture, in Fairbanks. There are approximately 33,000 acres (13,355 hec) of Class 2 soils, which have moderate limitations on choice of plants and may require moderate conservation practices, and approximately 6,175 acres (2,499 hec) of Class 3 soils, which have more severe limitations on plant choice and higher requirements for conservation practices, in the Greater Fairbanks soil survey area of 264,000 acres (106,837 hec) (United States Department of Agriculture, 2011).

The Fairbanks North Star Borough (FNSB) encompasses the city of Fairbanks, the city of North Pole, and several smaller towns and had a 2007 population of 97,484 people in 7,444 square miles (19,280 square kilometers) (U.S. Census Bureau, 2008b). Because almost all residents rely on a common set of resources for shopping, education, and entertainment located within or near the city limits of Fairbanks, the FNSB is treated as one community; "Fairbanks" is used to refer to the community as a whole.

The food system of Fairbanks reflects its blend of modern U.S. city and historic frontier town. Fairbanks largely relies on the GFS to supply its food. Fairbanks' geographic isolation relative to the contiguous U.S., combined with its subarctic climate, mean that the vast majority of the community's food is imported from great distances outside the state; only an estimated 5% of food consumed by

Alaskans is produced in the state of Alaska (University of Alaska Fairbanks Cooperative Extension Service, 2006). The food system includes modern full-service supermarkets; convenience stores; small markets; local farms and a farmers' market; as well as food acquired directly through subsistence hunting or fishing, gathering, or home gardening. The level of participation in subsistence activities makes Fairbanks unique when compared to urban areas outside of Alaska. Due to the manner in which subsistence resources are managed legally within the state, detailed statistics are not kept on urban hunters in Alaska; however, it is estimated that Fairbanks residents, on average, harvest and consume 16 pounds of wild foods per person per year (Wolfe, 2000). Although rural Interior Alaska residents harvest far more subsistence foods annually (up to 613 pounds per person), wild foods remain important parts of the diet and culture of at least some urban residents. While this research focuses on retail-food access, all of these food sources contribute to the food system of Fairbanks and most other Alaskan communities.

The first chain supermarket entered the community in 1961 (Burgett, 1967). In 2007, Fairbanks had nine supermarkets. In addition to five supermarkets representing two national chains, Fairbanks had one "club" store with an annual membership fee and one discount grocer, both owned by a major retail chain, one independent grocer, and one store operated by the U.S. Army, which is not open to the general public.

The community's history and culture, combined with current interests, have kept an LFS component alive for more than 100 years. Gardening and small-scale farming has a rich history in the region (Lewis, 1998; Logsdon, 1983; Papp & Phillips, 2007). Nevertheless, Fairbanks has struggled with issues of food self-reliance since its founding. Only rarely, for a few years in the 1920s, did the community come close to supplying all its necessary food from local sources (Lewis, 1998; Papp & Phillips, 2007).

A growing interest in small-scale local food production, combined with this historic interest in self-sufficiency, has helped several small farms, a farmers' market, and a large community garden develop over the past 30 years. The most active local farms, in terms of local food system development, however, are less than 15 years old.

Geographic isolation combined with reliance on national chain supermarkets has implications for Fairbanks' food security in the event of a system shock that disrupts transportation. One of the supermarket chains has a warehouse 350 miles from Fairbanks that supplies the entire state; the other chains have no warehouses in Alaska and must restock all their food directly from the lower 48 states (M. Fern, personal communication, July 9, 2007). Anecdotal estimates, based on discussions with supermarket employees, place the amount of fresh food on hand in the state's supermarkets at two to three days' supply at any given time. A shutdown of the transportation system that brings food into the state by truck, barge, or air could have serious impacts in Fairbanks.

Fairbanks' current food system has several points of vulnerability, both extra-urban and intra-urban, that are common to many North American cities: reliance on foods produced outside the region and shipped into the community (extra-urban vulnerability); diminishing diversity in food suppliers; and migration of supermarkets out of urban core areas and into wealthier suburbs (intra-urban vulnerabilities). Some of Fairbanks' vulnerabilities are unique to high-latitude communities or those in marginal agricultural climates, particularly a short growing season and cold soils that limit local agricultural production.

The similarities between Fairbanks and other U.S. cities allow the use of Fairbanks to test hypotheses about the role of locally grown foods in the current food system. The unique aspects of Fairbanks, namely geographic isolation and challenging climate, make this study imperative for the region as it manages the challenges of rising energy costs, climate change, and population shifts.

Methods

Store Type and Availability

To compare locally grown and imported foods, a sample of seven vegetables was used. Vegetables are the most consistently available locally grown foods that can be easily compared to imported foods. Meat, dairy, and fruits are produced on some farms in the Fairbanks area (United States Department of Agriculture, 2009), but in quantities too small to provide opportunities for consistent price comparisons. The study was conducted in the summer only (June–September), because locally grown vegetables are widely available only during the summer months. This is an admittedly small sample on which to base conclusions about food access. However, the sample is adequate to test the methods of food access assessment within the context of the Fairbanks food system, where the range of locally grown foods is relatively small.

Five vegetables in the sample (broccoli, cabbage, carrots, lettuce, and potatoes) represent the top five vegetables by acres harvested in Alaska (National Agricultural Statistics Service–Alaska Field Office, 2006), which were assumed to be the most readily available vegetables locally. Two vegetables (tomatoes and zucchini) were the two most commonly grown vegetables among community gardeners in Fairbanks and were, therefore, considered to be popular and common vegetables in the area. Information about commonly grown vegetables was gathered during discussions the author held with approximately half of all members (29 of 54 people) of the only community garden in Fairbanks in June 2006.

A list was compiled of food stores in Fairbanks using online search engines and the local phonebook. Fifty-five food outlets were identified and forty-eight were surveyed in person to record the number of fresh items, number, and type of vegetables in other forms (canned, frozen) and the area of origin of each vegetable. Whenever possible during the store surveys, employees or operators (in the case of farm outlets) were interviewed regarding the source of produce, farming methods, and their experiences with sales and marketing of vegetables in Fairbanks.

Seven farm stands listed by the Alaska Department of Health and Social Services (DHSS) as accepting Farmers' Market Nutrition Plan coupons were not directly surveyed because it was not possible to determine whether they were in business at the time of the study. Despite being unable to contact the operators during the study period, the benefit of the doubt was given to the official listings, and the farm stands were included in the physical access assessment. However, they were not included in the price comparisons. Given the short growing season and local climate, all local farm outlets tend to have a similar selection of produce at the same time of year; comparisons of prices at the farmers' market and one farmstand revealed that all farmers charged approximately the same prices for vegetables. Therefore, it was assumed that the unsurveyed farm stands, if open, would stock a similar range of foods at similar prices.

Table 1. Fairbanks Food Outlets Included in Local Food Access Study

Food Outlet	Number	Surveyed	Fairbanks-grown available	Alaska-grown available	Imported available
Supermarket	9	9	1 (tomatoes only)	9	9
Farmers' market	1	1	1	0	0
CSA[a] pick-up site	10	10	10	0	0
Single-operator farm stands	7	1	7	0	0
Specialty stores	4	4	1 (occasional/limited)	0	4
Convenience stores	24	24	0	0	24 (limited)

[a] CSA = community supported agriculture operation

Stores were categorized based on the volume and type of vegetables available (see table 1). Although 24 convenience stores and four small or specialty stores are present in Fairbanks, the only consistent sources of a range of fresh vegetables were supermarkets and farm outlets. "Supermarkets" stock a full range of vegetables including all those on the survey list. "Farm outlets" stock mostly or exclusively fresh vegetables that are grown locally (within the Fairbanks area). Farm outlets include the local farmers' market, farm stands, and all pick-up sites for CSA enterprises in Fairbanks. For the purposes of this paper, only fresh vegetables are included in the analysis.

Using ArcGIS, stores were geocoded by address and sorted by store type and by availability of Alaska- and/or Fairbanks-grown vegetables. Several addresses could not be geocoded because the road layer available for Fairbanks has incomplete information. Nine stores were digitized individually and then added to the geocoded database. To ensure proper placement of these nine stores, online map services were consulted.

Using 2000 Census data, Fairbanks census tracts were divided into two groups based on median household income: above median household income (higher income) and below median household income (lower income). The nine higher-income tracts combined to account for 57% of the population and ranged from 3,512 to 8,253 people per tract. Ten lower-income census tracts ranged from 1,128 to 7,381 people per tract and accounted for 43% of the population. The location of the population centroid for each tract was obtained from the U.S. Census Bureau and plotted onto the map for use during distance analysis. Use of population centroids, a geographical point that identifies the center of an area's population, for large areas such as census tracts is not as accurate as using smaller units such as census blocks; however, census tracts were the smallest scale of socio-economic data available for Fairbanks.

Although store location can depend on population, household income was used as a variable in order to focus the inquiry on equity issues. Both people and food outlets have migrated toward suburban neighborhoods over the past several decades (Morland & Wing, 2007), but the market-based argument that retailers simply follow population movements does not address the fact that it is most often lower-income residents left in declining neighborhoods with declining services.

Distance to Food Outlets

Because presence or absence of a store in a census tract does not guarantee its accessibility to residents, distance to each store was also considered. Distance to food outlets was calculated using the Point Distance tool in ArcGIS to measure from each population-weighted centroid to all stores and to each type of store. Euclidian distance was measured, rather than the usually more accurate Network Distance, because even the most up-to-date GIS maps of the region did not include all roads or addresses, so distance calculations could not be considered entirely accurate using a road-network measure. Euclidian distance likely underestimates the distance between population centroids and destinations because it traces the most direct route, not the route following the existing road network.

Following Sharkey et al. (2010), the mean distance between each population centroid and the 55 food outlets was calculated for each census tract and mean distances to the various store types compared. The U.S. Army Commissary, which is a full-service supermarket, was excluded from the distance measures for all tracts except number 11, which encompasses the base, because it is not open to the public. However, base residents are free to shop off base so distance to all stores was calculated from the tract 11 population centroid.

Food Costs

Cost for each type of vegetable included in the sample was gathered during the store survey. The lowest-cost option for each fresh vegetable was recorded at each food outlet. This approach means that, at times, local organic food was compared to conventionally grown imported food, an approach that may have conflated two different issues: cost of locally grown and cost of organically grown. However, from the consumers' perspective these

two costs are already combined in the price of locally grown food. The consumer's choice is limited to locally grown (which may include costs associated with organic production) and lower-cost conventional foods. Nonetheless, further examination of price differences based on production methods and point of origin would be a fruitful line of inquiry. Costs for vegetables obtained through a CSA subscription are not included due to the difficulty of determining costs for individual vegetables in the CSA system, where food is distributed as a bundle, as well as the limited access to CSAs among the Fairbanks population, where only approximately 350 of 32,352 households were CSA members in 2007 (M. Emers, personal communication, June 3, 2007).

Cost per ounce for each vegetable is the unit of measurement. Lettuce is the only item not calculated in this manner as all nonpackaged lettuce in the survey was sold per head. The costs of vegetables grown in Fairbanks, in Alaska (but not Fairbanks), and outside Alaska were then calculated for each vegetable. One-way ANOVA was used to compare vegetable costs between the three points of origin.

Results

Median household income in Fairbanks in 2000 was US$49,076 and ranged from a high of US$69,688 in tract 12 to a low of US$25,901 in tract 1 (U.S. Census Bureau, 2000). Tracts 1–7 encompass the urban core of the community. Lower-income census tracts tend to be clustered in the center of the city with higher income tracts surrounding them (see figure 2). Exceptions are tracts

Figure 2. Fairbanks North Star Borough Census Tracts and 2000 Median Household Income

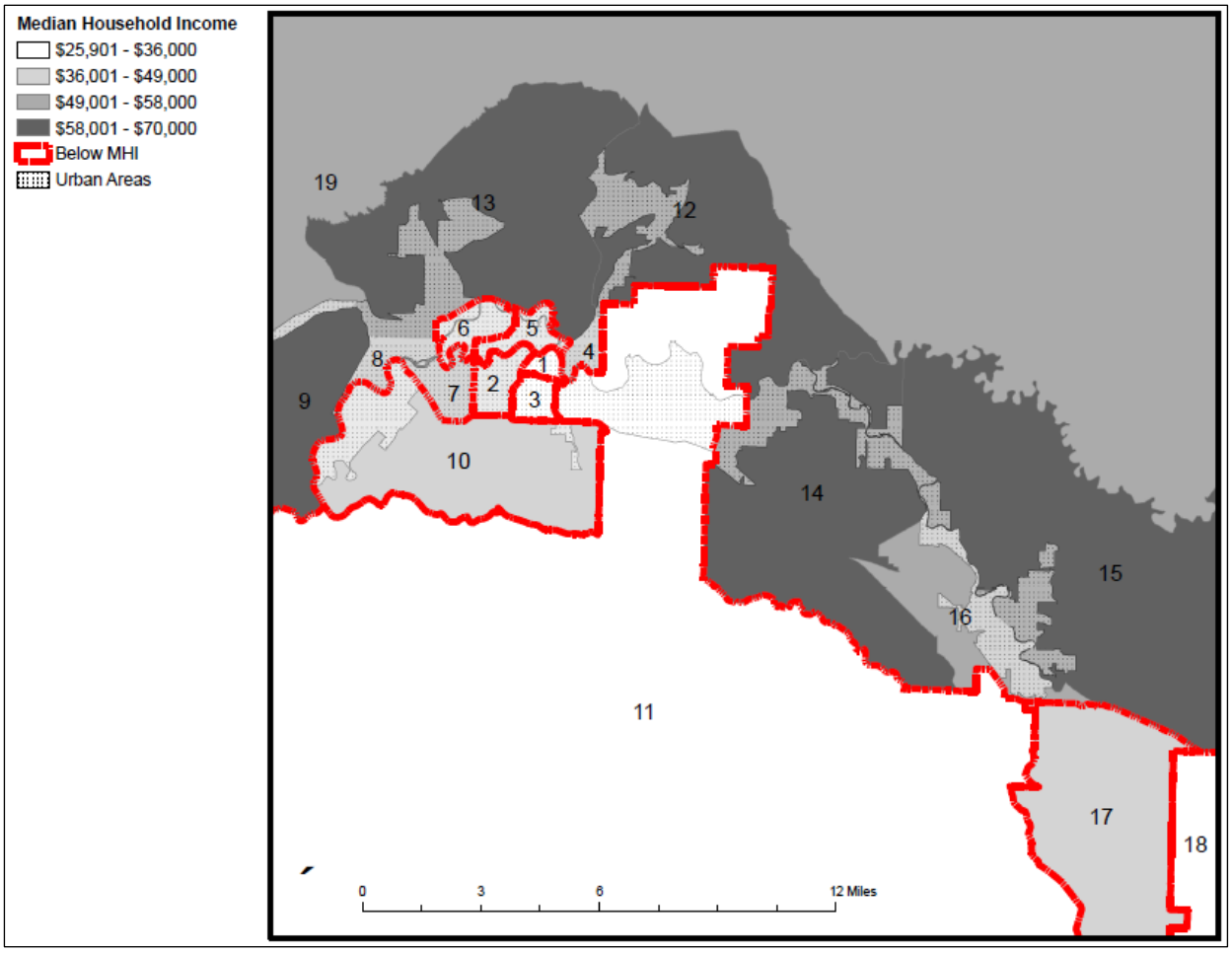


Figure 3. Stores per Census Tract in Fairbanks

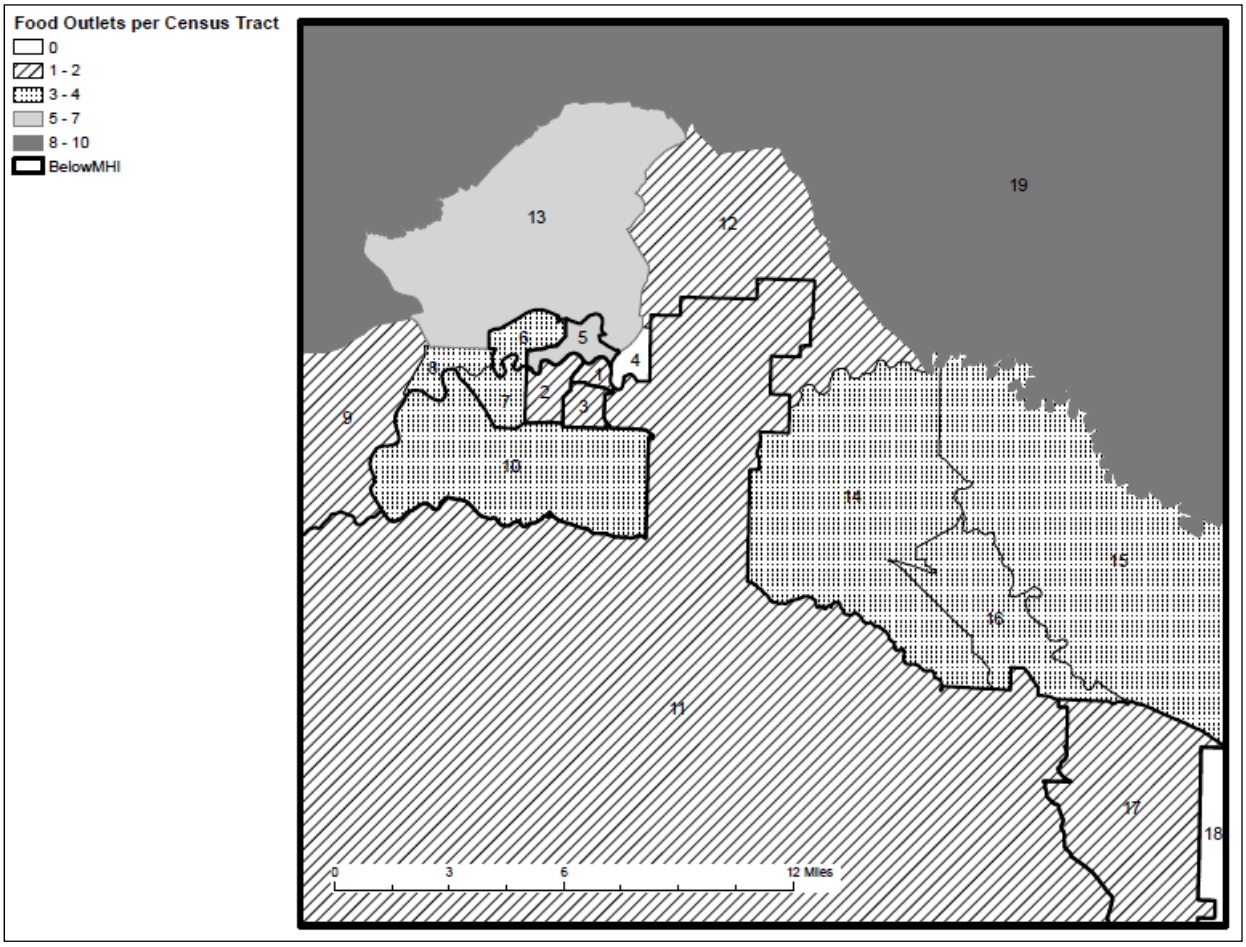


Table 2. Number of Stores and Store Types by Census Tract Type

Tract Type	Total Stores	Convenience	Small	Supermarket	Farm Outlets
Lower-Income	19	11	3	3	2
Higher-Income	36	13	1	6	16
Fairbanks	55	24	4	9	18

17 and 18, which are both rural areas to the southeast of the city of Fairbanks.

Allocation of Stores by Census Tract

The 55 food outlets in Fairbanks were categorized according to availability of fresh produce. Twenty-four of the stores are convenience or convenience-gas stores, which carry five or fewer types of fresh vegetables. Four stores are classified as "small," which stock a limited range (six to 12) of often specialty vegetables. Eighteen farm outlets and nine full-service supermarkets were also identified. Figure 3 illustrates the number of stores in each census tract. Table 2 summarizes the different kinds of stores in each tract type.

Distance to Food Resources

Presence or absence of stores in a particular area neither guarantees nor eliminates access to food resources. An important aspect of access to food is the distance one must travel to reach food resources, and whether or not one has the means to travel that distance. To provide a baseline for understanding food access in Fairbanks, the aver-

age distance to supermarkets for each tract type was measured. Supermarkets represent the most common location to access a wide range of foods and, therefore, provide us with basic information about food access in the community. By measuring conventional food access, we can then assess whether alternative foods, in this case locally grown foods, are more or less accessible than conventional foods.

Despite a difference of more than 1.5 miles (2.4 km), no statistically significant difference was found between the mean distances from lower-income population centroids to all supermarkets in Fairbanks (8.83 miles or 14.21 km) and the mean for higher-income tracts (7.10 miles or 11.43 km). See table 3.

The population of Fairbanks, like many western U.S. cities, is dispersed well beyond the city center, making distances to stores high when all stores are considered as a group. The difference in distance to the closest store by census tract provides us with a more realistic picture of food access. For lower-income tracts, the mean distance to the closest supermarket is 4.47 miles (7.19 km) and for higher-income tracts is 2.26 miles (3.64 km), with no statistical significance in the distances. When two rural tracts (17 and 18), in which the closest stores are approximately 20 and 12 miles (32 and 19 km) away, respectively, are removed from the lower-income distance calculations, the average distance to the closest supermarket in lower-income tracts drops to 1.2 miles (1.93 km), shorter than the average in higher-income tracts. There is still no significant difference between lower-income and higher-income tracts (see table 3).

Local Food Access

Having established that physical access to conventional foods is, at least statistically, equitable across census tract types, we turn to the question of physical access to locally grown foods. Although some stores in Fairbanks stock locally grown foods occasionally, they rarely had more than one to three items at a time, and these items were not regularly available even during the local growing season. Only one supermarket stocked any Fairbanks-grown foods — and that was only tomatoes grown by one local producer observed during the store surveys. For these reasons, only distance to farm outlets is considered when calculating distance to local foods. The farm outlets are generally open only one or two days each week, but when open provide a range of locally grown vegetables.

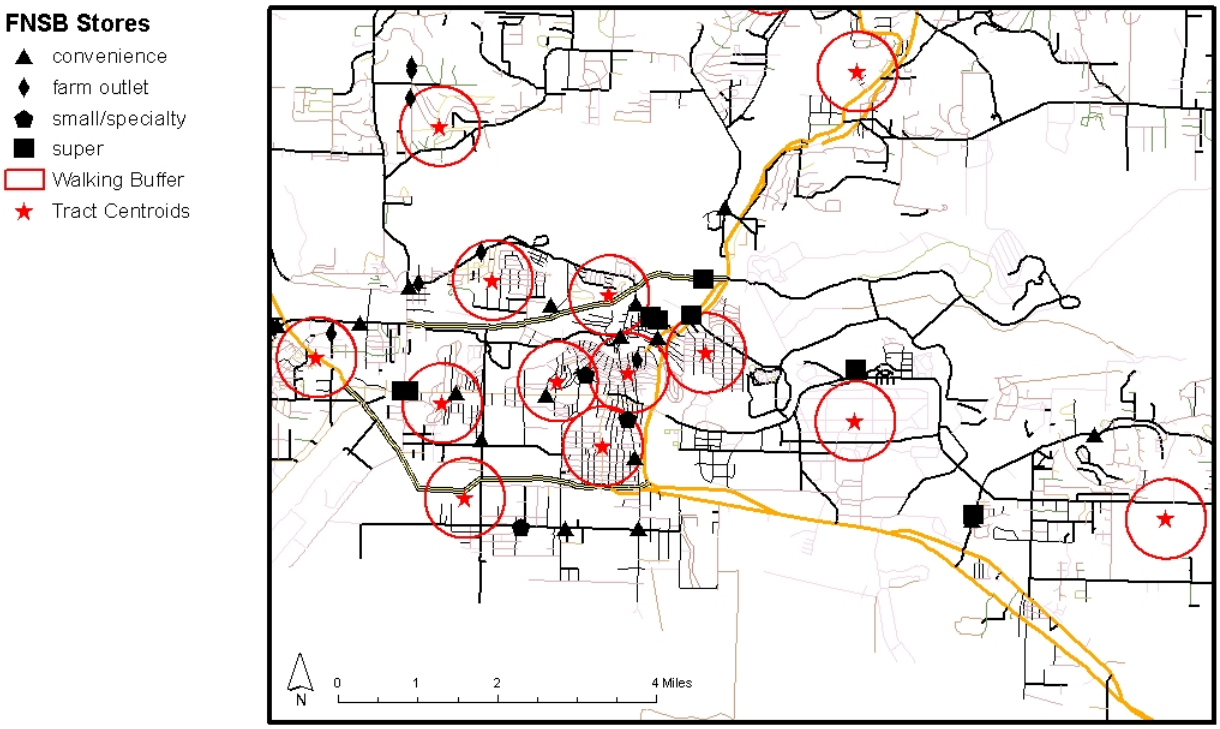
The mean distance to outlets for locally grown foods in lower-income tracts is 13.40 miles (21.57 km) and 10.89 miles (17.53 km) for higher-income tracts — but there is no statistically significant difference between the two. The closest farm outlets range from 0.21 miles (.34 km) for tract 1 to 17.23 miles (27.73 km) for tract 17, with an average distance to the closest of 2.89 miles (4.65 km). The average closest distance for lower-income tracts is 3.93 miles (6.32 km) and average closest distance for higher-income tracts is 1.94 miles (3.12 km). No statistical difference is discernible by tract type.

Table 3. Average Distance to Stores (in Miles and Kilometers) from Census Tract Population Centroids

Distance	Lower-Income	Higher-Income	Fairbanks
All supermarkets	8.83 / 14.21	7.10 / 11.43	7.9[a] / 12.71
Closest supermarket	4.47 / 7.19	2.26 / 3.64	3.31[b] / 5.33
Closest supermarket (excluding tracts 17 & 18)	1.20 / 1.93	2.26 / 3.64	N/A
All local food outlets	13.40 / 21.57	10.89 / 17.53	12.08[a] / 19.44
Closest local food outlet	3.93 / 6.32	1.94 / 3.12	2.89 / 4.65
Farmers' market			7.59[b] / 12.21

[a] Distance to supermarket compared to distance to local outlet p = .000
[b] Distance to closest supermarket compared to distance to farmers' market p=.004

Figure 4. Half-mile Walking Distance Buffers Around Census Tract Population Centroids



Note. Tracts 17,18, and 19 are not shown as there are no stores within walking distance.

With a farm outlet an average of less than 3 miles (4.8 km) from each population centroid, it might appear that local foods are actually more accessible than imported. However, this is not necessarily a reasonable assumption. The majority of the farm outlets mapped (10) are CSA pick-up sites, which require consumers to be members in order to access the available food. Only about 1% of Fairbanks households were served by CSAs in 2007. The vast majority of residents would have needed to purchase locally grown foods at the farmers' market. Given these constraints, it is reasonable to consider the average distance to the farmers' market, 7.59 miles (12.21 km), as a more accurate estimate of distance to local foods, which is significantly farther than to the closest supermarket ($t = -3.338$, $p = .004$).

The issue of scheduling and availability — when these outlets are open — is yet another matter that should be considered when assessing the role of locally grown foods in a food system. The farmers' market is open two days per week during the summer months (roughly June through September). The additional distance necessary to reach local food outlets and the limited schedule means that consumers may need to make a separate trip or special arrangements to access local foods. While for many consumers of local foods, these are minor inconveniences in comparison to the perceived benefits of locally grown foods, they can be barriers to increasing the consumer base for local foods to include lower-income people or for those with work, family, or child-care responsibilities that hinder their movement throughout the day (Allen, 1999; Bellows & Hamm, 2001).

Distance and Transportation

Although distance to various food outlets appears, on the surface, equitable across census-tract type, these results do not necessarily equate to equitable physical access to food. While distance to a store may be similar for two different households, if access to transportation is not equal across house-

holds, such distances may mean two entirely different things (Bader et al., 2010). Information on personal transportation ownership by census tract is not available for Fairbanks. However, lower-income households tend to have lower rates of car ownership (U.S. Census Bureau, 2008a), meaning that travel to shopping must be accomplished by foot, public transportation, or taxi (Algert et al., 2006; Whelan, Wrigley, Warm, & Cannings, 2002).

To determine whether any stores in Fairbanks are within walking distance of census tract population centers, half-mile buffers were placed around each centroid (see figure 4). One-half mile was chosen as reasonable walking distance based on existing literature[1] (Algert, et al., 2006). However, the physical structure of a city and its climate must be considered when analyzing walking distance. In many Western U.S. cities, sidewalks are not common, forcing residents to walk in roadways. Additionally, in Fairbanks the impact of climate and geography cannot be ignored. Although this study focuses on summer months, winter conditions in Fairbanks hinder residents' ability to walk to destinations.

Ten of the 19 tract centroids had at least one store within the half-mile buffer. However, only two have a supermarket within walking distance (tracts 4 and 7), and only one is within walking distance of the farmers' market (tract 6).

Fairbanks has a public transportation system consisting of seven bus routes. Each of the seven lines stops at one of the major grocery stores, and two of the routes stop near the farmers' market. The availability of public transportation can ease food access issues, but does not eliminate them. Doing grocery shopping by bus can be challenging because of the need to walk to and from the closest bus stop, carry grocery bags from the stop, and coordinate shopping trips with bus schedules (Bader et al., 2010; Whelan et al., 2002).

Affordability

An important dimension of access to food is the affordability of that food. The price analyses here are limited to outlets selling vegetables on a per-item basis (the local farmers' market, one farmstand, and the supermarkets) and excludes CSAs, which, as discussed above, do not itemize their produce and served only a tiny percent of Fairbanks households during this study. However, additional research should be undertaken to assess per-item costs using the CSA approach in order to understand the potential role of CSAs in improving economic access to locally grown foods.

Table 4. Vegetable Costs (per ounce), June–July 2007 in the FNSB (all prices in USD)

Vegetable	Nonlocal	Alaska-grown	Fairbanks-grown
Broccoli	$0.12	$0.09	$0.19
Cabbage	$0.07	$0.05	$0.10
Carrots	$0.06	n/a	$0.35
Lettuce	$1.62 each	$.99 each	$1.94 each
Potatoes	$0.02	$0.02	$0.10
Tomatoes	$0.19	$0.19	$0.26
Zucchini	$0.13	n/a	$0.11

Table 4 summarizes the average price of the seven-vegetable sample by point of origin. Fairbanks-grown vegetables come from farms up to 95 miles (153 km) from the city; Alaska-grown vegetables are from the commercial agricultural area approximately 330 miles (531 km) from Fairbanks; and nonlocal vegetables come from outside the state and travel as much as 2,400 miles (3,862 km) to Fairbanks. Alaska-grown vegetables from the Matanuska-Susitna region of Alaska, where food crops are grown on exponentially larger scales than in the interior region of the state,[2] were available at

[1] U.S. urban planning standards often rely on a ¼ mile radius for walking distance in dense urban developments. Few neighborhoods in Fairbanks would meet the definition of dense, urban area, so this analysis follows the ½ mile distance used in similar studies in communities with similar a similar urban form.

[2] For example, the Matanuska-Susitna agricultural region produced 128,500 cwt (5,829 metric tons) of potatoes and 20,000 cwt (907 mt) of carrots in 2005, compared to the

all supermarkets but one. All prices represent the lowest-cost option for each fresh vegetable at each food outlet at the time of the weekly survey.

Mean prices by region of origin are calculated as cost per ounce, with the exception of lettuce because it was sold per head, not by the pound. There were significant differences between vegetable prices by point of origin ($f = 5.050$; $P = .009$). A Bonnferoni post hoc test indicates that Fairbanks-grown vegetables are significantly more expensive than comparable vegetables from each of Alaska-grown and nonlocal sources (see table 5), with Alaska-grown the least expensive option.

Price differences may be affected by seasonal variations in food availability, production methods, and consumer demand. Local potatoes and carrots were not widely available at the time of the survey because they are late-season crops (usually not available until late July at the earliest). Given that both vegetables are relatively inexpensive, they may reduce mean prices for locally grown vegetables. However, the lack of availability of two common vegetables throughout most of the summer in Fairbanks raises issues of access in terms of seasonality and availability of common foods. The short growing season places some limitations on what can be grown locally and how long it will be available throughout the year (Lewis, Hebert, & Swanson, 2004). Increased reliance on locally grown foods may mean reliance on easily stored produce or food storage practices such as canning and freezing. The potential impacts of climate change on agriculture in Fairbanks are discussed in greater detail below.

Table 5. Price Comparison by Point of Origin

Origin	Average price	Items
Nonlocal	$0.1044*	48
Alaska-grown	$0.0708**	12
Fairbanks-grown	$0.1818*,**	17

* $p = .026$
** $p = .015$

Tanana Valley (Fairbanks) region's 37,000 cwt (1,678 mt) and 500 cwt (23 mt) of the same vegetables, respectively.

Farming practices have almost certainly affected the cost of locally grown food. Fairbanks farmers tend to use more sustainable farming methods such as organic or chemical-free production and tend to rely on physical labor rather than mechanized farm equipment, which many farmers advertise at their farm stands and farmers' market stalls. The implications of production techniques are discussed further below.

Finally, demand for locally grown produce is high in Fairbanks. Although only 350 households were served by CSAs in 2007, each CSA farm maintained a waiting list of potential customers. And it was not unusual for farmers selling produce at the farmers' market to completely sell out before the end of the market day (personal observation). With sufficient consumers able and willing to pay higher prices for locally grown foods, there is little incentive for farmers to lower prices, even if that were possible given their expenses and labor inputs.

One attempt to reduce the costs and improve the access of LFS initiatives is the USDA's Farmers' Market Nutrition Plan (FMNP), which provides coupons for use at farmers' markets to low-income families. Similar programs have been successful in improving food access for low-income urban residents elsewhere (Alkon, 2008; Macias, 2008). Participants in the Women, Infants, and Children (WIC) nutrition program and eligible seniors age 60 and older can receive US$25 worth of coupons per year through the FMNP to be used at participating local markets or farm stands for Alaska-grown fresh, unprocessed fruits, vegetables, and herbs. The Alaska Department of Health and Social Services estimates that the FMNP generated US$250,500 for participating farmers in 2006 (State of Alaska, 2007). DHSS also reports that many participants continued to shop at the local markets after using all of their coupons.

While the FMNP appears to be a successful step toward linking low-income families with local producers, the value of the coupons provided to each

family is a fraction of average household expenses for fresh vegetables. In 2000, Americans spent an average of US$1.45 per person per week for fresh vegetables (Blisard, Stewart, & Jolliffe, 2004) . A household of four could be expected to spend US$5.80 per week on fresh vegetables. The US$25 book of coupons per year is equivalent to approximately one month of vegetables per household.

Discussion

This study captures a snapshot of several components of the Fairbanks food system at one particular moment in time. As with any aspect of a community, we can expect the food system to change over time in response to any number of drivers, including population shifts, climate change, and consumer preference. While some valuable lessons can be gleaned from this preliminary analysis, the real value is in establishing food access indices (Pearce, Witten, & Bartie, 2006) that can, and should, be revisited over time. For example, since the data was collected for this study, the single farmstand in downtown Fairbanks has evolved into a multivendor weekly farmers' market. While not likely to significantly change the physical or economic access equity issues on its own, the additional market does provide more choices for consumers and greater exposure to locally grown foods for community members.

Other baseline indicators identified through this study should be revisited in the near future to assess community progress toward greater access to locally grown foods and greater equity in the food system in general. The current pattern of geographic allocation of food outlets across Fairbanks revealed few differences between lower- and higher-income census tracts in terms of their physical distance to food. In fact, some lower-income census tracts are closer (1.2 miles or 1.9 km on average) to supermarkets than higher-income tracts (2.26 miles or 3.64 km on average). However, statistical differences are not the same as discernible differences for the people who confront their food-access issues regularly. Lack of access to personal transportation may make the 1.2 miles to the closest supermarket in lower-income tracts a barrier for some households. And with few stores within walking distance of population centers, many residents may find their physical access to healthful foods somewhat limited. Additional research that determines how people travel to food outlets would be beneficial to the community in terms of planning for future food outlets or alternative food access programs.

This study found that locally grown foods are less physically accessible than conventional foods on a communitywide scale. Locally grown foods are not available in supermarkets. The most consistent source of local food, at the time of writing, was one farmers' market, which is significantly farther away from population centers (7.59 miles or 12.21 km), on average, than are the closest supermarkets (3.31 miles or 5.33 km). CSA pick-up sites provide one successful model for physical food access because they are intended to be convenient to farm shareholders. Inclusions of CSA pick-up sites in the spatial analysis of food access points helped to drop the average distance to local food resources to 2.89 miles (4.65 km) on average. However, in the case of Fairbanks, these enterprises were limited in terms of their ability to meet current demand, serving only about 1% of community households, and therefore were not currently contributing to local food access at a communitywide scale. Revisiting both the effect on local food access of the new farmers' market and the percent of Fairbanks households engaged with CSAs is an important task for LFS practitioners and planners.

Locally grown vegetables in Fairbanks were more expensive than the lowest-cost comparable vegetables available in supermarkets. Affordability of food is affected by production methods, location of production, and consumers' ability to pay (Ericksen, 2008). Practicing more ecologically sensitive production methods, as many Fairbanks farmers do, may improve environmental and human-health outcomes, but it can be financially difficult because farmers may lose out on the benefits of economies of scale and government subsidies (Fraser, Mabee, & Figge, 2005) and the practices tend to be more labor intensive, further raising farmer costs. Switching to more conven-

tional farming methods may lower food prices, but poses potential harm to the local environment and may reduce the interest of some consumers who value environmentally sensitive growing techniques. If sustainable agriculture costs fall over time, as Horrigan, Lawrence, and Walker (2002) suggest, Fairbanks might see prices for locally grown foods fall as farms become better established. Including age of farm as a variable in future price analysis may elucidate this effect.

The location of food production can affect food costs in two ways: cost of transportation and availability of local resources. In Fairbanks, locally grown foods travelled no more than 95 miles (153 km) to the farmers' market, compared to more than 2,400 miles (3,862 km) for some imported vegetables, yet were more expensive. Transportation costs are, therefore, less of a driver of local food costs than factors like production methods (discussed above) and local agricultural capacity. Soils in the Fairbanks area are not ideal for agriculture (USDA Class 2 and 3 only). Poor soils place some limits on yield as well as crop choice. In addition, the short growing season means farmers have a limited window in which to recoup their costs through sales. Climate change in the region is expected to extend the growing season (Juday et al., 2005). However, other expected changes like increased drying will likely limit future agricultural potential (ibid). The Arctic Climate Impact Assessment found that the additional costs for irrigation, which will be necessary given a drier climate, may increase the costs of farming in the region and, therefore, keep the price of foods grown in arctic regions higher than those grown in more conventional agricultural regions (Juday et al., 2005).

Variables to consider in future research should include farming methods, length of production season on each farm, and yield per acre on each farm. In the case of this study, further separating locally grown foods by farming methods (organic, chemical-free, or conventional) may have resulted in samples too small to accurately compare, but this approach should be applied in future studies whenever possible.

High demand for locally grown foods, evidenced by waiting lists for CSA memberships and brisk sales at the farmers' market, also affects food prices. Clearly, some consumers are able and willing to pay higher prices because they value food produced locally. If farmers can charge higher prices, and recoup more of their costs, they have little incentive to lower prices simply to improve food access.

In the short term, government-funded programs like the Farmers' Market Nutrition Program indirectly subsidize small farmers by helping low-income households participate in LFSs. However, the program depends in the government's ability and willingness to subsidize the food system and has, so far in Alaska, provided a relatively small subsidy of US$25 per year — roughly equivalent to one month's worth of vegetables for a family of four.

The finding that commercially grown vegetables from south-central Alaska are less expensive than either locally grown or imported vegetables and are at least as physically accessible (seasonally) as imported foods is illustrative of a principal perhaps not discussed enough in alternative food systems research: the need to move beyond the false dichotomy of global and local (Hinrichs et al., 1998). It is not within the scope of this paper to determine whether these regionally, but not immediately local, foods could fill food system gaps in Fairbanks. But, this finding prompts us to look beyond philosophical arguments to search for those food system practices that most effectively meet the needs of the most people now and into the future. Future research should explore the potential for both regions — Fairbanks and south-central Alaska — to expand production to meet the food and nutritional security needs of state residents.

Accurate assessment of food system indices requires the use of the best data available. Several data weaknesses should be remedied in future work in this geographic and subject area. In the case of this study, the smallest census unit for which socioeconomic data was available was the census tract.

Census blocks would be a far more effective unit of study and should be used, whenever possible, in similar research elsewhere. Network distance, which measures distance along existing transportation pathways, is a preferred measure when assessing distance to a resource. Outdated GIS maps for the Fairbanks area made Euclidean distance preferable in this particular case. However, future studies, particularly those focused on methods of transportation to food outlets, would benefit from use of network distance measurements.

Conclusions

Assessment of local food system initiatives, such as this study, are only one step in the process of redesigning and redeveloping our food systems to ensure provision of food security, environmental security, and social welfare. Once access indices have been identified for a community, assessments should be repeated periodically to track changes in the food system.

This snapshot of the Fairbanks food system, and local components within the system, has revealed some important patterns. Physical access to healthful foods (represented by access to supermarkets) is fairly equitable across economic levels — with the caveat that, without personal transportation, some households may struggle more than others to access supermarkets. However, all residents, regardless of income, are likely to have somewhat less access to locally grown foods. New local food outlets, such as the recently expanded market in downtown Fairbanks, may improve access and exposure to local produce over time. And, because existing CSAs provide a good model of physical access, any increases in CSA capacity may also contribute to improved physical access over time.

Improving economic access to locally grown foods presents more of a challenge. At present, locally grown vegetables are significantly more expensive than the lowest-cost comparable alternatives in supermarkets. Further research should be focused on determining those factors, such as farming methods, size and age of farm, and consumer demand, that most affect the price of locally grown foods and whether opportunities exist to make changes in these variables and thus to improve economic access.

A key finding from this assessment is that regionally, but not immediately local, vegetables were the least expensive choice found in the store surveys and were widely available in supermarkets. It may help to close local food access gaps in Fairbanks if the definition of "local" is broadened to include regionally produced foods. Regionally grown vegetables meet several of the goals of LFS development, particularly reduction of food miles and support for local economies. However, these regionally grown vegetables are not necessarily grown using organic methods, as many locally grown food are. Although they provide a middle ground, reliance on this source of food leaves the community at risk of sustaining a two-tiered food system (Friedmann, 2010) in which some residents can participate in a local system that provides organic, fresh foods, while some residents are limited to a different set of foods: less local, nonlocal, non-organic, or a combination thereof.

The relative accessibility of regionally grown vegetables, as well as concerns about the potential for sustained inequity in the food system, illustrate why it is important to assess individual food systems. We must be able to identify those components of the food system that are most successful based on a number of metrics, including accessibility, environmental impacts, and cultural acceptability, and track changes in how those components function over time.

The process of improving our food systems will take experimentation, adaptation, and, likely, compromise. The focus in food system planning should be on developing a set of best practices that can be demonstrated to meet the food security needs of the most people now and into the future. Spatial analysis and other quantitative assessments, such as those used in this study, that reveal patterns in both conventional and alternative food system components can be used to help LFS practitioners and planners identify gaps and opportunities in their communities.

Practices and approaches that improve the key food system outcomes of food security, environmental security, and social welfare should drive food system design. More research is needed in this area in order to address significant data gaps in the overall effectiveness of alternative food system initiatives in meeting these key outcomes, particularly in the area of equitable food access. More rigorous assessments of all sectors of food systems should be undertaken to begin the process of collecting a set of best practices that can be shared among and adapted to all communities.

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Mitigating agricultural greenhouse gas emissions: A review of scientific information for food system planning

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Abstract

Agriculture contributes significantly to anthropogenic greenhouse gases (GHGs), with estimates of agriculture's contribution ranging from 10% to 25% of total global GHG emissions per year. The science regarding mitigating (reducing and removing) GHGs through agriculture is conflicting and inconclusive. However, the severity and urgency of climate change and its potential effects on food security demonstrate that we must include mitigation within food system planning frameworks. In British Columbia, Canada, the provincial government has established significant GHG reduction targets for its agencies, and has called on local governments to reduce their carbon footprints through a charter and incentive, as well as through growth management legislation. At the same time, local governments, are giving increased attention to development of local/regional agri-food systems. However, GHG mitigation efforts do not yet seem to factor into local agri-food system discussions. Although frameworks for reporting agriculture GHGs exist, local government measurement of agriculture mitigation is hampered by a lack of agriculture GHG inventories, limited data availability, and the inherent variability in agriculture emissions and removals due to the dynamic nature of farm ecosystems. With the goal of informing local governments and food system planners on the importance of agriculture GHG mitigation, this paper (1) reviews the science of GHGs, (2) describes sources of agriculture GHG emissions and illustrates potential mitigation practices, (3) discusses the variability of agriculture mitigation science, (4) highlights the importance of agriculture GHG inventories, and (5) emphasizes the necessity for local agriculture mitigation strategies.

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Keywords
agriculture, carbon sequestration, climate change, food systems, greenhouse gas (GHG), GHG inventory, GHG mitigation, local governments

Introduction

The Earth's climate is changing in direct response to anthropogenic GHGs, as manifested in increasing global average air and ocean temperatures, melting of snow and ice, and rising sea levels (Intergovernmental Panel on Climate Change (IPCC), 2007a). In 2004, 77% of total global anthropogenic emissions (49,000 $MtCO_2e$) were from carbon dioxide (CO_2), 14% from methane (CH_4), 8% from nitrous oxide (N_2O), and 1% from other GHGs (IPCC, 2007b). The global food system is estimated to contribute at minimum one-third of all global anthropogenic emissions, more than twice that of the transport sector (IPCC, 2007a; Scialabba & Muller-Lindenlauf, 2010). Agriculture alone contributes between 10% and 25% of annual GHGs, both directly and indirectly, through land-use changes, land management, and production practices (Scialabba & Muller-Lindenlauf, 2010; Smith…Sirotenko, 2007). Methane, nitrous oxide, and carbon dioxide are considered the three[1] most important GHGs emitted from agriculture (Smith…Sirotenko, 2007; Smith, Grant, Desjardins, Worth, Li, Boles, & Huffman, 2010). In the coming decades, agriculture GHG emissions are expected to rise as the global population increases and as changes in diets (especially consumption of more animal protein) continue (Smith…Sirotenko, 2007).

The United Nations Framework Convention on Climate Change (UNFCCC) promotes mitigation and adaptation as two main options to address climate change. Mitigation involves reducing GHGs emitted into the atmosphere and removing atmospheric GHGs through the use of sinks (carbon sequestration). Climate change adaptation for agriculture involves building resistance (the ability to resist the impact of a disturbance) and resilience (the ability to recover from disturbance) within agro-ecosystems, communities, and governance operations to prepare for climatic change and its impacts (Holt-Giménez, 2002; Pimm, 1984). Mitigation and adaptation differ in at least three ways including: (1) temporal and spatial scales at which the options are effective; (2) methods by which costs and benefits can be inventoried, estimated, and compared; and (3) stakeholders and governance drivers involved in their implementation (Klein, Schipper, & Dessai, 2005). Finding synergies between the two response options is considered ideal. However, due to their differences, each response requires separate attention and individual action in order to properly respond to climate change. Although the importance of adaptation is recognized, the focus of this paper is on mitigation within agriculture.

Regionally appropriate improved agriculture practices can reduce the amount of GHGs entering the atmosphere (Scialabba & Muller-Lindenlauf, 2010; Smith…Sirotenko, 2007), and carbon sequestration is considered a partial solution to short- and medium-term removal of atmospheric carbon (Hutchinson, Campbell, & Desjardins, 2007; Lal, 2009; Morgan et al., 2010). However, the science of mitigating GHGs through agriculture is sometimes variable, conflicting, and inconclusive. The scientific uncertainties around mitigating GHGs in agriculture may imply the need to postpone action while additional knowledge and greater clarity are sought, but given the urgency of climate change, agriculture mitigation planning must be vigorously pursued and strategies implemented. In fact, despite these uncertainties, a number of long-term policy decisions to mitigate GHGs are being implemented by various levels of government around the world.

Climate change mitigation strategies within agriculture must consider and address regional environmental, economic and social priorities. In British Columbia, Canada, mandated climate policies are challenging local governments to achieve signifi-

[1] Water vapor is an important GHG, but the effects of its emissions (especially from agriculture) are not well understood at this time, and therefore it is not included in this discussion. Refrigerants such as hydrofluorocarbons (HFCs) and perfluorcarbons (PFCs) are also associated with agriculture, but they are released in smaller quantities.

cant GHG reduction targets within their operations. Since 2008, local government attention has focused on where the greatest GHG reductions are perceived to exist, namely, transportation, waste, and buildings. At the same time, local and regional agri-food systems strategies are being pursued to achieve food security and public health goals. However, the merging of GHG emissions reductions and regional food system planning has been limited. With the goal of raising awareness of the necessity for agriculture GHG mitigation planning by local governments, the objective of this paper is to give an overview of the pertinent scientific information. Specifically, we (1) review the science around climate change and GHG emissions, (2) identify sources of agriculture emissions and illustrate potential mitigation practices, (3) discuss the uncertainties associated with agriculture mitigation, (4) describe agriculture GHG inventories, and (5) highlight the need for local governments to engage in measuring and monitoring agriculture emissions.

Science of Greenhouse Gases (GHGs)

Greenhouse gases are a group of trace substances in our atmosphere that absorb and emit infrared radiation emanating from the Earth's surface. If it were not for trace GHGs in our atmosphere, the surface temperature of Earth would be -18°C (Jenkinson, 2010). However, since the start of the Industrial Revolution in the 1750s, human activities have substantially increased atmospheric concentrations of GHGs. For example, the atmospheric concentration of carbon dioxide (CO_2) has increased from 280 parts per million (ppm) in the 1750s to 379 ppm in 2005. Within the same time frame, methane (CH_4) concentrations have increased from 715 parts per billion (ppb) to 1774 ppb, and nitrous oxide (N_20) has increased from about 270 ppb to 319 ppb (IPCC, 2007a).

A GHGs' ability to contribute to global warming, referred to as global warming potential (GWP), is determined by its atmospheric lifetime and capacity to trap heat over a given period of time. GWP compares the mass of a particular gas relative to the same mass of carbon dioxide. For example, evaluated over a 100-year time frame, one unit of N_2O has a GWP 296 times that of one unit of CO_2, and CH_4 has a GWP 23 times one unit of CO_2 (Forster et al., 2007). To describe the flow of GHGs into the atmosphere, researchers use carbon dioxide equivalents (CO_2e) as the unit of measure. The CO_2e value is obtained by multiplying the total quantity (mass) of a gaseous emission by its GWP. $MtCO_2e$ is the standard measurement of the amount of CO_2 emissions that are reduced or secluded from our environment, and stands for metric tonne (ton) carbon dioxide equivalent. A ton of carbon dioxide equals 2204.62 pounds of CO_2 ("Common Questions About $MtCO_2$," 2008).

Sources of Agriculture GHG Emissions

Methane: Methane emissions from agriculture are associated with the decomposition of organic materials (plant debris and animal wastes) in anaerobic (without oxygen) conditions, from ruminant livestock digestion (enteric fermentation in cattle, sheep, and goats), stored manures, and crops grown in flooded conditions (such as rice). CH_4 emissions from animal waste can be reduced through improved storage and handling of waste (e.g., covering manure pits) and through the use of anaerobic digesters (Smith…Sirotenko, 2007). Decomposing manures also release N_2O, which complicates manure management mitigation strategies because certain practices that decrease CH_4 may increase N_2O. Composting manures rather than leaving them as liquid slurry, for example, was found to decrease CH_4 emissions but to increase N_2O emissions (Paustian et al., 2004). CH_4 emissions from enteric fermentation can be mitigated by dietary manipulation[2] (such as replacing forages with concentrates [e.g., starch or fiber], improving pasture quality, optimizing protein intake, etc.), breeding for lower emitting animals, and using dietary additives (such as probiotics) that suppress bacteria that produce methane (Eagle, Henry, Olander, Haugen-Kozyra, Millar, & Roberton, 2010; Smith…Sirotenko, 2007; Smith et al., 2008).

[2] There is ongoing discussion about GHG mitigation by dietary manipulation of cattle due to differences in methodologies and regional practices. This discussion is beyond the scope of this paper.

Nitrous Oxide: Nitrous oxide is released when bacteria mineralize nitrogenous substances in soils and manure pits, and when synthetic nitrogenous fertilizers applied to fields volatize into the atmosphere. Soil microorganisms produce N_2O emissions through two microbial soil processes: nitrification (conversion of ammonium [NH_4^+] to nitrate nitrogen [NO_3^-]) and denitrification (conversion of nitrate nitrogen [NO_3] to dinitrogen [NO_2]). The most important conditions that affect N_2O emissions from fields treated with fertilizers containing ammonium and nitrate include (1) environmental factors such as ambient temperature, soil oxygen concentrations, soil texture, and soil pH, and (2) farm management and crop production practices such as fertilizer type used, application rate (the amount of ammonium [NH_4^+] and nitrate [NO_3^-] present for nitrification and denitrification, respectively), timing and method of application, and type of crop species treated (with major differences between grasses, legumes, and annual crops) (IFA/FAO, 2001). Recommended practices to reduce N_2O emissions from production agriculture activities include changing nitrogen fertilizer sources (e.g., changing from anhydrous ammonia or urea to slow-release fertilizers or biological sources), using nitrification inhibitors, minimizing N fertilizer rates, calibrating N fertilizer application to crop needs, and adjusting N fertilizer placement (Eagle et al., 2010; Scialabba & Muller-Lindenlauf, 2010; Smith…Sirotenko, 2007; Snyder, Bruulsema, Jensen, & Fixen, 2009).

Carbon Dioxide: Carbon dioxide from agriculture activities is generated directly from microbial decomposition of organic matter, biomass burning, and on-farm combustion of fossil fuels to run machinery. CO_2 is generated indirectly from the manufacturing and transport of various production inputs (e.g., pesticides and fertilizers) and from farm infrastructure (Lal, 2004). Recognized practices to reduce production agriculture CO_2 emissions include minimizing external inputs (e.g., pesticides and fertilizers), improving energy efficiency of farm machinery and minimizing their use, improving irrigation practices (through appropriate scheduling and application mechanisms), minimizing fuel-consuming operations, switching fuel sources (from gasoline and diesel to natural gas, ethanol, or biofuel), implementing on-farm renewable energy production (e.g., anaerobic digesters, solar, wind, geothermal or hydroelectric power), establishing biofuel plantations on degraded soils, and reducing loss of soil organic carbon by increasing soil organic matter content via incorporation (e.g., shifting to conservation tillage or no-till, retaining crop residues, avoiding burning residues) (Eagle et al., 2010; Kruger et al., 2010; Lal, 2004; Niggli, Fliebbach, Hepperly, & Scialabba, 2009; Smith…Sirotenko, 2007).

Carbon Sequestration: The sequestration, or holding, of carbon refers to the transfer of carbon dioxide (CO_2) from the atmosphere to plants, soils, and fauna in the terrestrial biosphere (Nelson, 2009). Carbon dioxide is the only GHG that can be removed from the atmosphere and sequestered on the farm. Currently, carbon sequestration is the most cost-effective short-term option for reducing CO_2 in the atmosphere. However, estimates indicate that carbon sequestration can only make modest contributions to mitigating anthropogenic CO_2 (Hutchinson et al., 2007; Lal, 2009; Morgan et al., 2010) and it is important to recognize that soil C sequestration is nonpermanent, difficult to verify, and not a substitute for, but rather a complement to, GHG emission reduction strategies (Lal & Follett, 2009). Recommended methods to increase on-farm carbon sequestration include restoring organic (histosol/peat) soils and wetlands, converting cropland to grassland, woodland, or natural ecosystems, implementing agroforestry (e.g., alley cropping, shelterbelts, silvopasture, riparian buffers, and windbreaks), using short-rotation woody crops, switching from annual to perennial crops, using organic amendments including biochar, improving management of rangelands (uncultivated) and pasture (cultivated), using winter cover crops, eliminating or minimizing summer fallow, using diversified crop rotations, and improving irrigation practices to support optimum plant growth (Eagle et al., 2010; Hutchinson et al., 2007; Morgan et al., 2010; Powlson, Whitmore, & Goulding, 2011).

Variability of Agriculture Emissions: The Uncertain Science

The science of agriculture GHG mitigation is inexact and the uncertainties associated with agricultural emissions range between 13% and 100% (Meridian Institute, 2011). On-farm agriculture emissions can come from mechanical sources and from nonmechanical sources (Russell, 2011). Generally, mechanical sources of GHGs — those associated with purchased energy to run machinery — are easier to estimate than nonmechanical sources. Nonmechanical GHG emissions result from a variety of biochemical processes that occur in soils, air, plants, and animals. The uncertainty of nonmechanical emission sources is due to the dynamic nature of agro-ecosystems, which are influenced by many factors. Specific factors that can influence nonmechanical GHG fluxes from agricultural lands include climate, topography, land use, land cover, soil characteristics, soil management, crop management, livestock management, and input management (Moreau, Adams, Mullinix, Fallick, & Condon, 2011). The science around agro-ecosystem GHG emissions is further complicated because agricultural land acts both as a source and a sink for GHGs. This balance between GHG emissions and removal on agriculture land varies over time and space, and current estimates are uncertain (Smith…Sirotenko, 2007).

Agriculture GHG Emission Inventories: One Manages What One Measures

The measurement, reporting, and verification (MRV) of GHG emissions through inventories is considered fundamental to emissions management and reductions because it quantifies emission rates and provides essential baseline data from which prioritized reduction strategies can be developed (Russell, 2011). Inventories also provide an integral part of the monitoring process by which reduction strategies can be evaluated (British Columiba Ministry of Community Sport and Cultural Development, 2010). The development, compilation, and reporting of GHG emissions are done in accordance with the UNFCCC using the IPCC quantification guidelines (Intergovernmental Panel on Climate Change, 2006). The IPCC guidelines cover categories of emissions by sources and removal by sinks. The GHG Protocol Initiative is another key global agency working to build effective standards for GHG emission accounting and reporting (Greenhouse Gas Protocol, 2011).

National Inventories: In Canada, the National Inventory Report (NIR) is used to account for national GHG emissions to international agencies. It includes agricultural emissions from enteric fermentation, manure management, and direct and indirect emissions from soil (Environment Canada, 2010). In 2008, inventories indicated that Canadian agriculture accounted for approximately 8.5% of total national GHG emissions. Of the 8.5% from agriculture, 51% comes from soils, 35.5% from enteric fermentation, and 12% from manure management (Environment Canada, 2010). Agriculture emissions not included in the Canadian NIR were from on-farm fuel consumption (these emissions are accounted for in the Energy sector inventories), embedded emissions in machinery and infrastructure, land-use changes, agri-chemical manufacture and transport, biological fixation by legume-rhizobium association, methane emissions from Canadian rice production, and field burning of crop residues.

Provincial Inventories: In B.C., provincial GHG inventories are conducted using national and international reporting methodologies (BC Ministry of Environment, 2010a). The first, *British Columbia Greenhouse Gas Inventory Report 2007,* provides the baseline against which subsequent reports will be compared. Similar to the national emission reports, agriculture emissions inventoried include enteric fermentation, manure management, and direct and indirect emissions from soil (BC Ministry of Environment, 2010b). Provincial inventories indicate that agriculture accounts for 3.8% of total emissions: 50% from enteric fermentation, 33% from soils, and 17% from manure management. The low apparent emissions from agriculture reflect accounting methodologies that do not incorporate agriculture's full contribution to anthropogenic GHG emissions.

Local Government Inventories: In contrast to provincial, national, and international emissions reporting guidelines, there are no defined protocols for local government monitoring and reporting of GHG emissions associated with agriculture. At the regional level where we live, Metro Vancouver participates in the preparation of the *Lower Fraser Valley Emission Inventory* that accounts for agriculture GHG estimates (Metro Vancouver, 2007). However, individual municipalities currently conduct assessments of GHG emissions from buildings, transportation, and solid waste only and do not account for agriculture within their Community Energy and Emissions Inventories (CEEIs). Although some municipalities collect data on enteric fermentation, these emissions are described only as "memo items" and are not included in total area emission calculations. As a result, no agriculture emission estimates are accounted for in the total reported emissions from municipalities in British Columbia (BC Ministry of Environment, 2010a). Reasons for agricultural CH_4 exclusion from the municipal inventories include (1) emission values used in national estimates for manure management do not reflect variable regional or local environmental conditions; (2) variation in farm practices greatly affects manure emissions; and (3) B.C. lacks systematic observation and measurement of various farm practices. For N_2O, the main reason for exclusion is a lack of information at the local level.

Discussion

Food system planning is confronted with the daunting challenge of mitigating and adapting to climate change while simultaneously ensuring food security, economic prosperity, community development, human health, and the advancement of sustainable agri-food systems. The uncertain science of agriculture GHG mitigation poses a unique challenge for food system mitigation and adaptation planning. This uncertainty, and the fact that there is no globally applicable list of mitigating practices, highlights the importance for local governments and food system planners to identify regional sources of emissions and factors affecting them and then to identify opportunities for improved efficiencies and prioritize early action items. Furthermore, long-term climate change policy decisions by governments are mandating significant GHG emissions reductions in all sectors of human enterprise. Food system planning that does not address GHG mitigation and adaptation will be vulnerable to anticipated climate changes and to the political, economic, and social repercussions of not doing so.

Ultimately, climate change mitigation within the agricultural sector must occur at the local level through the combined efforts of farmers, non-government organizations, communities, scientists, industry, planners, and local governments. Planning for agriculture mitigation requires developing strategies that strengthen agricultural GHG inventories and identifying and prioritizing regionally appropriate actions that reduce GHGs. As part of this, it is essential to conduct research related to agriculture, economics, and policy.

Generally, agriculture GHG emissions inventories tend to give a diminished impression of the sector's impact because many emission sources are either accounted for in other inventories (e.g., on-farm fuel consumption is accounted for in the energy inventory) or not at all (e.g., embedded emissions in machinery and infrastructure). Despite the challenges and uncertainties associated with obtaining agriculture emissions data, not accounting for them in municipal inventories means there is no baseline data from which prioritized and place-specific reduction strategies can be identified, let alone promoted. Furthermore, excluding agriculture from GHG inventories suggests to the local government and the agriculture communities within their jurisdiction that GHG mitigation in agriculture is not pertinent and pressing, when indeed it is.

A number of important agricultural research questions that need to be answered have been identified (Pretty et al., 2010) and some that are specific to mitigation include exploring (1) how can global food production be increased while simultaneously reducing emissions, (2) what do low input production or carbon-neutral systems look like and how can they be designed, and (3) how can

crop breeding, new technologies, improved agronomic practices, and integrated cropping systems improve mitigation efforts?

Economic drivers, barriers, and implications of climate change mitigation need to be explored further at local levels. Financial incentives, investment policies, and other market mechanisms (such as carbon trading, carbon taxes, offset markets, payment for environmental services, and preferential support for local agri-food systems) are examples of tools and strategies that may assist farmers in adopting regionally appropriate mitigation practices that may be otherwise cost-prohibitive. However, research is vitally needed to determine the potential impacts of such strategies and to understand under what circumstances such strategies achieve the greatest economic, societal, and environmental good. Early investment in mitigation and adaptation actions is essential to building long-term resilience of the sector (Meridian Institute, 2011).

Policy plays an essential role in enabling climate change mitigation within the agricultural sector. However, understanding and navigating policy and regulatory constructs are supremely complicated due to the interacting influences and directives of policies (some climate-focused and others not) that directly affect agriculture (see Moreau, Moore, & Mullinex, 2012, in this issue). Analyzing policy at the local level is critical to agricultural climate change planning in order to identify key influencing policies that will directly or indirectly affect mitigation strategies (Smith…Towprayoon, 2007). Furthermore, policy synergies, conflicts, and contradictions need to be understood.

Conclusions

The agricultural sector is vital to sustainable human existence, and therefore we cannot ignore the real and substantial role that agriculture plays in GHG emissions nor the potentially catastrophic effects on food security and sustainability if planning for the sector does not consider climate changes. In summarizing the scientific information relating to agriculture GHG mitigation, we hope to have presented and framed the pertinent information necessary for local food system planners to begin to make planning decisions that are informed and appropriate relative to climate change and agri-food systems. We also hope that this review and subsequent discussions will prompt local agri-food system planners to advocate for the information and resources they need to accomplish the critically important task of promoting the mitigation of production agriculture's GHG emissions at the local level. Finally, because the science around production agriculture and climate change denies conclusive direction, we cannot delay: time is of the essence. Community and regional planners must begin to address sustainable agri-food systems and greenhouse gas mitigation.

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Planning for climate action in British Columbia, Canada: Putting agricultural greenhouse gas mitigation on local government agendas

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Abstract

Significant greenhouse gas (GHG) reductions from all sectors of human enterprise are necessary to avoid further effects and reduce the current effects of climate change. Agriculture and the global food system are estimated to contribute to one-third of all anthropogenic GHGs. In British Columbia, Canada, mandated GHG reduction targets and voluntary climate action programs are challenging local governments to include emission reduction targets, policies, and actions within official planning documents. At this early stage of GHG reductions, local government attention does not yet include agriculture but is directed toward the transportation, buildings, and waste management sectors. Given agriculture's contribution to GHG emissions and local government's engagement with GHG mitigation and food system planning, it seems reasonable to anticipate that over time, local governments should and will engage increasingly in reducing GHGs from agriculture. With the goal of advancing agriculture GHG mitigation by local governments, this paper reviews the jurisdictional powers governing agriculture and climate change within British Columbia. It examines how local governments can support mitigation within the sector through their roles in planning, policy, programming, and public engagement, and identifies potential research agenda items.

Keywords

agriculture, climate change, greenhouse gas emissions (GHGs), GHG inventory, GHG mitigation, local government, planning, policy

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Introduction

Climate change poses a significant challenge to humanity and will require definitive action by

society for profound, transformative change. Significant reductions of greenhouse (GHG) emissions in every sector, including agriculture and the agri-food system as a whole, are necessary and will require strategic coordination and planning. Mitigation and adaptation are the two main climate change response options outlined by the United Nations Framework Convention on Climate Change (UNFCCC). Mitigation of climate change involves reducing GHG emissions entering the atmosphere and removing atmospheric GHGs through sinks (such as carbon sequestration). Adaptation refers to building resistance (the ability to withstand the impact of a disturbance) and resilience (the ability to recover from disturbance) within agro-ecosystems, communities, and governance frameworks, to prepare for climatic change and its impacts. Although adaptation within the agriculture sector is vital, the focus of this paper is on GHG mitigation.

Greenhouse gas emissions from the global food system are estimated to contribute to one-third of all anthropogenic (human generated) emissions (Intergovernmental Panel on Climate Change (IPCC), 2007; Scialabba & Muller-Lindenlauf, 2010). While GHG emissions reductions are necessary in all stages of the food system (agriculture, processing, packaging, transportation, retailing, catering and consumption, home preparation, and waste management), particular attention to agriculture is necessary in order to ensure food security, economic vitality, and sustainable communities congruently. Agriculture (the cultivation and production of food, fuel, and fiber) contributes between 10% and 25% of annual GHG emissions, mainly through methane, nitrous oxide, and carbon dioxide emissions from land-use changes, agricultural land management, and farming practices (Scialabba & Muller-Lindenlauf, 2010; Smith et al., 2008).

In British Columbia (B.C.), Canada, provincial climate policies mandate that local governments achieve significant GHG reduction targets within their operations. The targets seek to reduce GHG emissions to 33% below 2007 levels by 2020 and to 80% below 2007 levels by 2050. As part of these regulations, local governments are required to include GHG reduction targets, policies, and actions in their two main planning frameworks: Regional Growth Strategies (RGSs) (in effect since 31 May 2011) and Official Community Plans (OCPs) (in effect since 31 May 2010). At this early stage of being required to consider GHG reductions in the regional and community plans, local government's attention to emissions reductions is not yet directed towards agriculture, but is focused on sectors where the greatest reductions are thought to exist, namely buildings, transportation, and waste, which are under their operational authorities.

Historically, local governments in B.C. have been instrumental in implementing sustainable practices within local contexts (Nowlan, Rolfe, & Grant, 2001). With this track record, it is reasonable to anticipate that over time, local initiatives will be designed to meet climate change mitigation and adaptation challenges within the local agricultural sector. For example, there is a growing engagement by local governments in regional food system planning, which has been supported by a partnership involving federal, provincial, and local governments (City of Vancouver, 2011; Metro Vancouver, 2011). This partnership is being extended to cover climate change themes (British Columbia Healthy Communities, 2011). With these types of initiatives, along with new planning legislation, and as more information is available on ways to reduce agriculture GHG emissions, local governments will be in the position to play a role in reducing agriculture and food production emissions.

Although the points noted above hold promise for local government involvement in GHG mitigation of agriculture, they also highlight the diversity of interests and their associated complexity. It is important to step back and begin to outline a step-by-step strategy for defining and achieving effective results. One of the first steps in mitigation planning commonly recommended is to identify and understand all existing policies and programs that influence a sector's ability to implement change and take action to reduce emissions (British Columbia Ministry of Community, Sport and

Cultural Development, 2010). For agriculture, this is a complicated task that requires assessing the multilevel jurisdictional authority of national, provincial, and local levels of government, as well as the laws, policies, and programs administered by each.

Although local governments in B.C. are increasingly engaged in both GHG emissions reduction planning and food system planning, the two planning strategies remain disconnected, and as a result, local-level GHG mitigation within the agriculture sector is not being properly addressed. With the goal of raising awareness of the necessity for agriculture mitigation planning by local governments and to increase knowledge of those engaged in local/regional food system planning, we provide an overview of the jurisdictional powers governing agriculture and climate change within British Columbia and provide detailed attention to the role that local governments can have in creating local initiatives designed to mitigate GHGs within the province's agricultural sector.

Jurisdictional Powers Governing Agriculture and Climate Change

Addressing mitigation within the agriculture sector and creating effective strategies for climate action requires some knowledge about the jurisdictional powers of different levels of government (national, provincial, and local). Canada is a federation of provinces where the orders of government have distinct, but in some cases overlapping, jurisdictions (Curran, 2009). Both federal Parliament and provincial legislatures have the constitutional authority to make laws (Nowlan et al., 2001), but local governments (both regional and municipal) do not have standalone legal authority. Their powers are delegated to them through provincial regulations, such as the Local Government Act. Even if they have power to make many decisions that affect agriculture, this may be limited by their legislation or other federal and provincial enactments. Furthermore, local governments have discretionary authority with respect to the use of their powers. They can also choose whether to participate in federal and provincial initiatives. Having an understanding of the interplay among these considerations is imperative to designing an effective, locally based GHG emissions strategy and implementation programs for the agriculture and agri-food sector.

Federal and Provincial Agriculture Policy

Canada's constitutional arrangement puts jurisdiction and legislative authority over agriculture in the hands of the federal and provincial governments, both of which voice authority in realms of international trade, marketing, interprovincial coordination, and subsidy regulation, among others (Found, 1996). The five main federal governing agencies involved with agriculture in Canada include: Agriculture and Agri-Food Canada (AAFC), the Canadian Food Inspection Agency (CFIA), the Department of Fisheries and Oceans (DFO), Environment Canada, and Health Canada (Department of Justice, 2011). Agencies are responsible for particular services and for administering and enforcing particular acts and regulations (see table 1) (Fuller & Buckingham, 1999). At the federal level, we identified a total of 33 enactments that potentially affect agriculture and food production.

Within B.C., we identified 10 key provincial acts affecting agriculture (see table 1) (B.C. Ministry of Agriculture, 2011; Curran, 2009). The Agricultural Land Reserve Act (ALC Act), initially enacted in 1973 with major revisions in 2002, applies to private and provincial land within the Agricultural Land Reserve (ALR) and is the primary authority used to protect B.C. farmland from urban sprawl, as well as purportedly to promote agriculture's viability. This act is critical to land use policies and takes precedence over most other legislation. It effectively links provincial interests to local government land use planning and bylaw functions. Furthermore, it restricts the placement of fill on, or removal of soil from, land in the ALR. The Assessment Act establishes provincial authority and responsibility for property value assessment. Local governments set tax rates that apply to these assessed values. The Environmental Management Act governs multiple practices relating to farm operations, including management of agricultural waste (e.g., pesticide and fertilizer waste, compost,

Table 1. Federal, Provincial, and Local Government Policies, Policy Tools and Programs Influencing Agriculture and Climate Change in British Columbia, Canada

Governance Level	Agriculture Acts and Regulations (Governing Agency)	Agriculture Policy Tools	Climate Change Acts and Regulations	Climate Change Policy Tools	Programs Addressing Both Agriculture and Climate Change
Federal: Canada	• Agriculture and Agri-Food Administrative Monetary Penalties Act (CFIA) • Animal Pedigree Act (AAFC) • Canada Agricultural Products Act (CFIA) • Canada Grain Act (AAFC) • Canada Water Act (Environment Canada) • Canadian Agricultural Loans Act (AAFC) • Canadian Dairy Commission Act (AAFC) • Canadian Environmental Protection Act, 1999 (Environment Canada) • Canadian Food Inspection Agency Act (CFIA) • Canadian Wheat Board Act (AAFC) • Constitution Act, 1867 • Department of Agriculture and Agri-Food Act (AAFC) • Department of Environment Act (Environment Canada) • Environment Enforcement Act (Environment Canada) • Experimental Farm Stations Act (AAFC) • Farm Credit Canada Act (AAFC) • Farm Income Protection Act (AAFC) • Feeds Act (CFIA) • Fertilizers Act (CFIA) • Fish Inspection Act (CFIA) • Food and Drugs Act (CFIA) • Hazardous Products Act (Health Canada) • Health of Animals Act (CFIA) • International River Improvements Act (Environment Canada) • Meat Inspection Act (CFIA) • Migratory Birds Act (CFIA) • Pest Control Products Act (Health Canada) • Pesticide Residue Compensation Act (Health	• Growing Forward Framework The Way Forward: Summary of Agriculture and Agri-Food Canada's Science and Innovation Strategic Action Plan 2010 (Agriculture and Agri-food Canada (AAFC), 2010)	• Budget Implementation Act, 2007 (Clean Air and Climate Change Trust Fund) • Canadian Emission Reductions Incentives Agency Act • Canadian Foundation for Sustainable Development Technologies Act • Kyoto Protocol Implementation Act	• National Resources Canada: The Climate Change Impacts and Adaptation Division (ecoAction, 2007)	• The eco-Agriculture Biofuels Capital Initiative (ecoAction, 2007)

Governance Level	Agriculture Acts and Regulations (Governing Agency)	Agriculture Policy Tools	Climate Change Acts and Regulations	Climate Change Policy Tools	Programs Addressing Both Agriculture and Climate Change
	Canada) • Plant Breeders' Rights Act (CFIA) • Plant Protection Act (CFIA) • Prairie Farm Rehabilitation Act (AAFC) • Seeds Act (CFIA) • Species at Risk Act (Environment Canada)				
Provincial: British Columbia	• Agriculture Land Commission Act • Assessment Act • Environmental Management Act • Farm Practices Protection (Right to Farm) Act • Fish Protection Act • Integrated Pest Management Act • Land Titles Act • Local Governments Act • Natural Products Marketing Act • Water Act	• The British Columbia Agriculture Plan: Growing a Healthy Future for B.C. Families (B.C. Ministry of Agriculture, 2008a) • The Environmental Farm Plan (B.C. Ministry of Agriculture, 2011a) • ALR and Community Planning Guidelines (Agricultural Land Commission (ALC), 2011)	• Carbon Tax Act • Environmental Management Act • Greenhouse Gas Reduction Targets Act (GGRTA) • Local Government Statutes Amendment Act • Zero Net Deforestation Act	• The B.C. Provincial Climate Action Plan (B.C. Ministry of Environment, 2009) • Preparing for Climate Change: Securing B.C.'s Water Future (Natural Resources Canada, 2011)	• B.C.'s Agricultural Sector and the Greenhouse Gas Reduction Targets Act (B.C. Ministry of Agriculture, 2009) • B.C. Climate Action Plan (Climate Action Initiative, 2010) • A Crop for the 21st Century: Carbon Credits and Agriculture in British Columbia (B.C. Ministry of Agriculture, 2008b)
Local Government	• Regional Growth Strategies (RGS) • Official Community Plans (OCP) • Agricultural Area Plans (AAP) • Bylaws (zoning and farm) • Development Permit Areas	• Agricultural Plans for Local Governments in British Columbia (B.C. Ministry of Agriculture, 2011c) • Metro Vancouver Regional Food System Strategy (Metro Vancouver, 2011) • Planning for Agriculture (Smith, 1998) • Vancouver Food Charter (City of Vancouver, 2011)		• Climate Action Charter • Community-Wide Climate Action Planning Framework (British Columbia Ministry of Community, Sport and Cultural Development, 2010) • Partners for Climate Protection	

Note: CFIA = Canadian Food Inspection Agency; AAFC = Agriculture and Agri-Food Canada

biosolids, etc.), open burning, and application of compost and biosolids to agricultural land. The Farm Practices Protection (Right to Farm) Act applies to farmers operating in the ALR or in areas zoned for or licensed to farming. As long as farmers comply with other legislative acts (the Environmental Management Act, Integrated Pest Management Act, and Public Health Act), the act protects farmers following "normal farm practices" from nuisance claims or complaints about potential disturbances resulting from farm operations. The policies and guidelines of the act help link farm practices with local land use policies, with the goal of balancing farmer rights with those of nearby residents. The Fish Protection Act requires permits for farming or development near streams or open fish-bearing waterways. The Integrated Pest Management Act describes general requirements for pesticide use and sales. The Land Titles Act authorizes local governments to approve or refuse applications for building subdivisions on farmland. The Local Government Act (LGA) delegates provincial power to local governments. Within this act, and through the Farm Practices Protection (Right to Farm) Act and the Agricultural Land Commission Act, provincial responsibility for agriculture is linked to local government bylaws. Under the LGA, local government responsibility for and oversight of agriculture applies to land use, planning, zoning, and building and/or development control. However, care needs to be taken when interpreting these powers as their use is fettered by other provincial legislation, for example the ALC Act. The Natural Products Marketing Act governs the promotion, control, and regulation of natural products within B.C. The Water Act gives the province control over all surface and groundwater.

Federal and Provincial Climate Change Policy

Canada ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, which requires national governments to gather and share information on GHG emissions, best practices, and national policies. The UNFCCC commits governments to launching national strategies for addressing GHG emissions and climate change adaptation, and requires nations to cooperate in preparing for climate change impacts (UNFCCC, 2011). The Kyoto Protocol, which was adopted by Canada in 1997 and entered into force in 2005, is an international agreement linked to the UNFCCC that sets binding targets for industrialized countries to reduce GHG emissions by 5%, against 1990 levels, over the years 2008–2012. The main distinction between the convention and the protocol is that the former *encouraged* industrialized countries to stabilize GHG emissions, while the latter *commits* them to doing so. In 2011, Canada was the first country to formally withdraw from the Kyoto Accord. The Canadian government said the Kyoto protocol would not work because it did not include the United States and China, the world's two largest emitters. Furthermore, the government said it needed to avoid the $14 billion in penalties for not meeting its goals. The Canadian national GHG emissions estimates reported in the 2008 National Inventory Report (NIR) of 734 $MtCO_2e$[1] were 33.9% above Canada's Kyoto Protocol target (563 $MtCO_2e$/year for 2008–2012). In 2009, Canada signed the Copenhagen Accord through which Canada is committed to reducing GHG emissions, based on 2005 emissions, by 17% by 2020 (ecoAction, 2011). This means that by 2020, Canada's total annual emissions must be below 620 $MtCO_2e$. Unlike the Kyoto Accord, the Copenhagen Accord includes both the United States and China and is not legally binding.

In B.C., the 2007 Greenhouse Gas Reduction Targets Act (GGRTA) and the 2008 Local Government Statutes Amendment Act mandate the province, including its local governments, to reduce GHG emissions to 33% below 2007 levels by 2020 and to 80% below 2007 levels by 2050. The GGRTA made B.C. the first jurisdiction in North America to make a legally binding commitment to achieving carbon-neutral operations. Using 2007 as the baseline year of emissions (68.0

[1] $MtCO_2e$ is the standard measurement of the amount of CO_2 emissions that are reduced or secluded from our environment, and stands for metric tonne (ton) carbon dioxide equivalent. A ton of carbon dioxide equals 2204.62 pounds of CO_2 ("Common Questions About $MtCO_2$," 2008).

$MtCO_2e$), B.C. is mandated to reduce its emission to 45.5 $MtCO_2e$ by 2020 and to 13.6 $MtCO_2e$ by 2050. The GGRTA also commits the provincial government and public-sector organizations (e.g., Crown corporations, health authorities, universities, colleges and school districts) to carbon neutrality, which requires measuring GHG emissions, reducing them where possible, offsetting the remainder, and reporting them (B.C. Ministry of Environment, Climate Action Secretariat, 2009).

The Role of Local Governments in Mitigating GHGs Within Agriculture

Thought of as the level of government "closet to the people," local governments have historically played a key role in addressing sustainability issues within B.C. because of their role in land use planning, service delivery, policy, and regulation (Nowlan et al., 2001). Local government refers to the council of a municipality or the board of a regional district. The province of British Columbia has 151 municipalities within 27 larger regional districts (Nowlan et al., 2001). Local government attention to agriculture can yield multiple co-benefits that support development of sustainable communities. As Daniel Hernandez, quoted by Benfield, succinctly put it,

> Our challenge as planners, developers and policy-makers of the built environment in an era of climate change is to figure out how to strengthen agriculture systems and biodiversity of our farmlands, and connect them to livable cities and their consumers. Our intention should be to support policies that preserve these valuable resources and strengthen their economic viability. (Benfield, 2011)

For local governments in B.C., provincial climate change statutes mandate that local governments include GHG emission reduction targets, policies, and actions in their official planning documents (B.C. Ministry of Environment, 2009). The bulk of local government GHG emissions attention, at present, is directed toward the transportation, buildings, and waste-management sectors where local government is perceived to exercise the most influence and where the greatest potential for significant GHG reductions is thought to reside. Although there are global frameworks that inventory agriculture GHG emissions and agriculture emissions are accounted for in national, provincial, and regional inventories, local-level agriculture emissions are not currently included with local government emissions reporting. Nor does local government engage in agriculture or food system GHG mitigation planning. Reasons why local governments may not engage in agriculture GHG mitigation planning include (1) a perception by local government that they have limited influence over production; (2) agriculture is not currently included in municipal emission inventories (out of sight, out of mind); and (3) the complexity and uncertainty associated with understanding agriculture GHG mitigation make planning in this domain difficult.

Local governments in B.C. are seeking ways to help agriculture within their areas, including planning for local and/or regional agri-food systems (Connell & Sturgeon, 2011; Smith, 1998). We suggest that mitigating GHGs within agriculture is an important area for local government attention. Thus in the remainder of this paper we review local governments' roles within the context of agriculture GHG mitigation in the areas of (1) planning, (2) policy, (3) program participation, facilitation, and support, and (4) public promotion.

Planning

Agriculture planning has a long history within British Columbia. In the 1970s and 1980s, planning activities were focused on preserving agricultural land, culminating in the Agricultural Land Commission (ALC) Act and the Agricultural Land Reserve (ALR). In the 1990s, the province's planning focus shifted to improving farming practices. This shift resulted in amendments to the ALC Act and the Local Government Act and in the enactment of the Farm Practices Protection (Right to Farm) Act. In B.C., the three types of planning tools that have the greatest influence on land use and community design for agriculture are Regional Growth Strategies (RGSs), Official Community Plans (OCPs), and Agricultural Area

Plans (AAPs). RGSs, which should directly reflect provincial planning goals, are developed by regional districts and must be agreed upon by constituent municipalities. The Local Government Act establishes authority for the RGS and states that the purpose of an RGS is to "promote human settlement that is socially, economically and environmentally healthy and makes efficient use of public facilities and services, land and other resources" (British Columbia Laws, 2011). RGSs typically cover a range of issues and set a 20-year vision for regional growth and development. OCPs, which can be developed by both regional districts for unincorporated areas and municipalities for all or part of their jurisdiction, must be consistent with RGSs. OCPs are based on a 5-year planning horizon and state the objectives and policies that guide decisions on planning and land use management within the area covered by the plan. On 31 May 2010, legislation was enacted to require OCPs to address GHG reduction. AAPs are developed by local governments in partnership with agricultural advisory committees and other stakeholders in the community and recommend strategies to encourage and enhance agriculture (B.C. Ministry of Agriculture, 2011b). The provincially supported Local Government Agricultural Planning (LGAP) program provides financing to local governments to support AAP development within municipal and regional districts. AAPs provide direct linkages with OCPs, give baseline assessments of the agriculture land base, highlight opportunities and challenges facing local agriculture, support the creation of land use policies and designations, detail planning implementation strategies, and recommend zoning and farming bylaws. In order to become official and obtain the same legal status as an OCP, AAPs must be formally adopted by local governments.

Local governments are increasingly recognizing the importance of regional agri-food systems. In March 2011, Metro Vancouver completed a Regional Food System Strategy and at least six of its member municipalities had completed agricultural area plans and strategies (Metro Vancouver, 2011; B.C. Ministry of Agriculture, 2011c). The city of Surrey's Sustainability Charter is a comprehensive framework for implementing a 50-year vision for a sustainable city (City of Surrey, 2011). The city of Vancouver's Food Charter conveys a vision and key principals for a sustainable food system (City of Vancouver, 2011). However, while local government planning efforts are increasingly recognizing the importance of advancing sustainable food systems, few plans deal directly with climate change, production agriculture, and GHG mitigation in an integrated way. Nevertheless, it seems reasonable to anticipate that over time local governments will increasingly engage in reducing agriculture and food system GHG emissions.

Agricultural planning at the local level is expected to confer numerous benefits, which include reducing urban/rural conflict through stakeholder engagement; improving local farming economic activity; supporting consistency within federal and provincial policies; stimulating new thinking and changing attitudes of stakeholders involved with the planning process; enabling agricultural planning integration into larger community plans; providing support language and knowledge to assist local government in making land use decisions; and creating a methodology for dealing with issues that arise (Connell & Sturgeon, 2011; Nowlan et al., 2001). All the benefits of agricultural planning highlight the support and demonstrate the need for GHG mitigation planning within the sector at the local and/or regional level.

In B.C., provincial policies mandating municipalities to include GHG reduction targets and actions within their planning frameworks provide impetus for planners to bring forward innovative and effective strategies. The B.C. Climate Action Plan describes GHG reduction strategies for agriculture, while other documents discuss agriculture and carbon offset trading (see table 1) (B.C. Ministry of Agriculture, 2008b). However, there is little information related to how practices to mitigate agricultural GHG emissions can be implemented and incorporated into RGSs, OCPs, or other programs (B.C. Ministry of Environment, 2009). The B.C. Agriculture Climate Change Action Plan developed by agriculture industry uses a number of guiding principles to outline both strategic direction and

concrete action for mitigation and adaptation by the sector (Climate Action Initiative, 2010).

Policy

From the legal perspective, mitigating GHG emissions from agriculture is a challenge due to the number of interconnected policies and regulations that directly address or indirectly influence agriculture and climate change actions. Furthermore, a number of nonclimate and nonagriculture policies (e.g., international free trade agreements, trade barriers, energy policies, and environmental policies) also affect emission reductions activity (Smith et al., 2007). Although jurisdiction and legislative authority over Canadian agriculture ultimately resides with federal and provincial governments, local government policies (mainly via bylaws and development permits) can significantly affect agricultural production or climate action at the local level (British Columbia Local Government Department, 2011; Curran, 2009).

Local government bylaws and permits translate the policies and recommended practices within RGSs and OCPs into requirements that can affect agriculture in multiple ways, including parcel size determination, regulation of nonfarm land use, urban agriculture interface planning, rainwater management, direct farm business marketing, agritourism regulations, composting management, agricultural product processing, and accommodation regulations. Subject to approval by the Minister of Agriculture, farming bylaws related to farm operations, buildings, buffers, waste, and environmental practices are also developed and governed by local governments (British Columbia Ministry of Agriculture, 1998).

Program Participation and Support

Local governments in B.C. participate in two key climate change programs: Partners for Climate Protection (PCP) and the Climate Action Charter. The PCP program calls for participating municipalities to: (1) complete a GHG inventory, (2) set emission reduction targets, (3) develop a plan to reduce those emissions, (4) implement the plan, and (5) monitor and report on the results (Federation of Canadian Municipalities & ICLEI, 2010). The program is delivered across Canada with 216 municipalities participating, 66 of which are located in B.C. (Federation of Canadian Municipalities, 2011). Current inventory protocols do not account for agriculture emissions. Only emissions from transportation, buildings, and waste-management sectors are measured. The initial rationale for agriculture's omission is that local governments exercise only limited influence in this realm (National Climate Change Secretariat, 1998). However, given the important role that local governments can play in helping citizens and consumers of agricultural products make climate-smart purchasing decisions, and given the role that local governments can play to enable local agriculture, it may be timely to review these original assumptions.

As signatories of the Climate Action Charter, over 178 local governments in B.C. have voluntarily committed to becoming carbon-neutral by 2012 (B.C. Ministry of Community and Rural Development, 2010). The Climate Action Charter requires that local governments measure their organizational emissions, reduce GHG emissions and energy use, and offset remaining operational emissions to achieve a net zero. This program complements the PCP program and follows a similar emission inventory protocol targeting the transportation, buildings, and waste-management sectors.

In addition to participating in programs that address agriculture and climate change, local governments can enable GHG mitigation within agriculture by supporting local programs that assist producers in adopting regionally appropriate mitigation practices. For example, they can provide support for necessary infrastructure or subsidies to increase farmer adoption of otherwise costly practices. Furthermore, local government advocating for including agriculture GHG emissions in Community Energy and Emissions Inventories could provide baseline data that is essential to informing local prioritized reduction strategies.

Public Promotion and Stakeholder Coordination

Local government engagement with the public, farmers, communities, industry, and the provincial

and federal government enables it to foster dialogues, partnerships, and capacity-building opportunities necessary for climate change mitigation action within agriculture. For example, hosting public gatherings or events that support low GHG agriculture or building links between urban food activists and commercial producers are other actions that local governments can take toward climate action.

Discussion and Conclusion

Climate change represents a significant challenge, as it will undoubtedly require profound, transformational change in how we live on Earth and conduct the human enterprise, including food production. Ultimately, local initiatives designed to meet regional mitigation challenges are necessary for the agriculture sector in B.C. as elsewhere. Local governments involvement with sustainability, GHG emissions reductions, and local/regional agri-food systems development in conjunction with their roles in planning, policy, program development, and stakeholder engagement suggest they have an important, even critical, role to play in mitigating GHGs in agriculture. However, they cannot undertake this task alone, because mitigation actions are closely linked to provincial, federal, and international policies and programs. In addition to navigating the complex policy framework that affects agriculture, local governments must accept the challenge of identifying how to mitigate GHGs in agriculture despite the uncertainties associated with the scientific information (see Moreau et al. 2011 in this issue). To advance GHG mitigation planning in British Columbia we suggest the following research agenda items for local governments.

Coordinating and Planning for Systemic Action: Taking aggressive action toward tackling climate change requires concerted, focused strategic planning involving a multitude of stakeholders. Local government training and experience in community and economic development, design, natural resource stewardship planning, public consultation, and visioning means they are well suited to address strategic planning for climate action within agriculture and food systems. However, it is not likely that many staff have sufficient training in or knowledge of agricultural sciences or agro-ecology. Having staff receive training in both planning and agriculture would greatly enhance the systemic planning that is necessary. Alternatively, active and positive engagement with the agricultural community and regional experts, similar to the approach used to engage any community of interest in local planning processes, provides a start.

Education: Local government-supported partnerships between stakeholders can work to increase awareness and promotion of low GHG agricultural practices by educating and supporting farmers to improve efficiencies and by providing low GHG agriculture information to stakeholders. For example, educational campaigns aimed at encouraging land managers to minimize fertilizers based on the principles of "the right source, the right placement, at the right rate, and at the right time" may improve nitrogen efficiency and reduce costs while also reducing N_2O emissions and runoff. Furthermore, local government can raise consumer awareness about sustainable diets and encourage consumption behaviors that support low GHG foods (e.g., provide information on the benefits of a diet low in animal protein). University extension personnel, in collaboration with local government, should be called upon to establish low GHG farming demonstrations, disseminate applied research findings, and otherwise provide technical assistance to farmers and planners to implement low GHG farming practices.

Incentives and Investment: Promoting and enabling the transformation to low GHG agriculture production requires incentive and support for farmers and land managers (e.g., financing, public investments, crop insurance, payment for environmental services, carbon offset markets, etc.). Early investment in mitigation and adaptation actions is essential to building long-term resilience of the sector (Meridian Institute, 2011).

Local Government GHG Inventories Need To Account for Agriculture Emissions: Getting production agriculture included in local government inventories is a

necessary first step toward GHG mitigation. Without baseline data from which prioritized actions can be made, local governments cannot properly engage the agriculture sector to take action or garner the public support that is important to do so.

Identification of Key Policies: A number of policies and regulations affecting agriculture and climate change were identified in table 1. This does not include other policies that may influence agriculture production. A critical step toward implementing low GHG agriculture policies is to thoroughly evaluate all key policies and to identify levers, tools, synergies, impediments, conflicts, and contradictions between them. Additional review of the policy interface between agriculture, climate change, food security, trade, economics, and the environment is highly recommended. The goal would be to identify policies having the greatest influence over agriculture and to explore how agriculture GHG mitigation can support other policy goals (e.g., improving water and air quality, enhancing biodiversity, diversifying operations, enhancing local economics, and creating jobs).

Stakeholder Participation in Improving Regulation: A quagmire of policies and regulations exist that make it challenging to navigate climate action for agriculture. We recommend an open dialogue between those who create the regulations and those most directly affected by them in order to explore the question "how can regulations create opportunities to make the transition to low GHG agriculture possible?" In this way, the breadth of those concerned and affected can identify requisite policy adjustment and innovations.

Local Governments Need Provincial Support for Innovative Practices: Since local governments are required to establish GHG reduction targets in their planning documents, and must use their regulatory and approval authorities to achieve those targets, they can play a far-reaching role in climate action. However, they will lack resources and may need additional tools to properly influence GHG mitigation and adaptation within production agriculture. Therefore, it is essential that the province support innovative and transformational efforts made by their local governments. Programs like the Environmental Farm Plan enable producers to apply for economic incentives to implement beneficial management practices, many of which support climate change mitigation and adaptation (B.C. Ministry of Agriculture, 2011a). Similar programs implemented and promoted by local governments may assist production agriculture with implementing GHG mitigation actions.

Conclusions

Ultimately, anthropogenically induced climate change is a manifestation of how we, as individuals, live our lives and how our communities are organized and function. Planning for and implementing GHG mitigation in agriculture requires knowledge and consideration of a seemingly overwhelming number and complexity of features that directly and indirectly influence production agriculture. But, just because the situation is complex and hence very challenging, we cannot ignore the very real and substantial role agriculture plays in atmospheric GHG levels, and therefore its importance in GHG mitigation strategies.

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