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Administrative Publication Number 068

January 2015

Trends in U.S. Local and Regional Food Systems

Report to Congress

United States Department of Agriculture

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Trends in U.S. Local and Regional Food Systems

A Report to Congress

Sarah A. Low, Aaron Adalja, Elizabeth Beaulieu, Nigel Key, Steve Martinez, Alex Melton, Agnes Perez, Katherine Ralston, Hayden Stewart, Shellye Suttles, and Stephen Vogel, of USDA Economic Research Service, and Becca B.R. Jablonski, of Colorado State University

Errata

On February 23, 2015, the following figures were corrected to include Alaska and Hawaii: Figure 2, "Total direct-to-consumer sales, by county, 2012"; Figure 3, "Change in direct-to-consumer sales, 2007-12 using constant 2012 dollars"; and Figure 4, "Farms with direct sales to retail or restaurants, 2012, and food hubs, 2014."

On March 20, 2015, near the bottom of page 2, the first year in which the Census of Agriculture began to collect information on farmers' direct-to-consumer sales was corrected to 1978 rather than 1976. Also, a data source identified in Figure 1 was corrected to read "National Farm to School Network."

Abstract

This report provides an overview of local and regional food systems across several dimensions. It details the latest economic information on local food producers, consumers, and policy, relying on findings from several national surveys and a synthesis of recent literature to assess the current size of and recent trends in local and regional food systems. Data are presented on producer characteristics, survival rates and growth, and prices. The local food literature on consumer willingness to pay, environmental impacts, food safety regulations, and local economic impacts is synthesized when nationally representative data are unavailable. Finally, this report provides an overview of Federal and selected State and regional policies designed to support local food systems and collaboration among market participants.

Keywords: local food systems, direct to consumer marketing, intermediated marketing, farm to school, food hubs, farmers' markets, local food prices, Food Safety Modernization Act, Farm Bill, environmental issues, Census of Agriculture, Agricultural Resource Management Survey

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United States Department of Agriculture

A report summary from the Economic Research Service January 2015

Find the full report at *www.ers.usda.gov/publications/ap-administrative-publication/ap-068.aspx*

Trends in U.S. Local and Regional Food Systems: A Report to Congress

Sarah A. Low, Aaron Adalja, Elizabeth Beaulieu, Nigel Key, Steve Martinez, Alex Melton, Agnes Perez, Katherine Ralston, Hayden Stewart, Shellye Suttles, Stephen Vogel, and Becca B.R. Jablonski

What Is the Issue?

This is a congressionally mandated report, written at the request of the House Agriculture Committee as a part of the Fiscal Year 2014 Appropriations Bill, in January 2014. The Committee directed the Economic Research Service (ERS) to provide a report assessing the scope of and trends in local and regional food systems and to make it publicly available on the ERS website.

Local food has been the subject of Federal, State, and local government policy in recent years as consumer interest in and demand for local foods has grown. Because local foods have been linked to the full suite of USDA priorities—including enhancing the rural economy, the environment, food access and nutrition, informing consumer demand, and strengthening agricultural producers and markets—up-to-date information is critical for understanding the evolution and effects of local and regional food systems across the country.

What Did the Study Find?

Producer participation in local food systems is growing, and the value of local food sales, defined as the sale of food for human consumption through both direct-to-consumer (e.g., farmers' markets) and intermediated marketing channels (e.g., sales to institutions or regional distributors), appears to be increasing.

- In 2012, 163,675 farms (7.8 percent of U.S. farms) were marketing foods locally, defined as conducting either direct-to-consumer (DTC) or intermediated sales of food for human consumption, according to census of agriculture data. Of these farms, 70 percent used only DTC marketing channels, which include farmers' markets and community supported agriculture (CSA) arrangements. The other 30 percent used a combination of DTC and intermediated channels or only intermediated channels.
- The number of farms with DTC sales increased by 17 percent and sales increased by 32 percent between 2002 and 2007; however, between 2007 and 2012 the number of farms with DTC sales increased 5.5 percent, with no change in DTC sales. That DTC sales did not increase may be due to plateauing consumer interest or to growth in non-direct sales of local food (i.e., local food sold through intermediated marketing channels like grocery stores or institutions), the value of which is not measured by the census of agriculture.
- Agricultural Resource and Management Survey (ARMS) and census of agriculture data indicate that local food sales totaled an estimated $6.1 billion in 2012. This is only an estimate because neither data source collects complete information on the value of intermediated sales.
- Farms with gross cash farm income below $75,000 accounted for 85 percent of local food farms in 2012, according to census data. These farms are estimated to account for only 13

ERS is a primary source of economic research and analysis from the U.S. Department of Agriculture, providing timely information on economic and policy issues related to agriculture, food, the environment,and rural America.

percent of local food sales. Local food farms with gross cash farm income above $350,000 accounted for 5 percent of local food farms and 67 percent of sales.

- Farms selling local food through DTC marketing channels were more likely to remain in business over 2007-12 than all farms not using DTC marketing channels, according to census of agriculture data. Farms with DTC sales tended to experience smaller increases in sales than all other farms, however.
- It is difficult to draw conclusions about the local economic impact of local foods systems because the existing literature has narrow geographic and market scope, making comparing studies complicated. Data necessary to conduct economic impact analyses are costly to obtain, and researchers have yet to agree on a standard way of accounting for the opportunity costs involved when local foods are produced and purchased or on a standard set of economic modeling assumptions. Many questions surrounding the economic impact of local foods remain unanswered and could be addressed by future research (e.g., Are local food systems good for the rural economy? Might the economic benefits of expanding local food systems be unevenly distributed?)

The Food Safety Modernization Act (FSMA) calls for sweeping changes to the U.S. food safety system. Regulatory focus shifts from response (to contamination) to prevention in order to ensure that the U.S. food supply is safe. This will be the first time that the U.S. Food and Drug Administration (FDA) will have jurisdiction over onfarm activities, and FSMA will impose relative uniformity of standards across suppliers of fresh produce. Currently, food safety in produce is a hodgepodge of decisions by individuals, grower organizations, buyers, and governments that can vary by farm size, commodity, region, and country.

- Although FSMA was passed in 2011, the rulemaking process for FSMA is ongoing and will ultimately include numerous new rules (i.e., regulations) and guidance documents.
- Both the proposed Produce Safety Rule and the proposed Preventive Controls Rule may affect local food farmers; these rules build on prevailing voluntary food safety guidelines. DTC farms apply more manure than all non-DTC farms and thus could be disproportionately affected by any FSMA regulations on the application of biological soil amendments.

Understanding who buys local foods and why is valuable for targeting marketing efforts by producers, grocery stores, restaurants, and others needing information on consumer demand for local food. ERS analysis of the USDA Farm to School Census, 2011-2012, finds farm to school programs exist in more than 4 out of 10 school districts across the country.

ERS analysis of 2006 Nielsen Homescan data finds that selected produce prices at DTC outlets are generally lower, on average, than prices at retail stores in all seasons. Nonetheless, DTC food prices for some product/location combinations were higher than retail store prices.

We draw no conclusion on whether local food production has a different environmental impact but do present some information about environmental practices of farms with and without DTC sales and synthesize literature on the nexus between the environment and local/regional food systems.

Many States and localities are supporting local food system development. While this report does not inventory such activities, we highlight some programs going on at the regional level. Collaboration is a common theme. Communities appear to be leveraging both Federal and State programs, while also partnering with nonprofits, the private sector, and other government entities.

Federal policies related to local and regional food systems were greatly expanded by the Food, Conservation, and Energy Act of 2008, and are further expanded in the Agricultural Act of 2014, which strengthened support for intermediated marketing channels.

How Was the Study Conducted?

This report draws on USDA surveys, censuses, and statistical analyses as well as the available academic literature to provide the latest information on the economics of local and regional food systems. Specifically, this report uses the latest (2012) Census of Agriculture data to describe local food producer characteristics, geography, and farm business survival and growth rates. This report also uses the ERS/NASS Agricultural Resource Management Surveys from 2008 to 2011 to provide a larger sample of local food farms than previous research. The report also summarizes findings from the 2011-12 USDA Farm to School Census. We believe this report is also the first to present a nationally representative comparison of produce prices at direct and conventional retail outlets; for this analysis we use 2006 Nielsen Homescan data.

Trends in U.S. Local and Regional Food Systems

A Report to Congress

Introduction

Consumer, producer, and policymaker interest in local foods appears to be growing. Farm operations with direct-to-consumer (DTC) sales of food for human consumption increased from 116,733 to 144,530 between 2002 and 2012. Consumers have more opportunities to purchase food directly from producers, with 8,268 farmers' markets operating in 2014, up 180 percent since 2006. Martinez et al. (2010) offer a comprehensive overview of the concepts, impacts, and issues surrounding local food systems, noting that growing interest in local foods in the United States is the result of consumer interest in environmental and community concerns (where community concerns include supporting local farmers and the local economy but also increasing access to healthful foods). To complement these interests, Federal, State, regional, and local policy to support local food systems is growing. This report builds on the work of Martinez et al. (2010) by synthesizing research subsequent to its publication, and adding original analysis of data on local food producers, consumers, and prices.

What, exactly, do we mean by the term "local foods"? The definition of local food is complex, varying with purpose, geography, and data availability (Martinez et al., 2010). For some consumers, "localness" may not be based on distance, but rather on local ownership of the farm (Adams and Adams, 2011). For others, local food is associated with natural, organic, and other specialty foods marketed through DTC outlets, grocers and restaurants, and foodservice providers in institutions such as schools, universities, and hospitals.

"Local and regional food systems" refers to place-specific clusters of agricultural producers of all kinds—farmers, ranchers, fishers—along with consumers and institutions engaged in producing, processing, distributing, and selling foods. Since neither term is well defined, the distinction between local and regional food systems is unclear; hence, these terms are often used interchangeably, as in this report.

This report provides the latest economic information on local food systems with the goal of better informing producers, consumers, and policymakers about local and regional food systems. For example, understanding who buys local food and why they do so is not only valuable for producers hoping to market food locally, but also for grocery stores and restaurants.

Local and Regional Food Producers

In 2012, 7.8 percent of U.S. farms sold food through local food marketing channels, including direct-to-consumer (DTC) marketing channels (e.g., farmers' markets, roadside stands, u-pick) and intermediated marketing channels (e.g., direct to restaurants, institutions or to regional food aggregators). In addition to producing food, these farms must consider how they will market their output.

This section of the report focuses on what we know about producers marketing food locally and their economic impact on the local economy. We begin the chapter by discussing recent growth in marketing channels associated with local food systems; we find growth in the number of intermediated markets. but the value of these sales is difficult to estimate given a lack of data. Working with available data, we examine the size and scope of local food farms, their characteristics, and geography. Between 2007 and 2012, more farms participated in DTC marketing channels but there has been no corresponding change in the value of DTC sales. We then compare survival rates of DTC farms with similarly sized farms without DTC sales, finding that while DTC farms are more likely to remain in business, they are less likely to experience growing sales than farms not involved in DTC sales. The section concludes with an overview of recent literature on the local economic impact of local food systems although it cannot draw generalizable conclusions because existing studies are based on specific local contexts and requisite national-level data are unavailable.

Growth in Certain Local Food Marketing Channels

Several local food marketing channels have experienced growth since 2006-7.[1] As of 2014, there were 8,268 farmers' markets in the United States, having grown by 180 percent since 2006 (fig. 1). While the growth in farmers' markets signals increased consumer interest, for some local food farmers marketing food in multiple locations can increase marketing and transportation costs, reducing overall net farm income. Intermediated marketing channels (e.g., food hubs, direct sales to restaurants) may reduce marketing and transportation costs for participating producers.

Regional food hubs are enterprises that aggregate locally sourced food to meet wholesale, retail, institutional and even individual demand (see box, "Regional Food Hubs"). Since 2006-07, the number of food hubs has increased by 288 percent (fig. 1).

Farm to school programs have multiple objectives, ranging from nutrition education to serving locally sourced food in school meals. According to the USDA Farm to School Census, 4,322 school districts have farm to school programs, a 430-percent increase since 2006 (fig. 1).[2]

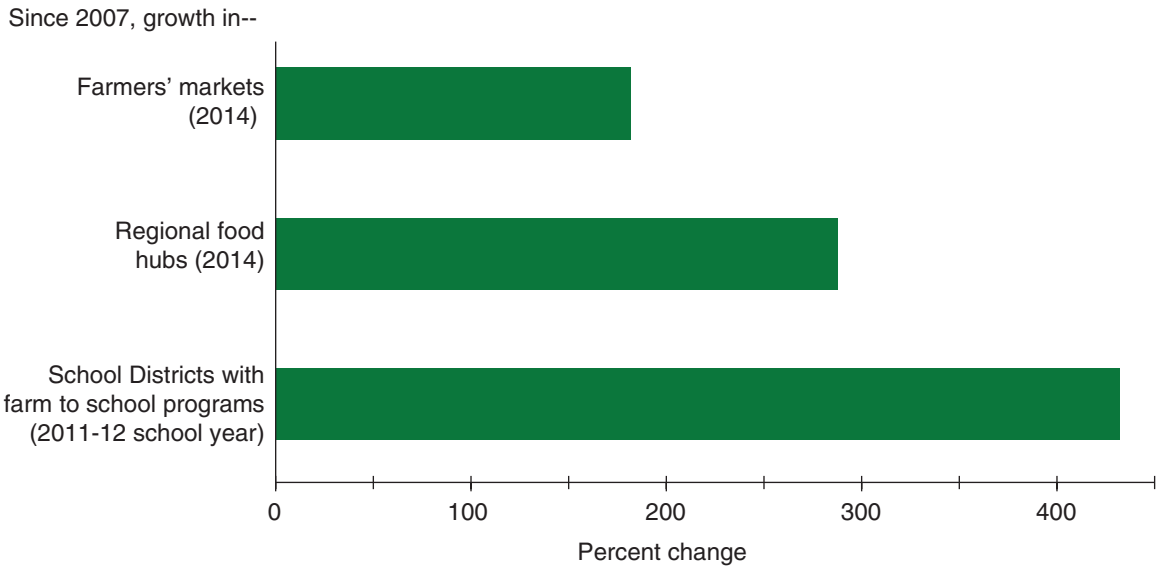
Geography and Characteristics of Farmers in Local and Regional Food Systems

Since 1978, the census of agriculture has asked farmers to report the sales of food for human consumption marketed directly to consumers through various DTC outlets such as farmers' markets

[1]Data on these three local food marketing channels provide only a partial picture of local and regional food systems. National data collected over time do not exist for many marketing channels, including farm-to-college/hospital/prison arrangements, nor for the extent to which farmers have sold commodities by using Internet portals such as Market Maker.

[2]More results from the USDA Farm to School Census are available on pages 39-42 of this report.

Figure 1
Increase in local & regional marketing channels



Sources: USDA, Agricultural Marketing Service, Food Nutrition Service; National Farm to School Network.

and farm stands.[3] For the first time, the 2012 Census of Agriculture asked farmers to report if they sold any food for human consumption through outlets that in turn sell directly to consumers (including restaurants, grocery stores, schools, hospitals, or other businesses). Including these nondirect local food marketing channels brings the census closer to consumer notions of local foods, (e.g., locally produced, but purchased from the grocery store), and Matteson and Hunt's (2012) definition of retail agriculture. King et al. (2010) and Low and Vogel (2011) refer to these nondirect marketing channels as *intermediated marketing* channels. Farm use of local food marketing channels is often correlated with the size of the farm operation and whether livestock or crop commodities are being produced (see box, "Definition of Terms").

Using the Census of Agriculture To Examine Direct-to-Consumer Marketing

DTC sales averaged 0.4 percent of total agricultural sales over 2002-12 (table 2). Between 2002 and 2007, the number of DTC farmers increased by 17 percent, while the value of DTC sales increased by 32 percent, when measured in inflation-adjusted (constant) dollars. Between 2007 and 2012, the number of farmers using DTC channels increased by 5.5 percent, while the value of DTC sales actually declined by nearly 1 percent when measured in constant dollars. In 2012, counties with the highest DTC sales remained concentrated in the Northeast and the West Coast (fig. 2), as in 2007 (Martinez et al., 2010). Such geographic clustering does not exist for 2007-12 change in DTC sales, as measured in constant dollars (fig. 3). While much of the country had little change in DTC sales between 2007 and 2012, some counties had a decline while others exhibited an increase, predominantly counties in or near urban areas.[4]

[3]The U.S. Department of Commerce, Bureau of Census conducted the census of agriculture every 5 years through 1992, after which USDA's National Agricultural Statistics Service took over this task.

[4]We define no change as +/-$123,000 because this value represents one standard deviation of the 2007 distribution.

Regional Food Hubs

Regional food hubs have emerged as collaborative enterprises for moving local foods into larger mainstream markets, providing scale-appropriate markets for midsized farmers and opportunities for small and beginning farmers to scale up without increasing time spent marketing food (Barham, et al., 2012). According to the 2013 National Food Hub Survey, conducted by scientists at Michigan State University, 76 percent of food hubs worked exclusively or mostly with farmers with sales under $500,000, of which 26 percent were beginning farmers (those with less than 10 years' experience farming) (Fischer, 2013).

Food hubs work with farmers to preserve the source-identified characteristic of the food's origin and any special practices or circumstances under which the food was grown. By maintaining this information transparency throughout the local food supply chain, food hubs attempt to provide premium prices to farmers by selling differentiated products. Most food hubs do not necessarily require that farmers adopt specific production practices, but give preference to food grown meeting certain standards. According to the 2013 National Food Hub Survey, over 70 percent of food hubs expressed preferences for non-certified, but practicing organic farms and for commodities grown using integrated pest management, while over 60 percent expressed preferences for animal products raised free range/pasture and/or grass fed and for food meeting certified standards (e.g., USDA organic, humane, Fair Trade, or food safety practices) (Fischer et al., 2013).

Many food hubs also offer technical assistance to producers with the objective of maintaining a continuous supply and quality control standards demanded by retail and institutional consumers. According to the 2013 National Food Hub Survey, over 40 percent of the food hubs offered production and post-harvesting services, business management services, and food safety training. Over 60 percent provided product differentiation marketing strategies, and 80 percent offered marketing services to producers or helped them find new markets (Fischer, et al., 2013).

Food hubs have diverse business models. Of the 302 food hubs in the United States, 40 percent operate as private businesses, almost 30 percent as nonprofits, and 20 percent as cooperatives (table 1). While 40 percent of food hubs provide locally sourced food commodities to consumers, other food hubs are equally likely to cater exclusively to business and institutional buyers or operate as a hybrid, catering to both businesses/institutions and consumers. Business models and missions likely vary because food hubs are responding to the needs of local producers, consumers, and communities.

Table 1
Food hubs in the U.S. by legal status and food hub type

	Food hub clients:			
Legal status	Farm to business/ institution	Farm to consumer	Hybrid: business/ institution and consumer	Totals
Cooperative	18	25	18	61
Nonprofit	23	43	21	87
Privately held business	39	41	43	123
Other*	7	10	14	31
Total	87	119	96	302

*Incorporated, publicly and privately held corporations, and informally organized.

Source: USDA, Agricultural Marketing Service, List of Food Hubs, April 28, 2014.

Definition of Terms

In this report, *local food farms* collectively refer to farms and ranches earning income from selling food for human consumption through any local food marketing channel (referred to as *local food sales*). Local food marketing channels are classified into two types. In *direct-to-consumer* (DTC) marketing channels, producers engage consumers in face-to-face market transactions at roadside stands, farmers' markets, pick-your-own, onfarm stores, and community supported agricultural arrangements (CSAs). The majority of available data on local food marketing covers only these DTC marketing channels.

Intermediated marketing channels generally include all marketing opportunities in the local supply chain that are not farmer-to-consumer transactions, including farmers selling to grocers, restaurants, regional aggregators such as food hubs, and buying arrangements with the food service operations of schools, universities, hospitals, and other institutions. This definition of intermediated marketing channels is very broad. Data on specific intermediated marketing channels only recently began to be collected. For example, the 2011 USDA Agricultural Resource Management Survey (ARMS) asks farmers, for the first time, to explicitly report institutional sales. The 2012 Census of Agriculture does not include in its question on intermediated marketing channels any explicit intermediated channels, such as food hubs or institutional sales, nor does it ask about the value of sales through intermediated channels.

In this report, data on farmers' use of marketing channels are drawn from the 2008-11 ARMS and the 2002, 2007, and 2012 Censuses of Agriculture. Given the limitations of the ARMS and census of agriculture data, we categorize farmers' local food marketing options in three discrete categories: farms selling *exclusively* through DTC marketing channels, *exclusively* through intermediated channels, or through *both* DTC and intermediated marketing channels.

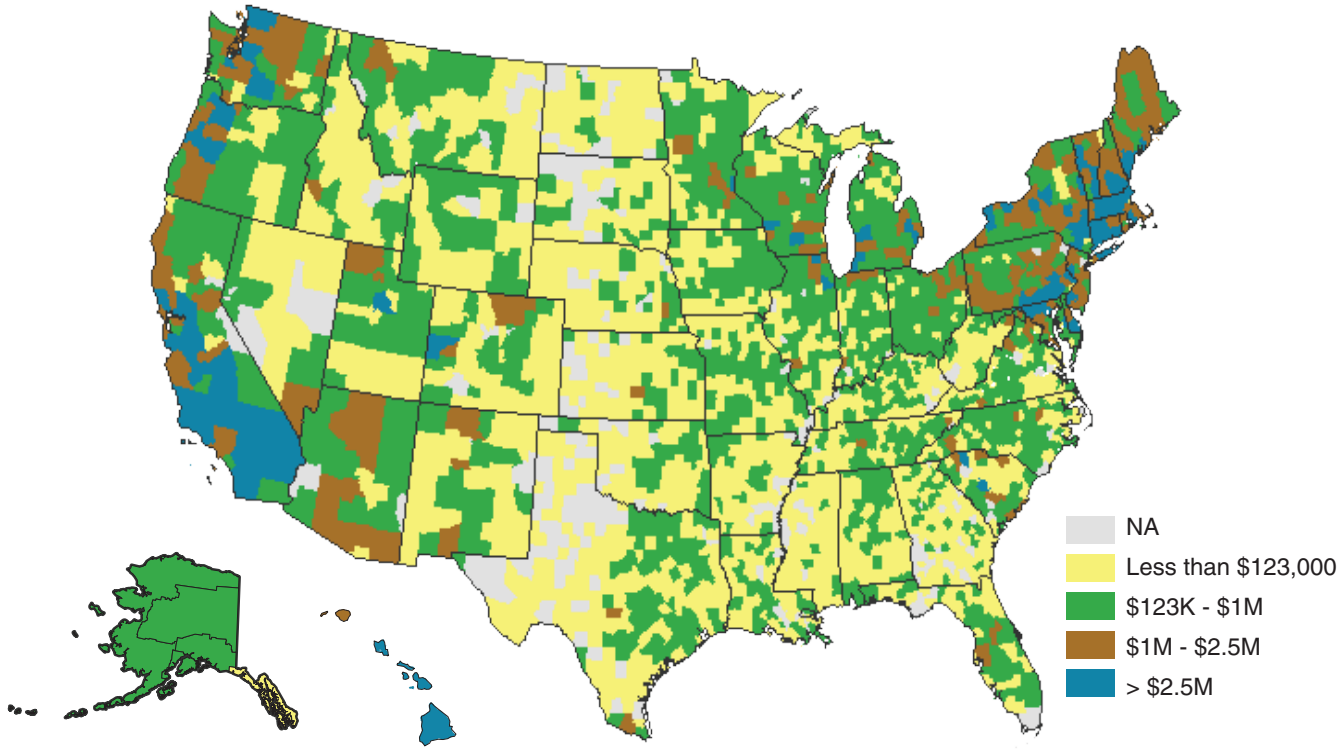
Table 2
Number of direct-to-consumer farms and sales, 2002-12

Item	Census year: 2002	2007	2012
All farms reporting direct-to-consumer sales	116,733	136,817	144,530
Percent of all farms	5.5	6.2	6.9
Direct-to-consumer sales (million dollars)	812	1,211	1,310
Percent of all farm sales	0.4	0.4	0.3
Direct-to-consumer sales (millions of constant dollars: 2012 = 100)	1,002	1,322	1,310
Percent change from previous census	36.1	31.9	-0.9

Source: USDA, National Agricultural Statistics Service, Census of Agriculture data, various years; Council of Economic Advisors, *Economic Report of the President* (2014), Table B-3: Quantity and price indexes for gross domestic product, and percent changes, 1965–2013.

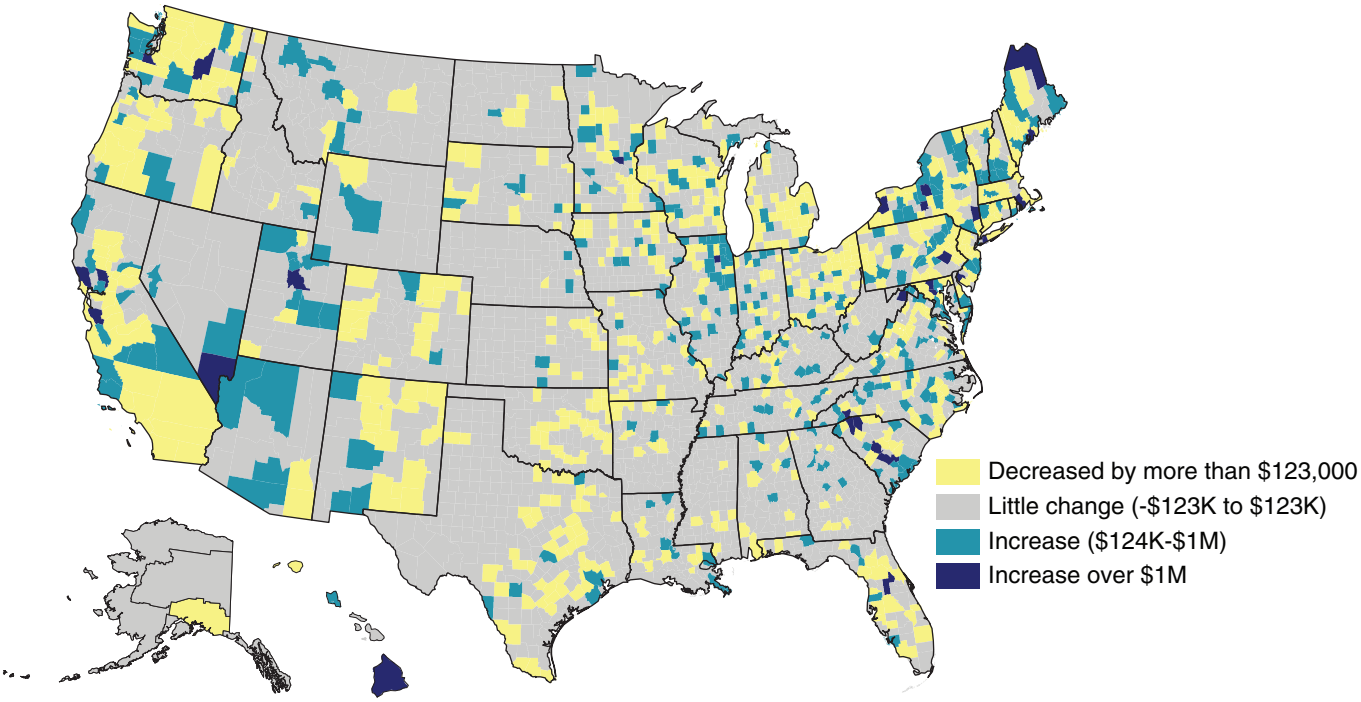
Two factors may have contributed to the lack of growth in DTC sales since 2007. First, consumer demand for local food purchased through DTC outlets may have plateaued, such that DTC outlets are competing for the same consumer dollar. Lohr et al. (2011) linked survey data on the distances that farmers and consumers are willing to travel to farmers' markets. In densely populated urban

Figure 2
Total direct-to-consumer sales, by county, 2012



Source: USDA Economic Research Service, data from Census of Agriculture, 2012.

Figure 3
Change in direct-to-consumer sales, 2007-12 using constant 2012 dollars



Source: USDA Economic Research Service, data from Census of Agriculture, 2012 and 2007.

areas, farmers' markets often compete with each other for vendors and consumers. In other areas, newer, more strategically located farmers' markets may lead to the decline of previously established markets.

Second, where local food systems have been thriving, farmers may have been able to increase sales through intermediated marketing channels. That is, growing consumer demand for local food may have been met by retailers rather than through DTC sales. Although a grocer-industry consultant reported that local sourcing of farm products was the top grocer trend in 2012, Guptill and Wilkins (2002) found a decade earlier that large grocers were beginning to market locally produced food in response to consumers frequenting farmers' markets and other DTC outlets. In a Mississippi case study, Morgan and Alipoe (2001) found that farmers' markets, farm stands, and pick-your-own arrangements did not compete with grocers in filling consumer demand for food but were complementary activities. Unfortunately, no national data are available to test this finding.

Food hubs may compete with other types of local food sales in certain regions. Existing research suggests that local food marketing outlets may be more competitive than complementary, but research on whether food hubs and farmers' markets are competitive or complementary outlets for local food is not available.

Most food hubs are found in metropolitan counties.[5] Fifty-six percent of the food hubs are found in a broad northeastern quadrant stretching from Wisconsin to North Carolina, and 23 percent are on the West Coast, extending inland (fig. 4).[6] Counties in which 100 or more farmers use intermediated marketing channels are concentrated in areas of the Northeast and Mid-Atlantic States, and on the West Coast (fig. 4), as are DTC farms (fig. 2).

Deficiencies in the Data: Developing Synthetic Estimates of Local Food Sales Value

Central to understanding the national scope of farmers' involvement in local and regional food systems is collecting the appropriate data at the farm gate. By including a question on farmers' use of intermediated marketing channels, the 2012 Census provides a national benchmark estimate of the total number of local food farms in the United States. In the 2012 Census questionnaire, however, farmers were not asked to report the value of their sales using intermediated marketing channels.

The ARMS, which queried farmers about use of intermediated marketing channels and the value of sales from these channels for 2008-11, generated estimates exhibiting substantial year-to-year variation. This variation stems from (1) the ARMS mission and survey design, which is not geared to collect data on small, niche agricultural sectors; and (2) the growth and innovation of local food marketing channels during this period, which changed faster than the ARMS questionnaires could be adapted.[7]

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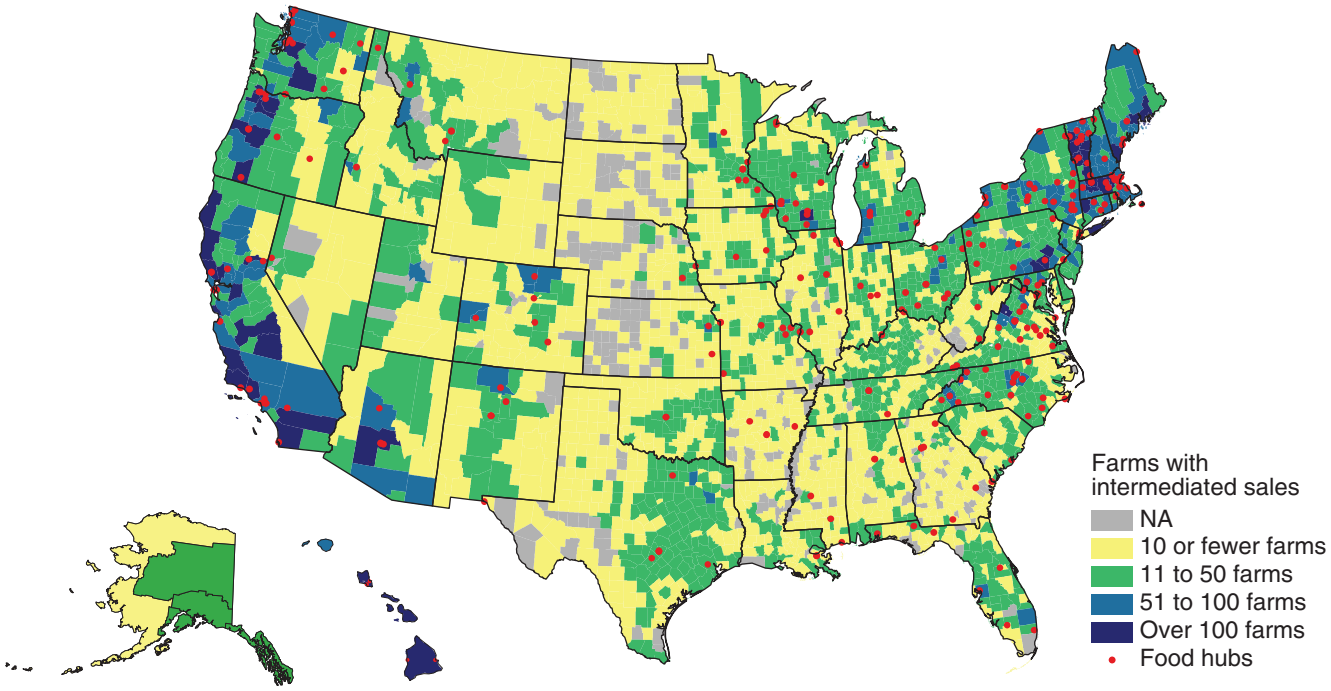
[5]Over 50 percent of the food hub's customers were within 50 miles of the food hub and 23 percent were between 50 and 100 miles of the food hub. Three-quarters of the food hubs were located in metropolitan counties, and 16 percent in adjacent nonmetropolitan counties (Fischer et al., 2013).

[6]The list of food hubs was provided by USDA's Agricultural Marketing Service (April, 28, 2014) (http://www.ams.usda.gov/foodhubs).

[7]See the appendix for a full discussion of the year-to-year variation in the ARMS data. The appendix also contains a procedure we used to derive synthetic estimates of total local food sales.

Figure 4
Farms with direct sales to retail or restaurants, 2012, and food hubs, 2014



Source: USDA Economic Research Service, data from Census of Agriculture, 2012; USDA Agricultural Marketing Service, 2014.

Table 3 presents 2008-11 ARMS estimates and 2012 Census counts of the number of local farms using the three marketing channel options: (i) exclusively using DTC outlets, (ii) using both DTC and intermediated marketing channels, or (iii) exclusively using intermediated marketing channels. The 2012 Census counts 163,675 farmers marketing local foods, of which 70 percent used only DTC channels and 30 percent used intermediated marketing channels only or both types of marketing channels. Averaged over 2008-2011, the smaller ARMS estimate (146,238 farmers) is 11 percent lower than the number of farmers using both marketing channels in the Census and 51 percent lower than the number of farmers in the Census exclusively using intermediated marketing channels. It may be that the ARMS underestimates the number of local food farms exclusively using intermediated marketing channels. It may be that the ARMS also underestimates the value of all local food sales in the United States since farmers using both types of marketing channels or only intermediated marketing channels generate higher sales per farm than farmers relying solely on DTC outlets (Low and Vogel, 2011).

Toward a Synthetic Estimate

Absent a census estimate of the total value of local food sales in the United States, we produce a synthetic estimate using the strengths of both the 2012 Census and pooled ARMS data. The census estimates on number of farms participating in DTC and intermediated marketing channels are comprehensive. The ARMS contain more detailed information on farm characteristics. Accepting the ARMS estimates of average sales per unit as given, a synthetic estimate of the value of local food sales can be obtained by multiplying the number of farms in the 2012 Census by ARMS esti-

mates of local food sales per farm (table 4).[8] Using this approach, we estimate that total local food sales are $6.1 billion. This estimate is 466 percent higher than the census value of total DTC sales ($1.31 billion). The $6.1 billion estimate is less than the 2013 grocer-industry consultant estimate of $9.0 billion, but higher than the average annual ARMS estimate of $4.0 billion (appendix table 1).

The 2012 Census data on the number of farms by farm size, marketing channel type, and production type (i.e., produce or livestock) allow us to compute estimates of local food sales tabulated by farm size and market channel type and by market channel and production type (see the appendix for a discussion on why we do not use ARMS, instead). Multiplying 2012 Census farm counts by the corresponding ARMS estimates of local food sales per farm means that each two-way comparison will introduce error in the two-way estimates. As such, the synthetic estimates of the totals are not equal.[9] These two-way comparisons exploit detailed ARMS data on farm structure not available in

Table 3
Estimated number of local food farms by marketing channel options, ARMS and 2012 Census of Agriculture

Item	ARMS (2008-11 average)		2012 Census of Agriculture	
Local food farms using:	Number of farms	Percent	Number of farms	Percent
Direct-to-consumer channels only	114,001	78	115,304	70
Direct-to-consumer and intermediated marketing channels	21,201	14	25,756	16
Intermediated marketing channels only	11,036	8	22,615	14
All local food farms	146,238	100	163,675	100

Note: The ARMS estimates are annual averages computed by dividing by 4 the data pooled over the years 2008-11. The 2012 Census reports 144,530 direct-to-consumer farms in Table 1. The estimate of 141,060 (115,304 + 25,756) direct-to-consumer farms in this table excludes 3,740 farmers not answering the census question on intermediated marketing channel use.

Source: USDA, Economic Research Service/National Agricultural Statistics Service, Agricultural Resource Management Surveys (ARMS), 2008-2011; Economic Research Service analysis of USDA, National Agricultural Statistics Service, 2012 Census of Agriculture data.

Table 4
Synthetic estimate of local food sales

Item	2012 Census		2008-2011 ARMS average		Estimated 2012 local food sales
	Number of farms	*X*	*LF sales per farm*	*/ 10^6 =*	*millions of dollars*
Local food farms using:					
Direct-to-consumer channels only	115,304		9,990		1,152
Direct-to-consumer and intermediated marketing channels	25,756		62,599		1,612
Intermediated marketing channels only	22,615		148,091		3,349
Total	163,675		–		6,113

Source: USDA, Economic Research Service/National Agricultural Statistics Service, Agricultural Resource Management Surveys (ARMS), 2008-2011; Economic Research Service analysis of USDA, National Agricultural Statistics Service, 2012 Census of Agriculture data.

[8]See appendix for a detailed discussion about the assumptions made to obtain this estimate.

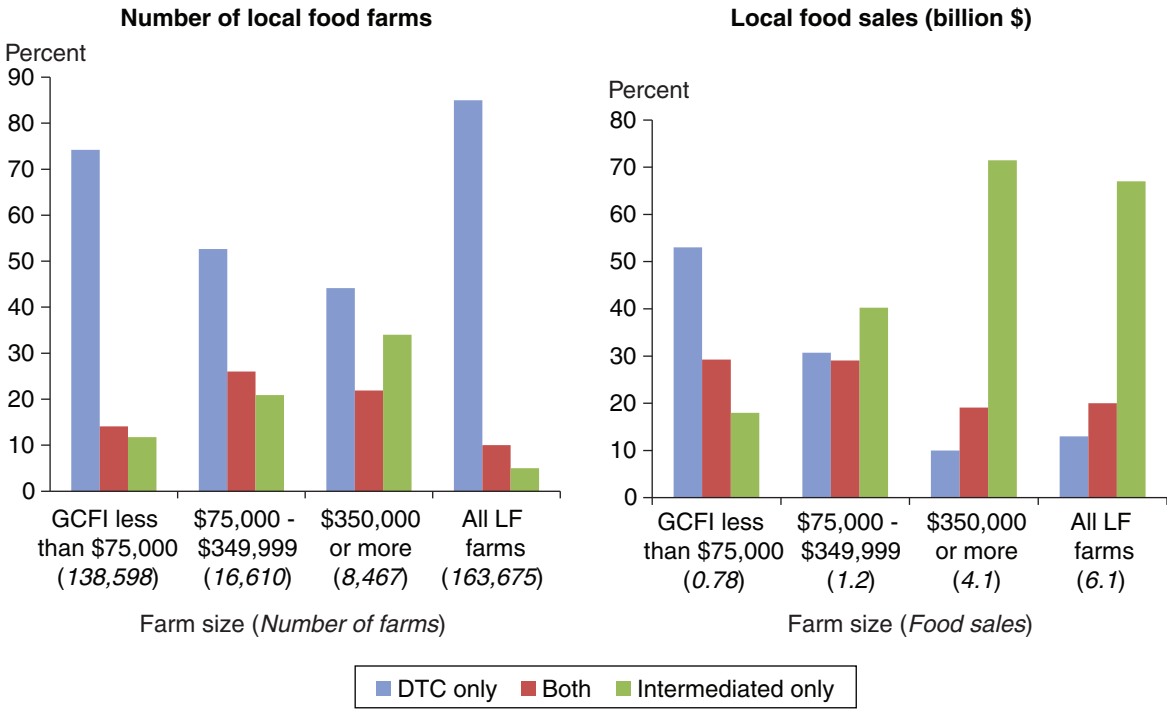
[9]The aggregate estimate of $6.1 billion in local food sales is bounded by the two-way estimates of $5.8 billion in sales summed across market channel use and production type and by the estimated $6.6 billion summed across farm size classes and market channels used. See the appendix for the tables constructing the two-way synthetic estimates of local food sales and for more details on the motivation and construction of the synthetic estimate.

the 2012 Census. Despite unavoidable measurement error, the information on what size farm grows what commodities marketed through which marketing channel options is preserved as shares of all local food farms in figures 5 and 6. The aggregate estimate of $6.1 billion is the control total for all local food farms in figures 5 and 6.

Farm Participation in Local Food Systems, Using Synthetic Estimates

Farmers' use of particular local food marketing channels is correlated with both the average size of farm operations, as measured by gross cash farm income (GCFI), and what they produce. Local food farms with less than $75,000 in GCFI account for 85 percent of all local food farms (fig. 5). Local food farms with GCFI between $75,000 and $350,000 represent 10 percent of local food farms—half earning GCFI up to $150,000 and half earning GCFI of $150,000 up to $350,000. Local food farms with CGFI under $75,000 generate only 13 percent of all local food sales, while the 5 percent of local food farms that have $350,000 or more in GCFI generated 67 percent of the value of total local food sales (fig. 5).

Figure 5
Local food farms and sales by farm size and market channel use



Note: The share of farms by farm size and marketing channel use are based on 2012 Census benchmark counts; the shares of total value of local food sales by farm size and marketing channel use are synthetic estimates.
DTC = direct-to-consumer; GCFI = Gross cash farm income.
Source: USDA, ERS/NASS, ARMS data, 2008-2011; USDA, NASS, 2012 Census of Agriculture.

Farm Sales Classes Defined

The recently updated ERS farm typology classifies U.S. family farms with gross cash farm income (GCFI) of less than $350,000 as *small farms*, those with GCFI between $350,000 and up to $1 million as *midsized farms*, and those with GCFI of $1 million or more as *large farms* (Hoppe and MacDonald, 2013). The recently updated ERS farm typology also defines a subcategory of small farms generating GCFI of less than $150,000 as *low-sales family farms.*

The distribution of local food farms is concentrated at low levels of GCFI. To facilitate comparisons of similarly sized farms with and without DTC sales, we examine local food farms by farm size using three size categories, two of which comprise subcategories of small farms: local food farms having less than $75,000 in GCFI, local food farms having GCFI of $75,000 up to $349,999, and the third category, local food farms having GCFI of $350,000 or more. Adjusted for inflation, these categories correspond to those used in Low and Vogel (2011).

Produce farms—those producing fruit, vegetables, or nuts—represent 29 percent of all local food farms and account for 51 percent of all local food sales (fig. 6).[10] In 2012, 34 percent of all U.S. produce farms sold food through local food marketing channels, whereas only 3 percent of all other crop farms and 8 percent of livestock and livestock product farms did so.

The extent to which farmers sell local food through intermediated marketing channels is correlated with farm size.[11] Even within farm size categories, however, those local food farmers marketing some food through intermediated marketing channels appear to earn disproportionately larger shares of local food sales generated by farms in each farm sales class.

In 2012, 74 percent of the 138,600 local food farms with GCFI less than $75,000 used DTC marketing channels only (fig. 5). Farmers using only DTC marketing outlets accounted for 54 percent of the $778 million in local food sales earned by local food farmers in this sales class.

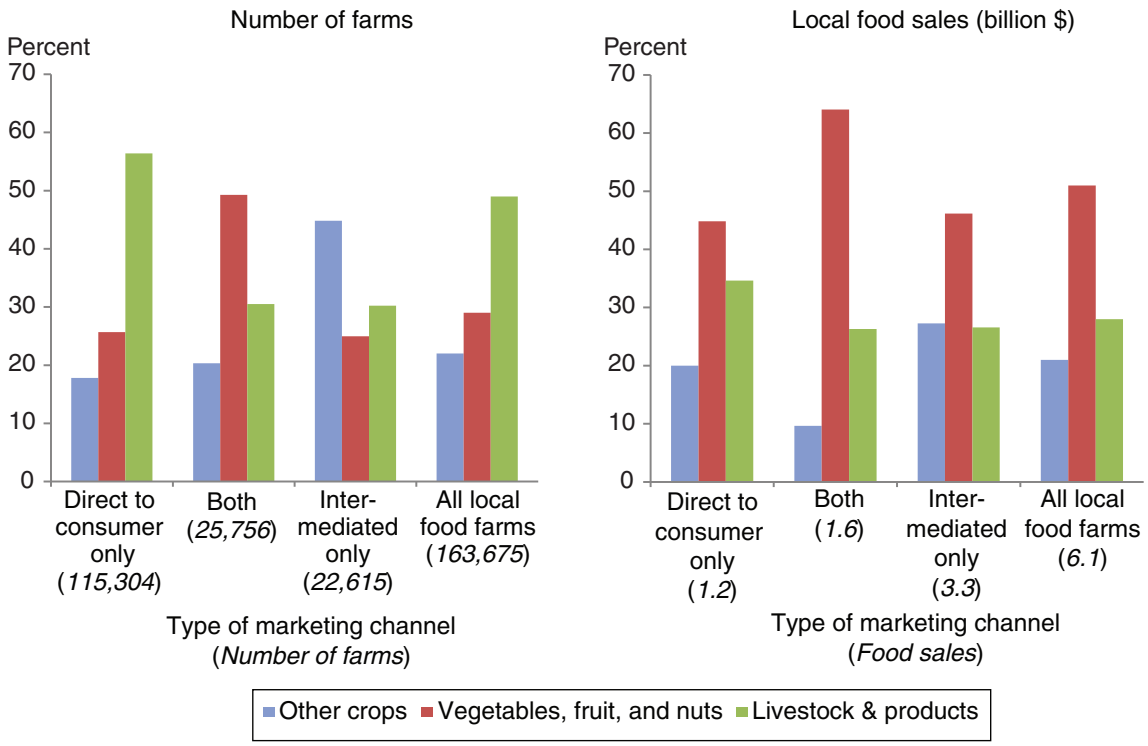
Among the 16,600 local food farms with GCFI between $75,000 and $350,000, 53 percent used DTC outlets exclusively and earned only 31 percent of $1.2 billion in local food sales generated by farmers in this farm sales class. We estimate that local food farmers with CGFI between $75,000 and $350,000 using intermediated marketing channels, either exclusively or in combination with DTC sales, earned a disproportionately large share of local food sales in this sales class, accounting for 69 percent of local food sales.

Local food farms with GCFI over $350,000 that marketed exclusively through intermediated marketing outlets generated the largest average sales and accounted for 71 percent of local food sales

[10]ARMS and Census classify farms by production type according to the agricultural commodity that accounts for at least 50 percent of farm sales. Farm production classification of local food farms are aggregated into three basic categories: fruit/vegetable/nut farms (produce farms), all other crop farms, and farms producing livestock and livestock products. We assume that farms classified by production type sell commodities within that production type locally. It is possible, for example, that a livestock farm may sell vegetables grown on a small plot through local marketing channels. In census questionnaires, farmers were asked to identify what commodities were sold through DTC channels; however, producer responses were never intended to be coded, preventing us from exploring the extent to which this practice occurs.

[11]In this section, data on the number of farms and shares of all local food farms by category are based on 2012 Census benchmark counts; the shares of total value of local food sales by category are synthetic estimates.

Figure 6
Local food farms and sales by market channel use and farm type



Note: The share of farms by marketing channel use and farm production type are based on 2012 Census benchmark counts; the shares of total value of local food sales by marketing channel use and farm production type are synthetic estimates. Source: USDA, ERS/NASS, ARMS data, 2008-2011; USDA, NASS, 2012 Census of Agriculture.

by farms reporting CGFI greater than $350,000. In contrast, the other 66 percent of local food farms of this sales class accounted for the remaining 29 percent of local food sales.

Produce farms' value of sales in local foods marketing channels stands out. Produce farms represent 26 percent of the 115,300 farmers using DTC sales exclusively; however, they generate 45 percent of the $1.2 billion in exclusive DTC food sales (fig. 6). Almost half of all farms using both DTC and intermediated outlets are produce farms; they generate $1.0 billion in local food sales (64 percent of $1.6 billion total sales by local food farmers using both marketing channels). Although produce farms comprise only 25 percent of farmers using intermediated channels exclusively, they earn 46 percent of its sales, or $1.5 billion.[12]

Farm Business Survival and Growth and Direct-to-Consumer Marketing

Operating a farm is a financially risky undertaking. Farm businesses operate in a competitive environment, with income that can vary substantially from year to year as product prices, input prices,

[12]With respect to marketing exclusively through intermediated channels, the produce farmers' share of total local food sales in 2012 appears to have declined since 2008, when produce farmers generated 60 percent of local food sales exclusively marketed through intermediated channels (Low and Vogel, 2011). This decline may be indicative of the emergence of local meats and dairy (Johnson et al., 2013).

and yields vary. This section discusses farm business survival and growth rates of farms using DTC marketing channels and finds that these farms are more likely to remain in business than all other farms but less likely to increase in size (measured by sales) over time.

Farm Business Survival

In the United States, the farm business survival rate is low.[13] According to census of agriculture data, only 55.7 percent of all farms having positive sales in 2007 also reported positive sales in 2012. Beginning farmers (those farming for no more than 10 years) are even less likely to report positive sales in consecutive census years. Only 48.1 percent of beginning farmers in 2007 reported positive sales 5 years later.

The census data also show that farmers who market food for human consumption directly to consumers have a greater chance of reporting positive sales in 2007 and 2012 than those who market through traditional channels.[14] The first two columns in table 5 compare the survival rates (the share of farmers who reported positive sales in 2007 and 2012) for farms in four sales categories. In each category, farmers with DTC sales had a higher 2007-12 survival rate. The differences in survival rates were substantial, ranging from 10 percentage points for the smallest farms to about 6 percentage points for the largest. The 2007-12 survival and growth rates reported in tables 5 and 6 display similar patterns to the 2002-07 survival and growth rates (not reported here).[15]

Direct marketing was also associated with higher survival rates among beginning farmers (columns 3 and 4, table 5). On average, beginning farmers who marketed directly to consumers had a 54.3-percent survival rate, compared to 47.4 percent for those who marketed their goods through traditional channels.

What is it about DTC sales that seem to enhance farmers' chances of maintaining positive sales? One advantage might stem from the fact that, for a given level of sales, farmers with direct marketing purchased less machinery and land than did those with traditional marketing. According to the 2012 Census of Agriculture data, farmers who marketed directly owned $20.82 worth of machinery per dollar of sales, compared to $31.10 for those who marketed through conventional channels. Farmers selling directly to consumers also owned less land: $240 worth of land per dollar of sales, compared to $309 per dollar of sales for other farmers. Because they did not need to purchase as much machinery and land to achieve a certain level of sales, farmers with direct sales did not need to leverage as much of their wealth to obtain financing. This is confirmed by the census data, which show that farmers with direct sales had annual interest payments of only $7.85 per $1,000 of owned assets, compared to $10.55 for those with no direct sales. A lower debt-to-asset ratio should indicate a better ability to repay loans and has been shown to reduce the risk of small business failure (Tveteras and Eide, 2000; Strotmann, 2007; Fotopoulos and Louri, 2000).

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[13]In this section, a farm business is considered to have survived (not exited) if its operator reported positive sales in consecutive censuses. This understates actual survival rates since some operations may remain in business with no sales—e.g., if there were a total crop failure but the operator had sufficient crop insurance to continue operating.

[14]This section uses farms with DTC sales and does not cover farms with intermediated sales because the 2007 Census of Agriculture contained no information on whether farms participated in intermediated markets. The "old" ERS farm typology (with farms having sales in excess of $250,000 considered "large") is used because it was in place when the 2007 Census of Agriculture was conducted.

[15]The findings illustrated in tables 5 and 6 are robust to controls for operation and operator characteristics, including farm location, farm business organization, type of commodity produced, and the operators' age and education.

Table 5

Business survival rates 2007-12 by initial farm size and marketing arrangement

	All operations		Beginning farmer in 2007	
2007 sales category	No direct sales in 2007	Direct sales in 2007	No direct sales in 2007	Direct sales in 2007
$1-9,999				
Survival rate, 2007-12	0.453	0.549***	0.416	0.507***
Observations	484,211	51,535	177,392	22,170
$10,000-49,999				
Survival rate, 2007-12	0.581	0.667***	0.521	0.611***
Observations	268,758	23,729	68,053	7,647
$50,000-249,999				
Survival rate, 2007-12	0.656	0.738***	0.593	0.649***
Observations	194,563	11,270	35,364	2,661
$250,000+				
Survival rate, 2007-12	0.728	0.791***	0.66	0.704***
Observations	178,515	5,450	27,115	800
All				
Survival rate, 2007-12	0.553	0.609***	0.474	0.543***
Observations	1,126,047	91,984	307,924	33,278

Notes: Asterisks denote rejection of the null hypothesis that the difference in means is zero at the (*) 10%; (**) 1%; and (***) 0.1% statistical significance levels. Sample includes all operations with positive sales in 2007. The survival rate is defined as the share of 2007 Census respondents with positive sales who reported positive sales in the Census in 2012.

Source: USDA, NASS, Census of Agriculture, 2007, 2012.

Farm income risk is another factor that could explain some of the differences in survival rates. For farmers who do not sell directly to consumers, profits can fluctuate widely because of changes in input and output prices and yields. Farmers who market to consumers are also exposed to these risks; however, these farmers derive some of their income from their marketing activities and not just production. Income from marketing depends on the margin between the wholesale and retail price and the time spent marketing. Even when input and output prices vary, the markup between the wholesale and retail prices should remain relatively stable. Hence, the additional income that can be earned from selling directly to consumers versus to wholesalers should not vary substantially because of price fluctuations. Therefore, it is plausible that total farm income is less risky for DTC farmers, but future research is needed to answer this question.

Farm Business Growth

While farmers who directly market to consumers are more likely to continue farming than those who do not, their businesses expand at a slower rate. Table 6 compares the arc percent change in nominal total gross sales between 2007 and 2012 for surviving farms in different sales catego-

Table 6

Percent change in sales 2007-12 by initial farm size and marketing arrangement

2007 sales category	All operations		Beginning farmer in 2007	
	No direct sales in 2007	Direct sales in 2007	No direct sales in 2007	Direct sales in 2007
$1-9,999				
Arc percent change, 2007-12	36.9	31.8***	41.5	35.4***
Observations	225,862	28,981	76,121	11,521
$10,000-49,999				
Arc percent change, 2007-12	2.8	-12.1***	2.1	-16.7***
Observations	158,367	16,057	35,902	4,736
$50,000-249,999				
Arc percent change, 2007-12	12.1	-3.3***	14.6	-6.5***
Observations	128,175	8,350	20,941	1,736
$250,000+				
Arc percent change, 2007-12	12.3	3.9***	11.5	-9.8***
Observations	130,434	4,336	17,936	559
All				
Arc percent change, 2007-12	19.3	13.5***	25.6	17.9***
Observations	642,838	57,724	150,900	18,552

Notes: Asterisks denote rejection of the null hypothesis that the difference in means is zero at the (*) 10%; (**) 1%; and (***) 0.1% statistical significance levels. Sample includes all operations with positive sales in 2007. The percent change for farm *i* is defined: $100*(x_{it+1} - x_{it})/0.5*(x_{it+1} + x_{it})$.

Source: USDA, NASS, Census of Agriculture, 2007, 2012.

ries.[16] Sales by farms using direct marketing grew less than those with no direct sales in every size category. On average, surviving farmers with direct sales in 2007 increased their total sales by 13.5 percent between 2007 and 2012, compared to 19.3 percent for farmers with no direct sales.

Among beginning farmers, direct sales were also associated with slower growth (columns 3 and 4 in table 6). On average, beginning farmers with direct sales increased sales by 17.9 percent between 2007 and 2012, compared to 25.6 percent for those without direct sales. For all but the smallest farm size category, the differences in growth rates between those with and without direct sales were larger for beginning farmers than for the full sample.

The difference in growth rates may stem from differences in labor requirements. Selling directly to consumers through farm stands, farmers' markets, or CSAs is labor-intensive. The 2012 Census data indicate that in every sales category, farmers with direct sales hire significantly more labor than farmers with no direct sales. Because farms that market through traditional channels require less labor, these farms can become larger before labor must be hired. In contrast, farms using direct

[16]The arc percent change for farm *i* is defined as: $100* (x_{it+1} - x_{it})/0.5*(x_{it+1}+x_{it})$. The arc percent change is preferable to the percent change because the arc percent change is: 1) symmetric regarding increases or decreases over time, 2) defined for zero values, and 3) bounded between -200 and 200. The third reason provides for more stable estimates when x has a skewed distribution with some observations having very large changes over time.

marketing would need to begin hiring labor at a smaller scale of production. Transaction costs associated with hiring labor could provide a disincentive for expansion.

The finding that farms with direct sales have both higher survival rates and slower growth might be explained by differences in off-farm opportunity costs. Gimeno et al. (1997) found evidence that small business survival depends not only on economic performance, but also on the entrepreneur's human capital and alternative employment opportunities. Farmers with limited off-farm income opportunities would be more inclined to remain in farming, despite lower farm profits and less ability to expand the business. We do not observe in the census data the time spent working on the farm so we cannot evaluate the returns to labor from farming.

We can compare off-farm income indirectly by examining total household income, however. The 2007 Census of Agriculture data indicate that only 48.9 percent of farmers with direct sales reported that their household income was greater than $50,000 annually, which is statistically significantly less than the 51.2 percent of farmers with no direct sales.[17] Additionally, 15.9 percent of farmers with direct sales reported less than $20,000 in annual household income—statistically significantly more than the 14.0 percent of those with no direct sales. The lower total household income suggests that farmers with direct sales may have had less favorable off-farm income opportunities. If true, this could provide them with an incentive to remain in business even if they have less ability or opportunity to expand production.

Higher survival rates and slower growth for those with direct sales might also be explained by different attitudes toward farm versus nonfarm work. Researchers have found evidence that nonpecuniary benefits from self-employment explain why small business owners remain in business despite earning less income (Hamilton, 2000). There is also evidence that the non-pecuniary benefits to farming (e.g., greater autonomy, independence, and lifestyle factors) are substantial (Key and Roberts, 2009). It is possible that farmers who sell directly to consumers derive greater nonpecuniary benefits from their work—perhaps they enjoy interacting with their customers. This would provide a greater incentive for them to remain in business even with lower business expansion possibilities.

Local Food Systems and the Local Economy

Despite the recent growth in local food systems and markets, economic impact assessments of these activities are still nascent (Boys and Hughes, 2013; O'Hara and Pirog, 2013). Martinez et al. (2010) found empirical support for the notion that local economic benefits may accrue from greater local retention of the spent food dollar, from spillovers to nearby businesses, and from increased entrepreneurship. Subsequent research largely focusing on case studies adds to the evidence reviewed by Martinez et al. that some positive economic impacts can occur. These studies are based in specific local contexts, however, and lack requisite data for complete evaluation. Thus, it is difficult to draw generalizable conclusions about the contributions of local food systems to a region's economy and there are many important areas for future research.

Economic Impact Assessments of Local Food Systems

Most of the local food economic impact assessment studies that are peer-reviewed and have explicit, reliable methodologies focus on the economic impacts of marketing channels, including farm to

[17]The 2007 Census of Agriculture data are used because the 2012 Census did not ask about household income levels.

school programs (Gunter and Thilmany, 2012), food hubs (Schmit et al. 2013), agritourism (Brown et al., forthcoming; Mansury and Hara, 2007), and farmers' markets (Henneberry et al., 2009; Hughes et al., 2008; Sadler et al., 2013). Other studies assess the hypothetical local economic impacts resulting from increased local consumption of locally grown agricultural products (Conner et al., 2008), and look at the links between community-focused agriculture and regional economic growth (Brown et al., forthcoming).

As Martinez et al. (2010) note, the most direct way local food systems can affect local economies is through import substitution—consumers purchasing food produced locally (instead of importing food from a neighboring region, State, or country), which increases economic impacts when local workers and businesses spend additional income (multiplier effects) on inputs or other products locally (Swenson, 2009). (Of course, import substitution can be a "zero-sum game" for the national economy, as regions reducing imports of say, leafy greens, may hurt the region of California dependent upon exporting leafy greens.) The total economic impact is composed of direct effects (the value of new food production and the labor income generated), indirect effects (the value of locally supplied inputs and services), and induced effects (the value of earnings spent in the study region by workers in the direct and indirect supply sectors).

Economic impact assessments of farmers' markets feature most prominently in the literature principally because there is more data on farmers' markets than other marketing channels. Martinez et al. (2010) reviewed this literature, reporting job multiplier effects ranging from 1.41 to 1.78. In essence, each full-time equivalent (FTE) job created at farmers' markets supports approximately half (0.41 to 0.78) a FTE job in other sectors of the region's (in this case, State's) economy.[18] These studies used a case study approach due to the effort required to obtain data and the heterogeneity of producers who sell through farmers' markets (Hardesty and Leff, 2010; LeRoux et al., 2010). Case studies are particularly useful when studying local food systems because policy, non-governmental organization contributions, and other circumstances that affect local food markets tend to vary across locales. Unfortunately, the case study approach makes generalizing research results difficult.

Schmit et al. (2013) conducted the first economic impact assessment of increased demand for food hub goods and services. They find output (dollar) multiplier impacts in New York State ranging from 1.82 to 1.63, which are higher than multiplier impacts from comparable industries such as wholesale trade and truck transportation.

Mansury and Hara (2007) examine a hypothetical agritourism promotion that increases demand for organic produce in a region of New York. They find that a successful campaign to promote organic agriculture increases production output and accrues most benefits to the smallest farm households in the region. Brown et al. (forthcoming) provide the first examination to include both DTC sales and agritourism income. They find no general association between growth in U.S. agricultural sales and growth in DTC and agritourism income, but they do find a positive relationship between the two in certain regions. Brown et al. conclude that DTC sales and agritourism income did not make significant contributions to national economic growth between 2002 and 2007, likely because local or regional impacts are to some extent a zero-sum game. They found that a $1 increase in farm sales led to an annualized increase of $0.04 in personal income in the county.

Swenson's (2011) study of small-scale meat processing in Iowa found that every $1 million in meat processing output required 13.3 jobs that paid $464,870 in labor income. When including the

[18]For a full discussion on interpreting multiplier effects, see Martinez et al. (2010, p. 44.)

multiplier impacts, $1 million of output supports a total of 17.6 jobs, $613,117 in labor income, and $738,777 in Iowa gross domestic product.

The economic benefits of farmers' markets may also extend beyond multiplier effects, which measure short-term impacts. Lev et al. (2003), for example, found that businesses near farmers' markets reported higher sales on market days. Not only were these additional sales found to directly support the businesses themselves, but they also generated extra tax revenue for the communities in which the markets were located. Brown (2002) found some evidence that farmers' markets increase property values in the market district.

Additionally, farmers' markets can function as business incubators by providing the infrastructure necessary to build skills and gain business experience (Feenstra et al., 2003; Gillespie et al., 2007). Regular interactions can "generate and circulate knowledge that vendors might use to develop new products and creative ways of marketing them" (Hinrichs et al., 2004: 32-33). Feenstra et al. (2003), for example, explored New York, Iowa, and California farmers' market contributions to the development of vendors' capacity as entrepreneurs and found that 66 percent of vendors expanded an existing product line, 50 percent added a new product category, and 40 percent made new business contacts. Sales income may be less important than the skills and business experience developed through participation in farmers' markets (Brown et al., 2007).

Challenges With Local Food Economic Impact Assessments

It is difficult to draw overarching conclusions from the existing body of research because most studies have narrow geographic and market scope (O'Hara and Pirog, 2013). Also, there are many definitions of "local food," and clearly delineating what should and should not be included is necessary in order to quantify economic impacts. Gunter and Thilmany (2012) provide the only peer-reviewed research that provides "scenarios" for local food definitions, modeling a hyper-local impact (a two-county farm to school program) and a regional impact (five-county region). As expected, the larger the definition of local, the larger the resulting economic impact.

Low and Vogel (2011) find that most local food systems involve intermediary businesses (e.g., aggregators, distributors, wholesalers) to get the product from farm to market.

Acknowledging the myriad of actors involved in sustaining local food systems is critical to determining its overall economic impact. The varied ownership structures and business headquarter locations (to which profits frequently accrue) of input, distribution, and other businesses servicing the local food system make definitions of both the system and the region challenging.

Other problems plague the existing body of research on local economic impacts. First, most of the current research makes assumptions about local food participants' patterns of expenditure, which may not accurately reflect their interindustry linkages, and so may miscalculate local economic impact.

Second, opportunity costs—or what O'Hara and Pirog (2013) refer to as "interpretation challenges"—remain largely unconsidered (Boys and Hughes, 2013). O'Hara and Pirog (2013) point out that measuring opportunity cost is not straightforward, and requires information about the extent to which increased consumer purchases of locally grown food offset other types of purchases, change market prices and/or supply chain characteristics, or affect land use. For example, to what extent do farmers' markets divert purchases from another "local" outlet versus increase overall purchases? If local food systems in rural areas require public subsidy, what are the opportunity costs of that

subsidy? If acreage is converted from field crops to vegetables, by how much does the income from the vegetables offset the decreased income from field crops? Without accounting for opportunity cost, economic impacts are likely to be overstated, or at least not fully understood.

Only a handful of local food economic impact assessments explicitly acknowledge the need to consider opportunity cost (Conner et al., 2008; Hughes et al., 2008; Gunter and Thilmany, 2012; Tuck et al., 2010; Swenson, 2008, 2010). However, none of this body of research collects the data necessary to more fully understand the opportunity costs of increased local purchases. For example, Hughes et al. (2008) assume a loss in grocery store sales due to expenditures at farmers' markets. They find that the economic impact of farmers' markets was still significant, but reduced substantially when accounting for the opportunity cost of such spending.

Schmit et al. (2013) are the first study to collect primary data to assess the opportunity cost associated with policies that support food hubs. However, their data collection is limited to customers currently purchasing product from food hubs. Even with this limited sample, they find that 49 percent of customers reduce purchases from other sources due to the availability of food hub goods and services and that, on average, total purchases from the local wholesale trade sector are reduced by 11 percent. This reduces the overall multiplier impact of food hubs by 10 percent.

It is not clear how estimates of net economic benefits would be affected if the costs of public investments in local food markets are included. Gunter and Thilmany (2012), for example, write in reference to their economic impact assessment of a farm to school program in Colorado that "as with past studies, a positive economic impact on the local community was found from increased purchasing of locally produced foods. But the impact is quite small and may or may not justify the cost (private and/or public) of the new investments necessary to build needed infrastructure, particularly when the net rather than gross impacts are analyzed."

Another unexplored dimension of opportunity cost is how impacts from local food systems are distributed between urban and rural places. As one might expect, the demand for local food appears to be concentrated in urban areas (Lichter and Brown, 2011; Hinrichs and Charles, 2012; Jablonski, 2014; Jackson-Smith and Sharp, 2008; Low and Vogel, 2011).

Studies of rural farmers' markets point toward urban advantages. Malone and Whitacre (2012) found that the most rural counties were under-represented in DTC sales. Schmit and Gomez (2011) and Jablonski et al. (2011) reported limited overall vendor sales in their studies of rural markets across northern and central New York, respectively. Even in studies of rural communities demonstrating consumer willingness to pay a premium for locally grown produce, evidence shows that there are often not enough customers to offset the production and harvesting expenses (Biermacher et al., 2007).

Food Safety and Local Food Production, Processing, and Marketing

Recent foodborne illness outbreaks in the United States have increased efforts from both government and industry groups to ensure that the U.S. food supply is safe (Palma et al., 2010). This section first discusses the current food safety regulations and standards affecting farms marketing produce and meat locally and then discusses the Food Safety Modernization Act (FSMA) that was signed into law on January 4, 2011. FSMA calls for sweeping changes to the U.S. food safety system for produce as focus shifts from *ex post* control and reaction to food safety incidents to risk-based preventive action with a focus on public health.

Current Food Safety Standards Affecting the Local Marketing of Fresh Produce

Based on the 2012 Census of Agriculture and ERS calculations, 37 percent of farms selling produce are engaged in DTC or intermediated sales. Prior to the passage of FSMA, Federal statutory law did not regulate the safety of fresh produce, which is grown on 8.4 percent of U.S. farms. Instead, private food safety standards—either voluntary, imposed by buyers, or industry-led commodity-specific initiatives—are prevalent throughout fresh produce markets.

A public food safety education program for fresh produce growers and packers began in 1998 when the Food and Drug Administration (FDA) published its *Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables*. All producers, including small producers of locally marketed fruit and vegetables, are encouraged to be Good Agricultural Practices (GAP) compliant. With partial support from FDA and USDA, a National GAPs Program was established to reduce microbial risks in fruits and vegetables by developing a comprehensive extension and education program for growers and packers (http://www.gaps.cornell.edu/index.html).

For more than a decade, USDA's Agricultural Marketing Service (AMS) has offered voluntary GAP and Good Handling Practices (GHP) audits of produce suppliers throughout the production and supply chain (USDA AMS, 2014). In 2012, the USDA Audit Program performed over 3,000 audits in 46 States, Canada, and Chile, covering over 90 commodities. Many produce buyers and food-service companies—including the USDA Commodity Procurement Program, Sysco, Subway, and Wal-Mart—recognize USDA's GAP and GHP certifications as an approved supplier audit (Wallace Center Winrock International, 2012).

Growers are motivated to become GAP certified in order to ensure customers of food safety, meet buyers' requirements, maintain market access, and manage their own business risk as an outbreak can damage a brand name or bankrupt a business (Becot et al., 2012; Calvin et al., 2004; Durham et al., 2011). Local food producers participating in farm to school programs may be compelled by schools or by the State to keep a record of their agricultural and manufacturing practices, and to observe quality control measures (Holcomb et al., 2013).

In response to small producer concerns regarding the cost and time needed for food safety verification, AMS crafted the ***Group GAP Pilot Project*** in 2010 (Wallace Center Winrock International, 2012). Small and midsize farms may be less likely to become certified under GAPs and GHP because of the perceived burden of recordkeeping and modifying farm infrastructure and equip-

ment (e.g., adding bathrooms, handwashing stations, and washing/rinsing systems for produce). The Group GAP Pilot Project is based on an international standard whereby a group of farms develop shared quality standards and operating procedures and are audited as one entity.[19]

Successfully transitioning USDA's Group GAP pilot project into a working, market-ready system will help alleviate some compliance challenges faced by small local producers of fruit and vegetables, providing much needed support to local and regional food systems. Following early pilot work with Good Natured Family Farms in the Kansas City region, AMS teamed up with the Wallace Center in 2013 to spearhead the selection of initial pilots (hubs or farmer groups), develop the first draft of a group GAP for use by the pilots, and raise funds to support development, outreach, and implementation of the program.

Private firms also provide independent third-party food safety audits for fresh produce. Buyers often require suppliers to abide by particular food safety requirements and compliance audits as they respond to increased consumer demand for food safety and assess their own liability risk. Produce farms, including small farms, wishing to market to big retailers must comply with their food safety requirements. Holcomb et al. (2013) indicate that many buyers now want a food safety audit that is recognized by the Global Food Safety Initiative (GFSI).[20] In 2008, Wal-Mart became the first nationwide U.S. grocery chain to require suppliers of its private label and other food products (i.e., produce, meat, fish, poultry and ready-to-eat foods) to have their factories certified against GFSI standards. For growers, a GFSI-compliant audit will often fulfill the needs of multiple buyers.

Holcomb et al. also cited Wal-Mart as recently embracing corporatewide efforts to make fresh produce suppliers adhere to the Produce Traceability Initiative requirements, without exemptions or exclusions for small farms or local produce. Increasingly, larger foodservice establishments (e.g., schools, hospitals, food retailers, and even farmers' markets) are requiring that their suppliers have food product liability insurance in order to mitigate the financial burden of foodborne illness outbreaks. In Boys' (2013) study, surveyed specialty crop farms in the Southeast were motivated to purchase liability insurance by traceability concerns, buyer requirements, and marketing strategy goals.

Some fresh-produce industry groups have developed their own commodity-specific food safety plans, often after a major foodborne illness linked to their industry.[21] For example, in 2006 a major foodborne illness outbreak was linked to spinach from California contaminated with *E. coli* O157:H7. The outbreak involved 204 illnesses in 26 U.S. States and Canada, 104 hospitalizations, 31 cases of kidney failure, and 3 deaths. The following year, the California Leafy Greens Marketing Agreement (LGMA) was established. It is a *voluntary* marketing agreement that establishes food safety standards and a process for *mandatory* audits for participants, organized by the California Department of Food and Agriculture with assistance from USDA's Agricultural Marketing Service

[19]For more information, see http://www.ngfn.org/resources/food-safety/introduction-to-globalgap-group-certification-option-2.

[20]GFSI was launched in 2000 as a non-profit organization focusing on a collaborative approach to the harmonization of food safety standards throughout the supply chain. Presently, the focus is to facilitate collaboration among international food safety experts for the continuous improvement of food safety management systems. Activities include harmonization of the definition of food safety requirements, development of a capacity building plan for small and/or less developed businesses to facilitate access to local markets, and a common consensus on the skills, knowledge and attributes for competency among food safety auditors (GFSI, 2014).

[21]Large, concentrated, homogenous industries often have an easier time organizing to develop a food safety program than smaller, more dispersed, or more heterogeneous groups of farmers (Avendaño and Calvin, 2006).

(Calvin, 2007). The food safety standards in the LGMA are much more specific than the FDA GAPs (which are generic for any commodity). For example, GAPs instruct growers to make sure that the water quality is adequate to carry out food safety protocols but do not specify acceptable water quality standards. LGMA membership stands at over 100 handlers[22] representing 99 percent of the volume of California leafy greens production (LGMA, 2014). Other commodity-specific audit programs include the Arizona LGMA, Mushroom Good Agricultural Practices, and the Tomato Food Safety Audit Protocol.[23]

Food Safety Regulations and Locally Marketed Meat

The number of livestock farms with DTC sales increased by 1,349 (1.2 percent) between the 2007 and 2012 Censuses of Agriculture, even as the number of livestock farms declined by 269,833 (18.6 percent); consequently, the share of livestock farms with DTC sales rose from 7.5 percent to 9.3 percent in 2012.[24] In 2012, livestock farms reported $648 million in earnings from DTC sales, nearly half the value of all DTC sales.[25]

Under the Federal Meat Inspection Act, all meat slaughter and production for interstate commerce must fall under inspection administered by USDA's Food Safety and Inspection Service (FSIS) or by cooperative state inspection programs.

There are some exemptions to inspection. For instance, an owner of a live animal may have that animal slaughtered at an establishment known as "custom-exempt." This exemption allows the processor to forgo daily State or Federal inspection, though the processing still must occur under basic sanitation. The resulting product must be labeled "not-for-sale." Custom-exempt processing cannot be used when a producer is marketing local meat, only when marketing live animals—e.g., selling a finished steer to a buyer who has it slaughtered for personal use (Johnson et al., 2012).

Studies show that food safety requirements for meat processors place a large burden on smaller processors—those most likely to serve producers marketing meat locally (Muth et al., 2007). The most common barrier affecting the smallest meat processors was that their average cost of compliance, as a share of revenue, was high relative to the industry average. USDA FSIS has a Small Plant Help Desk and prepares compliance guides to assist in dealing with regulatory matters. Moreover, the food safety requirements provide benefits to consumers, producers, and processors by greatly limiting the possibility that unsafe product enters commerce. Thus, the consumer is protected from illness, and the producer and processor are protected from product liability.

FSIS also has jurisdiction for poultry slaughter under the Poultry Products Inspection Act, although that law carries an exemption to daily inspection for producers who slaughter fewer than 20,000

[22]A handler is any person or company that handles, processes, ships or distributes leafy green product for market whether as owner, agent, employee, broker, or otherwise; retailers are not considered handlers (LGMA 2011/12 Annual Report).

[23]For more information on commodity audit programs see: http://www.ams.usda.gov/AMSv1.0/CommodityAudit.

[24]Data on intermediated sales were not collected in the 2007 Census of Agriculture, so we focus on DTC sales, for which we can assess growth. In 2012, 119,620 livestock farms had intermediated or DTC sales whereas 109,955 had DTC sales.

[25]This value includes DTC sales from livestock farms selling through only DTC channels and those selling through both DTC and intermediated channels.

birds per year.[26] Generally, poultry processed under this exemption can be marketed only directly to consumers, hotels and restaurants, or regional distributors like food hubs (USDA FSIS, 2006). The exemption prohibits producers/processors from selling their product to other processors for further processing (e.g., chicken sausage production). The exemption also prohibits interstate sales, although FSIS does have a cooperative program with qualified state inspection systems to allow the retail of state-inspected product out of state under limited circumstances.

Another opportunity for small producers is mobile slaughter. A mobile slaughter unit may travel from producer to producer to slaughter and process individual animals under Federal or State inspection.

Processing Locally Marketed Meats

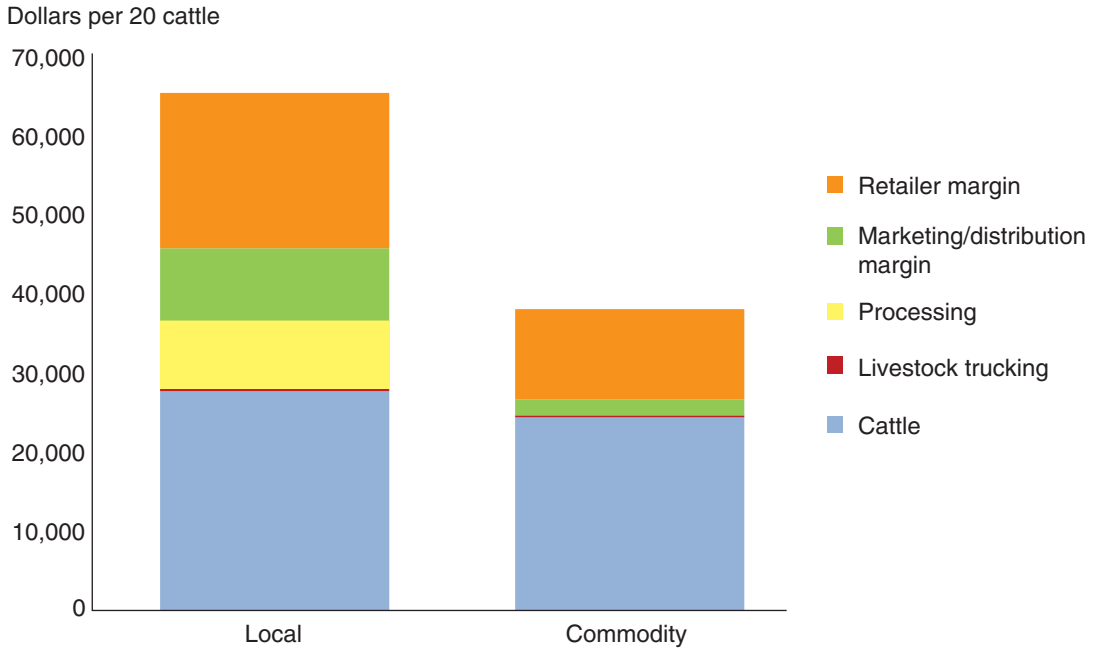
Access to meat processors with required inspection processes and the ability to customize orders is key to providing customers with locally produced meat products. While large processers typically produce standardized products, allowing for greater economies of scale, many small processors gain comparative advantage by providing customized products like special cuts, sausages, cured meats, and custom packaging/labeling. Difficulty aggregating animals of similar size and biosafety concerns limit the ability of large meat processors to serve small meat producers. Small producers and processors alike are faced with the need to manage costs without the benefit of economies of scale, requiring meat producers to identify small processors that can match their size and unique needs.

While demand for locally sourced animal products has increased (Woods, 2013), the number of small federally inspected cattle slaughter plants (those slaughtering under 10,000 head per year) has declined by 12 percent since 2001 to 554 in 2013, according to USDA NASS data. The majority of meat production in the United States takes place at large facilities built to process up to millions of animals annually. Ninety-four percent of cattle slaughtered in 2013 were processed in facilities that slaughtered at least 100,000 cattle during the year (USDA, NASS 2014). The scale of these operations is not suitable for customized orders, as evidenced by the overwhelming variation in processing, marketing, and distribution costs between locally marketed products and commodity products processed in large facilities (fig. 7).

Case studies have shown that producer/processor cooperation is crucial to satisfying the needs of local producers and processors. For example, Smucker's Meats in Mount Joy, Pennsylvania, has operated since 1965, but has expanded significantly in recent years after focusing on federally inspected processing for local customers on a fee-for-service basis (Gwin et al., 2013). Of Smucker's 150 regular customers, around 20-30 provide a steady amount of animals for processing on a weekly or monthly basis, thus guaranteeing a consistent revenue stream for the company. In return, Smucker's has provided producers with marketing assistance, delivery discounts, and help in finding markets for unwanted trim.

[26]To put 20,000 birds in perspective, slaughtering 20,000 birds might gross a producer $118,044 in 2013. This figure is estimated with the following assumptions: In the United States, 8.6 billion chickens were slaughtered in 2013 (USDA, NASS, 2014). The 2013 average live weight for young chickens (broilers) totaled 5.92 pounds. In 2013, the wholesale market price for broiler meat averaged 99.7 cents/lb (USDA, ERS, 2014). Thus, using the average weights and price as proxies, slaughtering 20,000 birds could gross a producer $118,044 in 2013.

Figure 7
Illustrative costs for marketing local and commodity beef



Note: Assumes 20 USDA select 660-lb carcasses, 62-percent carcass-to-meat yield and conventional margins. Commodity beef processing costs are generally fully offset by sales of byproducts.
Source: Gwin et al., 2013.

The Food Safety Modernization Act

Despite the mix of public and private standards in place, food safety incidents continue to occur. According to recent data from the Centers for Disease Control and Prevention, about 48 million people (1 in 6 Americans) get sick, 128,000 are hospitalized, and 3,000 die each year from food-borne diseases (http://www.fda.gov/Food/GuidanceRegulation/FSMA/ucm239907.htm). The 2011 Food Safety Modernization Act (FSMA) calls for sweeping changes to the U.S. food safety system for produce. Regulatory focus shifts from contamination containment to prevention. Language was included in FSMA legislation directing the FDA to implement the law in a way that is flexible, participative, consistent with Codex standards, and sympathetic to small business issues and industry's role in food safety with an overarching focus on public health. The rulemaking process for FSMA is ongoing and will ultimately include numerous new rules (i.e., regulations) and guidance documents. Five rules lay the cornerstone of the prevention-based, modern food safety system to be developed under FSMA.[27]

Compliance with food safety regulations may pose special challenges for food producers marketing their products locally. These producers tend to be smaller than farms and firms selling their prod-

[27]While FSMA will encompass multiple rules, FDA has identified Standards for Growing, Harvesting, Packing, and Holding of Produce for Human Consumption (The Produce Safety Rule), Current Good Manufacturing Practice and Hazard Analysis and Risk-Based Preventive Controls for Human Food (Preventative Controls Rule), Food Supplier Verification Programs (FSVP) for Importers of Food for Humans and Animals (Foreign Supplier Verification Program), Accreditation of Third-Party Auditors/Certification Bodies to Conduct Food Safety Audits and to Issue Certifications (Accredited Third-Party Certification), Current Good Manufacturing Practice and Hazard Analysis and Risk-Based Preventive Controls for Food for Animals (Animal Food) as the five cornerstone rules.

ucts on the national market. In addition, much of the food marketed locally is marketed directly to consumers and without any prevailing requirements for food safety practices or standards. The meat industry is almost entirely unaffected by FSMA, which increases the regulatory authority of FDA. USDA's Food Safety and Inspection Service (FSIS) has the authority to regulate the safety of meat and poultry products (and, under the 2014 Farm Bill, fish of the order Siluriformes, commonly known as catfish), while FDA regulates the safety of non-livestock products and other seafood.[28] For this reason, the remainder of this section focuses solely on the impact of FSMA on produce production, with an emphasis on fresh produce intended for local marketing.

Produce Safety and Preventive Controls Rules and Growers Marketing Locally

With the growing importance of produce in a healthy diet and recognition of several high-profile foodborne illness outbreaks associated with these foods, FSMA (Section 105) directs FDA to establish minimum science-based standards for the safe production and handling of fruits and vegetables. FDA's analysis of available foodborne illness outbreak data document 131 outbreaks associated with contaminated produce between 1996 and 2010, causing more than 14,000 illnesses and 34 deaths (FSMA Proposed Rule for Produce Safety http://www.fda.gov/downloads/Food/GuidanceRegulation/FSMA/UCM359258.pdf). Two draft rules focusing on fresh produce build on prevailing voluntary industry guidelines for food safety. These draft rules focus on setting enforceable standards that are reasonably necessary to prevent the introduction of known or reasonably foreseeable biological hazards and providing reasonable assurances that produce is not adulterated on account of these hazards. This will be the first time that FDA will have jurisdiction over onfarm activities, and FSMA will impose relative uniformity of standards across suppliers of fresh produce. Currently, food safety in produce is a mixture of decisions by individuals, grower organizations, buyers, and governments that can vary by farm size, commodity, region, and country.

Two proposed rules of particular interest to produce growers were initially released for public comment in January 2013. These are the Produce Safety Rule—*Standards for Growing, Harvesting, Packing, and Holding of Produce for Human Consumption*—and the Preventive Controls Rule—*Current Good Manufacturing Practice and Hazard Analysis and Risk-Based Preventive Controls for Human Food*. At the same time, a preliminary regulatory impact analysis was released, and FDA began soliciting stakeholder feedback through a series of public listening sessions, multiple site visits, and written comments.[29]

While no final rule is yet in place, the draft Produce Safety Rule would establish science-based minimum standards for the safe growing, harvesting, packing, and holding of produce in its raw or natural (unprocessed) state on farms. Other than sprouts, where risks were determined to be particu-

[28]FDA also has authority to regulate the safety of products with "relatively small proportions of livestock ingredients," e.g., with 2 percent or less cooked meat or poultry ingredients, by weight (USDA, 2005: http://www.fsis.usda.gov/OPPDE/larc/Policies/Labeling_Policy_Book_082005.pdf).

[29]Feedback was extensive from consumers and producers (small and large growers and handlers). Based on input received, FDA announced in December 2013 it would revise sections of the Produce Safety Rule. The revised rule was released while this report was in the process of being cleared for publication (September 29, 2014), and comments on the revised provisions are being accepted for 75 days after the publication date. Although not necessarily an exclusive list, sections of the January 2013 draft rules specifically identified for updates include water quality and testing, standards for using raw manure and compost, some provisions for mixed-use facilities, and procedures to withdraw qualified exemption (Taylor, 2013 http://www.fda.gov/Food/GuidanceRegulation/FSMA/ucm379397.htm).

larly high, the focus is on identified routes of microbial contamination (agricultural water; manure, and other biological soil amendments of animal origin; worker health and hygiene; equipment tools, buildings, and sanitation; and domesticated and wild animals) rather than commodity-specific standards. The proposed Rule applies to raw agricultural commodities (RAC) and activities within the *farm* definition. (See box for FSMA product coverage.)[30]

Several limitations on coverage will be particularly relevant for small and local fresh produce suppliers. Farms will be partially exempt from the proposed rule if their food sales average less than $500,000 per year during the last 3 years and a majority of the value of food sales is sold directly to qualified end-users. Qualified end-users include the direct consumer of the food (i.e., consumers purchasing food at DTC outlets) or a restaurant or retail food establishment (e.g., a grocery store) located in the same State as the farm or not more than 275 miles away.[31] These farms will need to label their products with the name and business address of the farm, visible at the point of sale, and the exemption can be withdrawn if the farm is directly linked to an outbreak or if FDA determines it is necessary to protect the public health.

Additional exemptions are included for small farms with less than $25,000 in annual value of food sold during the previous 3-year period and for produce that is used for personal or onfarm consumption. While these qualified exemptions from FSMA food safety standards will apply to small produce farms, individual buyers will determine whether to require FSMA—or other food safety standards—from their suppliers. In addition to the exemptions based on farm size, commodities that FDA determines constitute the lowest risk with respect to biological hazards are excluded from regulation under the FSMA rule on produce safety. These are products that are rarely consumed raw (like artichoke or eggplant) or that are destined for further processing that includes a kill step.

The extent to which fruit and vegetable farms may be exempt is unclear. In 2012, 60 percent of U.S. farms growing fruit and vegetables had annual farm sales less than or equal to $25,000 (U.S. Census of Agriculture, 2012).[32] Although this number is not directly comparable to the FSMA exemption, which is for a 3-year average, this percentage suggests a large proportion of fruit and vegetable *farms* meet the first criterion for exemption under the proposed Produce Safety Rule. Farms with sales under $25,000 in 2012 accounted for only 1.3 percent of U.S. fruit/vegetable farm sales, so most of the value of fruit/vegetable farm sales would be non-exempt. With regard to the qualified exemption, 35.3 percent of all fruit and vegetable farms had both DTC or intermediated sales and sales under $500,000, the closest proxy for "qualified end users" available using census of agriculture data.[33]

The Produce Safety Rule is proposed to become effective 60 days after FDA issues a final rule in the *Federal Register*, but producers will not be expected to comply immediately. At the time this report was written, the proposed rule stipulated that most farms would have 2 years to comply while

[30]Under the January 2013 FSMA definition, a *farm* is characterized as a facility in one general location that grows and harvests crops or raises animals (plus seafood) or both. Included are facilities that pack or hold food provided that the food packed or held in storage is grown, raised, or consumed on the farm or another farm with the same owner. Facilities that manufacture or process food may also be considered a farm if all the food processed in that farm is consumed on the same farm or another farm with the same owner.

[31]Qualified end users do not include food hubs or regional food aggregators.

[32]FDA's published estimates on number of farms that will be exempt and partially exempt from the proposed produce safety rule are different from these estimates; our estimates are based on 2012 Census of Agriculture data.

[33]The Census of Agriculture does not report a value for intermediated sales, only a count of farms with intermediated sales and the value of direct-to-consumer sales.

smaller operations are granted a longer grace period. Farms with less than $250,000 in average annual value of food sales over the previous 3 years will have 4 years to comply. Farms with $250,000 to $500,000 in average annual food sales would have 3 years to comply. For some water requirements, 2 extra years to comply will apply to all farms regardless of size.

Some of the proposed standards conflict with current production practices but may be changed as FDA prepares revisions to the Produce Safety Rule. For example, the January 2013 draft proposes standards for the use of biological soil amendments (manure and compost) that are more restrictive than USDA's requirement for organic production (NOP).[34] Under the proposed rule, when untreated manure is applied in a manner that does not contact covered produce and minimizes the potential for contact with covered produce after application, a 9-month waiting period is required between application and harvest.[35] The NOP, on the other hand, imposes a shorter interval between manure application and harvest (90- and 120-day intervals), depending on whether the edible portion of the crop comes in contact with the soil. Local food farms are more likely to use manure as a fertilizer and will thus be affected disproportionately, whether or not they are organic (see table 9 for share of DTC farms using manure as fertilizer versus non-DTC farms). Because of the longer wait time, local food farmers may choose to switch from manure to synthetic fertilizers (with associated costs). In the United States, 40 percent of organic farms market in DTC outlets.

Product scope under FSMA's proposed produce safety rule

The January 2013 draft produce rule applies to most fruit and vegetable commodities, including mushrooms, sprouts, peanuts, tree nuts, and herbs, in a raw or natural (unprocessed) state destined for human consumption. The draft rule does not apply to the following products:

- Produce that is rarely consumed raw;
- Produce that is not considered a raw agricultural commodity (RAC);
- Produce that is intended for commercial processing with a kill step such as canning, cooking, drying to create a distinct product like raisins, or pasteurizing (documentation is still required); and
- Produce used for personal or onfarm consumption.

FDA defines a RAC as "any food in its raw or natural state, including all fruits that are washed, colored, or otherwise treated in their unpeeled natural form prior to marketing." For example, a head of field-packed lettuce for sale is considered a RAC, but a head of lettuce processed into a bagged salad is not a RAC (Calvin, 2013). Similarly, a bag of fresh apples is considered a RAC but fresh-sliced apples in individual-serving packages are not a RAC. Commodities not typically consumed raw are exempted and include arrowhead, arrowroot, artichokes, asparagus, beets, black-eyed peas, bok choy, brussel sprouts, chick peas, collard greens, cranapples, cranberries, eggplant, figs, ginger root, kale, kidney beans, lentils, lima beans, okra, parsnips, peanuts, pinto beans, plantains, potatoes, pumpkin, rhubarb, rutabaga, sugarbeet, sweet corn, sweet potatoes, taro, turnips, water chestnuts, winter squash (acorn and butternut squash), and yams.

[34]While FDA published voluntary guidelines in 1998 for manure and compost use for all agricultural producers, USDA established mandatory requirements for organic producers as part of the national organic regulation published in 2000.

[35]FDA's supplemental proposal will likely revise this to focus on developing a risk assessment and needed research prior to establishing the waiting period between application and harvest in the final rule.

The January 2013 draft Preventive Controls Rule focuses on reducing food safety risks in facilities that manufacture, process, pack, or hold human food, including farms participating in these activities. The 2012 Census of Agriculture reports that 7.5 percent of U.S. fruit/vegetable farms had packing facilities; of these farms, 85 percent engaged in DTC or intermediated sales. The Preventive Controls Rule proposes that each food facility registered with FDA have in place a written food safety plan that includes hazard analysis, risk-based preventive controls (to include a blueprint for recall in case of a foodborne crisis), monitoring procedures, corrective actions, verification, and recordkeeping. Activities within the definition of *farm* would not be subject to this proposed rule. If a farm manufactures, processes, packs, or holds food that is *not* grown, raised, or consumed on that farm or is from someone else's farm then, under the January 2013 draft, the Preventive Controls Rule applies. Additionally, if a farm manufactures or processes food (including food manufactured or processed from another farm they own) but the food is not consumed on any of the farms they own, then the Preventive Controls Rule applies.

FSMA and Small Produce Farms Marketing Locally

While benefits from FSMA are calculated in terms of reduced illness and improved public health outcomes, additional costs incurred by individual producers or businesses will vary depending on current practices, access to exemptions, and timing of implementation. Research on the potential economic impacts of FSMA for smaller producers—the vast majority of local food farms—and processors is limited. Some insights on the potential economic implications of FSMA on the local and regional food industry, however, can be gleaned from related studies examining the economic impact of food safety initiatives and programs on smaller fruit and vegetable producers. The Oregon Public Health Institute indicated that, among the small and midsized fresh fruit and vegetable farms surveyed in Oregon, limited net farm income constrained the financial capacity of some growers to make costly onfarm improvements to meet GAP and GHP requirements (Prenguber and Gilroy, 2013).

In implementing FSMA standards, larger producers may benefit from economies of scale (Becot et al., 2012; Bovay and Sumner, 2013; Parker et al., 2012; Paggi et al., 2010). A survey of California leafy greens growers found that small and midsized farms incurred higher average costs per acre than large farms for all LGMA-dictated *modifications* since many larger farmers already had the required practices in place (Hardesty and Kusunose, 2009). Implementation of food safety requirements across farms, even with some fixed cost, can provide new marketing windows from smaller production areas if supply patterns shift, however. Woods et al. (2012) found that adoption of GAPs by fresh strawberry growers nationally could open in-season marketing windows for smaller production areas.[36]

Like all producers, small producers participating in local food systems may be unclear about how new food safety regulatory agendas will influence their cost structure, profitability, and market access (Martinez et al., 2010). A challenge is determining what they need to know and determining what they need to do, which must occur in conjunction with choosing their local food marketing channels.

Survey results of vegetable growers in Minnesota indicate that the greatest need in educational GAP training—particularly for small producers growing a diverse set of vegetable crops and marketing via DTC outlets—is in the areas of treating wash and processing water, taking measures to keep animals out of production fields, and sanitizing harvesting tools and containers on a scheduled basis

[36]Firms were not explicitly modeled, so production area can only serve as a proxy for firm-size in this example.

(Hultberg et al., 2012). Many private consulting firms and programs offer assistance with regulatory awareness and compliance, but their services may be costly for small farms.

Several publicly available training and outreach efforts are available to assist all producers including those that are resource-limited. The Produce Safety Alliance (PSA) and the Food Safety Preventive Controls Alliance (FSPCA) were launched in 2011. The Sprout Safety Alliance (SSA) was launched in 2012. All three efforts are designed to serve as broad-based public-private forums consisting of key industry, academic, and government stakeholders whose mission is to support safe food production by developing a nationwide core curriculum, training, and outreach programs. PSA is a collaborative project between Cornell University, USDA, and FDA that aims to provide industry training and education opportunities on current best practices and to guide future regulatory requirements, with special emphasis on small and very small farms and packinghouses (Produce Safety Alliance, 2014).[37]

[37]FDA also provides support for FSPCA and SSA.

Who Buys Local and Regional Foods and Why?

Understanding who buys local foods and why are valuable for targeting marketing efforts by producers as well as grocery stores, restaurants, and other food sellers. This information can also be useful when shaping public policies and programs aimed to support the local and regional food systems. Studies of consumers' willingness to pay (WTP) a premium for local food provide insights into whether any higher prices for local foods will provide a sufficient incentive to sell food locally, either through a DTC outlet or through an intermediary such as a grocery store. Martinez et al. (2010) reviewed literature on consumer WTP for local food as well as demographic characteristics of consumers that purchased local food. This section updates the literature review in Martinez et al.

What Motivates Consumers to Shop for Local Food?

In the nationally representative U.S. Grocery Shopper Trends Survey, conducted by a supermarket industry association, over 80 percent of surveyed grocery store shoppers reported purchasing local foods occasionally, while 9 percent reported purchasing local foods whenever possible (Food Marketing Institute, 2011). The survey also asked consumers' top reasons for buying locally grown foods in grocery stores. Freshness was the most frequent reason (83 percent) cited, and taste was the number three reason (with 56 percent) for buying local food (Food Marketing Institute, 2011). An earlier national survey, collected in 2003, found an interest in healthy, safe, and fresh foods increased the likelihood of buying locally (Zepeda and Nie, 2012).

Local food shoppers in the 2011 Trends survey were also concerned about supporting the local economy, a reason cited by 68 percent of grocery store shoppers shoppers (the second most-cited reason for buying locally-grown foods in grocery stores). Regional studies find a similar pattern (Rainey et al., 2011; Bean and Sharp, 2011).

Several studies have found that the social desirability of buying local food plays a central role in influencing consumers to participate in the local food economy.[38] A national survey found consumers who bought directly from farmers were strongly influenced by others around them, and felt confident that their actions "make a difference" for public and private outcomes (Onozaka et al., 2010). In Michigan, local food consumer activists reported a feeling of empowerment that comes from sourcing their own food locally (Bingen et al., 2010, Bingen et al., 2011). In another Michigan study, the perceived social desirability of buying local food may have led consumers to exaggerate the level of shopping at farmers markets (Conner et al., 2010).

Interestingly, the Trends survey did not identify food safety as a top motivation for purchasing local food, although knowing the foods' source—cited by 40 percent—could reflect concern for food safety. Studies in the Southeast and Arkansas found food safety to be among the motivations of farmers' market shoppers, with respect to both general food safety concern (Maples et al., 2013) and conscious attempts to avoid synthetic chemicals in food (Crandall et al., 2011). It is hard to generalize from smaller scale studies such as these, and results may apply only to the studies' respective area or set of circumstances.

[38]This literature review updates Martinez et al. (2010), which found that both national and regional studies found local food shoppers had certain attitudes in common, such as interest in cooking/gardening and supporting local businesses and producers.

The 2011 Trends survey found that 27 percent of respondents cited concern over the environmental impact of transporting food, but this was not one of the top motivations for buying local food in grocery stores. A 2003 national study found that concern for the environment increased the likelihood of buying locally (Zepeda and Nie, 2012).

How Much Do Demographic Characteristics Matter?

Studies found mixed results on the relationship between consumers' demographic factors and their likelihood of acquiring local food.[39] Some studies found that surveyed farmers' market patrons were predominantly female (Mayes, 2013) and that buying local produce was more likely among white families (Racine et al., 2013). In a study of Michigan consumers, Colasanti and colleagues (2010) cited the consensus of previous literature that farmers' markets tend to be patronized by narrow segments of society, especially White and middle to upper class. Still, among diverse study participants, interest in fresh, local products was widespread.

A national study found that consumer interest in local food varies regionally. Survey respondents who live in the Northeast were most likely to shop farm-to-consumer venues at least weekly (Blanck et al., 2011). Rural-urban differences have also been observed, but are not consistent in direction. Two separate studies in North Carolina found that local buying behavior was more likely in rural areas (Racine et al., 2013; McGuirt et al., 2014), partly due to price savings. In Albuquerque, New Mexico, consumers living in the most urbanized area had a stronger preference for "non-conventional"—local or organic—produce (Holmes and Yan, 2012).

Not surprisingly, distance to the local food outlet may be equally or more important than the metro status or region of consumers' location. In North Carolina and Texas, participants were increasingly willing to shop at the farmers' market when the market was incrementally closer to their residence (McGuirt et al., 2014, Abelló et al., 2014). In Albuquerque, consumers who travel the smallest distance for food shopping were most likely to buy "non-conventional" produce even in conventional grocery stores (Holmes and Yan, 2012), although this result could reflect correlation between distance traveled and other factors.

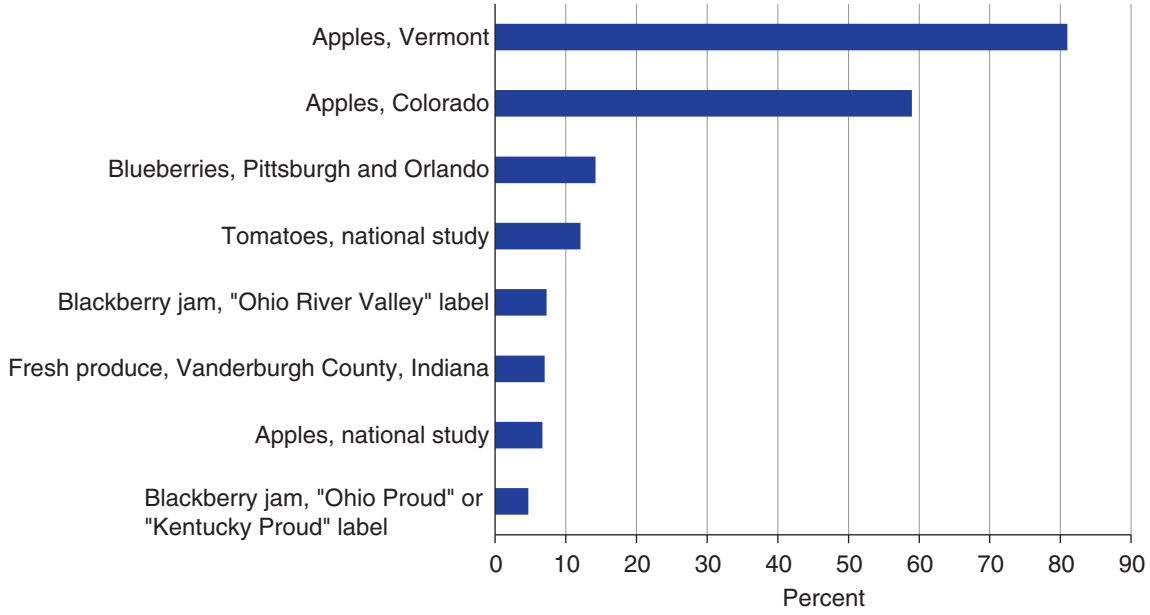
Recent literature has also identified differences in direct-market consumers according to venue type, which is of particular interest because many data sources do not differentiate between DTC marketing venues. Such differences could be related to the different levels of financial commitment required for CSA membership versus shopping at farmers' markets.

How Much Will Consumers Pay for Local Food?

Willingness to pay (WTP) studies use a variety of techniques to estimate the premium that consumers are willing to pay for a given attribute. Like the WTP studies reviewed by Martinez et al. (2010), more recent studies also show a large range in WTP among different locations and products (fig. 8). The studies also shed light on what is driving consumer WTP for local food, although comparisons are limited by differences in methodology and lack of generalizability of the

[39]This literature review updates Martinez et al. (2010), which found that studies of consumer characteristics varied in their conclusions, with two national studies finding education and income unimportant but some State and regional studies finding that local food purchases were more likely among higher income and more educated consumers.

Figure 8
Willingness to pay for local food (percent premium)



Source: Willingness to pay as a percent of base price calculated from reported results from the following: Apples/Vermont from Wang et al., 2010, averaged over respondents that had and had not purchased organic food. Apples/Colorado from Costanigro et al., 2011. Blueberries from Shi et al., 2013. Tomatoes/national and Apples/national from Onozaka and Thilmany, 2012. Blackberry jam from Hu et al., 2012. Fresh produce/Vanderburgh County from Burnett et al., 2011.

studies. The following review focuses primarily on WTP studies published after the 2010 review by Martinez et al.[40]

The relationship between WTP and distance is not consistent across studies, similar to results from studies of consumers who already purchase local food. One study focusing on the role of distance found that average WTP increased for labels claiming production closer to home (Burnett et al., 2011). Another study found WTP for blackberry jam labeled as having been produced in a specific area of the State was higher than for jam bearing a State label, but a broader regional label was apparently valued just as highly as substate claims (Hu et al., 2012).

More recent studies have further explored the role of attributes associated with local food as well as interactions among multiple "non-conventional" attributes. Onozaka and Thilmany-McFadden (2012) explored the interactions and substitutions among multiple attributes in a national survey focusing on apples and tomatoes. The study quantified WTP for different combinations of claims, including product origin (locally grown; imported from Chile, Canada, or Mexico), certified organic, certified fair trade, and carbon footprint. WTP for local was higher than for the other attributes.

[40]Martinez et al. (2010) found that estimates of consumers' WTP for local food ranged from a 9-percent premium for New England specialty products (syrup) and Colorado potatoes to a 50-percent premium for fresh Florida-grown produce. Consumers with higher WTP placed higher importance on quality, nutrition, the environment, and helping local farmers.

Costanigro and colleagues (2014) found that increased information can have different effects on WTP for different consumers. James et al. (2009) also studied the effect of information through background knowledge of agriculture, nutrition, and the environment and found that increased knowledge *decreased* WTP for local applesauce (James et al., 2009). The authors suggest that consumers with more knowledge about agriculture expect additional benefits for a higher price and feel they are able to judge these benefits.

Institutional Local Food Consumers

Restaurants also provide a channel for local food to reach consumers. In some cases, producers have organized cooperative efforts to market to restaurants, such as Colorado Crop to Cuisine (Thilmany, 2004). The type of restaurant was an important factor in the prevalence of local sourcing, with anecdotal evidence that smaller gourmet restaurants were more likely to purchase local food (Curtis and Cowee, 2009).

Recent surveys in Alabama, Nevada, and upstate New York have explored the prevalence of local sourcing in restaurants and barriers to sourcing locally. While survey response rates are low, ranging from 10 to 26 percent, the results provide some insights into perceived obstacles to local sourcing for restaurants. The studies found similar barriers, including inadequate availability, inconvenience, and lack of knowledge about where to purchase local food or what is available locally.

Availability of local ingredients through regular food distributors may be important. In Alabama, where 51 percent of respondents reported sourcing local ingredients, 70 percent of those that purchased locally obtained local food through their distributors, while about half bought from farmers' markets and 40 percent bought directly from farmers (Reynolds-Allie and Fields, 2012). Since the time required to buy local food was cited as an obstacle, increasing availability of local food through distributors could mitigate this barrier.

Other institutions such as hospitals, colleges, and universities have expressed interest in using locally produced food in foodservice. Huang et al. (2011) found that about 6 percent of hospitals surveyed nationally had started a local food buying program, among other practices to enhance sustainability. Some institutions have begun sourcing locally in response to encouragement from the American Dietetic Association's statement on sustainability. The nonprofit group Health Care Without Harm encourages hospitals to source food locally both for environmental reasons and to provide fresh and healthful food for patients and staff.

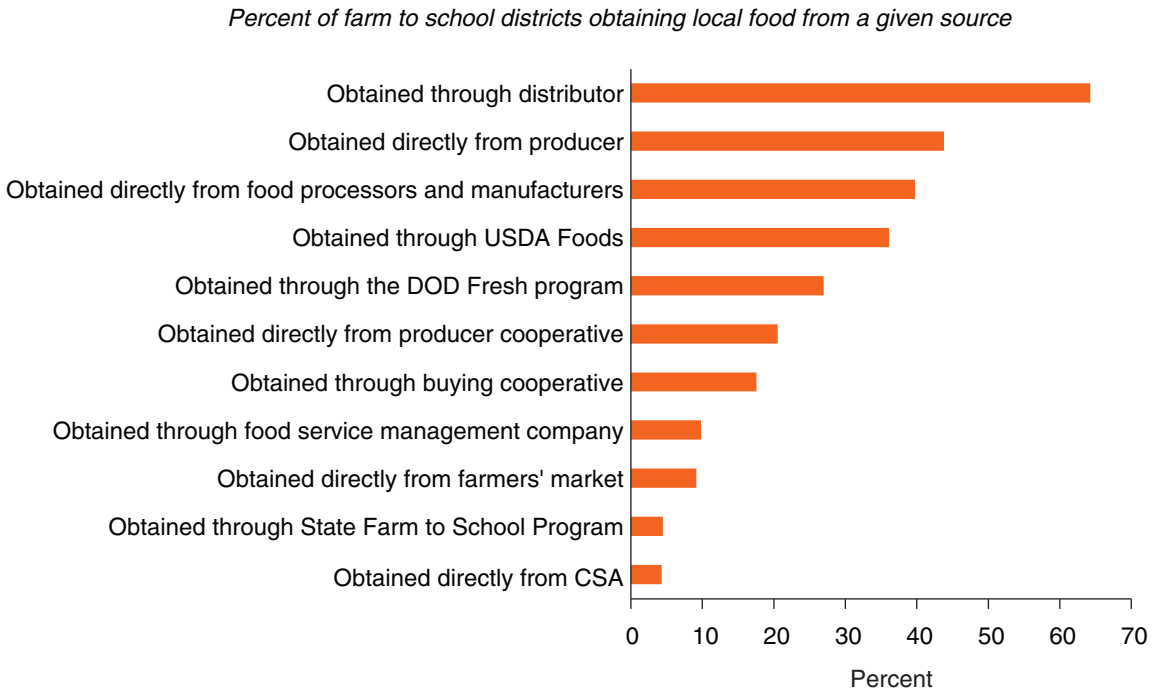
Farm to School

USDA encourages school districts to source locally produced food primarily through its Farm to School Program, established by the Healthy Hunger-Free Kids Act of 2010. To better understand participation, the USDA Farm to School Census was conducted by USDA's Farm to School Program in collaboration with ERS (USDA Food and Nutrition Service, 2014). All public school district School Food Authorities were invited to participate (for a total of 13,133), and 75 percent (9,887) completed a questionnaire that explored their involvement in farm to school activities.

More than 4 in 10 public school districts reported participating in farm to school activities during the 2011-2012 school year or starting during the 2012-13 school year.[41] Participation rates among districts varied widely with participation rates of greater than 75 percent in the Northeastern States (Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont) as well as Delaware, Hawaii, Maryland, and North Carolina. Of school districts with farm to school activities, 83 percent served at least some local food in school meals in school year 2011-2012. Other farm to school activities included the promotion of local foods through themed or branded promotions such as Harvest of the Month (42 percent), taste tests of local foods (38 percent), edible school gardens (31 percent), and field trips to farms (30 percent). The top food categories sourced locally were fruits and vegetables, cited by over three quarters of farm to school districts. Milk (37 percent), baked goods (22 percent), and other types of dairy products (18 percent) were also among the top food categories sourced locally.

Nearly two-thirds of school districts that participate in farm to school activities purchase local foods through a distributor (fig. 9), indicating that distributors are increasingly able to make local foods available to districts interested in providing them in school meals. More than 4 in 10 districts that had farm to school activities (44 percent) obtained food directly from producers.

Figure 9
Local food procurement sources for school districts participating in farm to school activities



Source: Farm to School Census (USDA Food and Nutrition Service, 2014). N=9,887. Statistics are unweighted, from a universe survey of public school district School Food Authorities with a response rate of 75 percent. Percentages sum to over 100 percent because respondents could identify multiple sources. DOD = Department of Defense.

[41]Statistics are unweighted. Almost all public school district School Food Authorities contain a single public school district, so for simplicity we refer to all Farm to School Census respondents as school districts.

Other methods used by school districts to source local foods included direct from food processors and manufacturers (40 percent), which could include milk from dairy processors as well as locally baked goods such as bread; USDA Foods (36 percent); and the Department of Defense (DOD) Fresh program (27 percent). USDA Foods refers to the commodities donated by USDA to school districts for use in school meals. Some States, such as Texas, arrange to have State-produced fruits and vegetables included in USDA Foods, and school districts can receive this produce as part of their allotments of USDA Foods. The DOD Fresh Program allows districts to use the dollar value of their allotments for USDA Foods to procure fresh fruits and vegetables from the DOD procurement system, and districts can request that these items be sourced locally or regionally.

Expenditures on local food were calculated for districts that were able to report total food expenditures for food service and the share of expenditures that were sourced locally. Local food expenditures, while incomplete due to reporting gaps, totaled over $385 million in the 2011-12 school year, and for the districts that were able to provide data, represented on average 13 percent of reported school district expenditures on food.[42] The value of local food donated by USDA through the DOD Fresh program was an additional $8 million.[43]

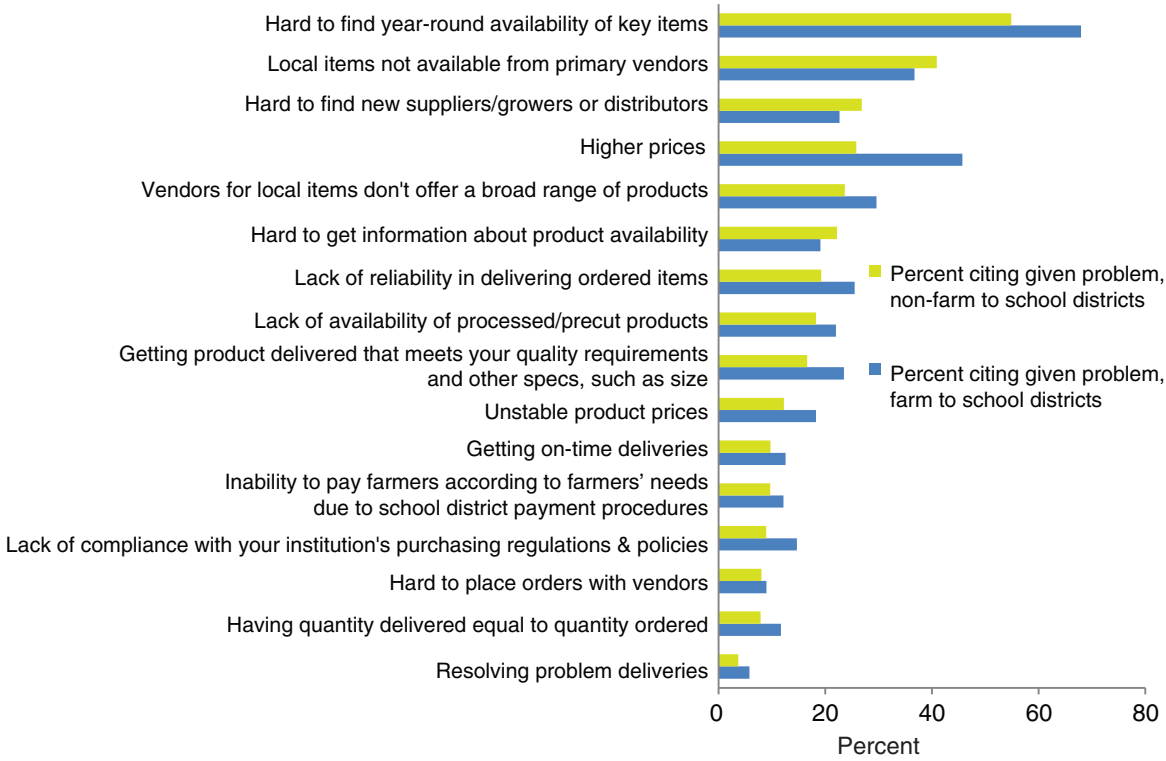
Respondents—from districts that had farm to school activities and those that did not—were also asked to indicate problems encountered in procuring locally produced food (fig. 10). The top problem cited by both groups was the lack of year-round availability of key items, cited by 68 percent of districts with farm to school activities and 55 percent of those with none. Other top difficulties for school districts with farm to school activities were high prices (46 percent) and unavailability of local foods from primary vendors (37 percent). High prices, while among the top difficulties cited, were cited by less than half of farm to school districts as problematic, consistent with results showing that prices for local foods are not necessarily higher than for conventionally marketed foods. For school districts *without* farm to school activities, other top difficulties in procurement were lack of availability from primary vendors (41 percent) and difficulty finding suppliers for local food (27 percent).

[42]The $385 million is not directly comparable to the total direct and intermediated sales reported in the first section of this report because it includes processed foods, e.g., direct from manufacturer.

[43]Data on local sourcing through DOD Fresh provided by the DOD Fresh Program.

Figure 10

Problems with local procurement by farm to school participation status, school year 2011-12



Source: Farm to School Census (USDA Food and Nutrition Service, 2014). N = 9,887. Statistics are unweighted, from a universe survey of public school district School Food Authorities with a response rate of 75 percent. Percentages sum to over 100 percent because respondents could identify multiple problems.

Prices at Direct-to-Consumer Marketing Outlets Versus Competing Retailers

Perceptions about prices at DTC outlets versus retail stores vary widely. Higher prices at DTC outlets may discourage patronage of these venues (Claro, 2011; Chambers et al., 2007). Local food advocates suggest that farmers who market through DTC venues can receive higher returns than through conventional marketing channels (Anderson, 2007). After subtracting marketing costs, producers may receive higher per-unit revenue and retain a greater share of the retail price. This may be especially important to small producers, many of whom rely exclusively on DTC outlets (Low and Vogel, 2011). This section briefly examines the literature comparing prices at DTC outlets and more conventional outlets. Our own national analysis of Nielsen Homescan data finds that selected produce prices at DTC outlets are lower, on average, than prices at retail stores in all seasons.

Peer-reviewed case studies have found that consumers perceive items at farmers' markets to be lower or more reasonably priced, and of higher quality, than items at supermarkets (Brown, 2003; Wolf et al., 2005). Others have found that participants in Federal nutrition programs that promote DTC purchases (e.g., Senior Farmers' Market Nutrition Program) perceive quality of produce to be as good (or better) and/or prices to be lower at the farmers' market compared to their grocery store (McCormack et al., 2010). But media coverage reflects inconsistency in how farmers' market prices compare to supermarkets (Ruth-McSwain, 2012). Only a handful of studies have compared contemporaneous prices for comparable products at DTC venues versus nearby retail food stores.

Analyses of prices at DTC outlets are limited and have focused on specific geographic areas. Six case studies were conducted in California, North Carolina, Iowa, and Vermont during select months of a particular year rather than over a number of years. These studies typically compare farmers' market prices to prices collected at grocery stores located nearby. Sommer et al. (1980) found prices for fruits and vegetables, in the summer/fall of 1979, to be 39 percent and 37 percent lower, respectively, at farmers' markets.

Since 2009, as interest in locally produced foods has grown, a few additional studies have emerged. When market basket comparisons are made, farmers' market prices are often found to be lower. For example, McGuirt et al. (2011) compare summertime prices of 230 produce items in 12 North Carolina counties and find an average price savings of 18 percent at the farmers' markets. However, it is difficult to generalize results for individual items. Claro (2011), for instance, compares the price of 14 produce items during July and August in Vermont. The average price for six items at the farmers' markets was found to be statistically significantly higher than the average price at corresponding grocery stores, while the average price at farmers' markets was statistically significantly lower for only two items.[44]

Comparison of DTC and Retail Prices Using Nielsen Homescan Data, 2006

To our knowledge, there are no studies using national data to analyze prices at DTC outlets across produce type, season, and geographic areas. The 2006 Nielsen Homescan panel data provide an

[44]Given the dearth of studies that compare prices for different items at different locations and times of the year, it is difficult to generalize how relative prices might be changing over time.

opportunity to compare U.S. average produce prices at DTC outlets, grocery stores, and supercenters. The Nielsen Homescan panel is a nationwide survey of households and their retail food purchases (see box, "Nielsen Homescan Panel Data"). The data include quantities, expenditures, product attributes, marketing channel or retailer type (grocery stores, supercenters, warehouse clubs, drug stores, mass merchandisers, convenience stores, health food stores, and "all other" retailers), store name, and household demographic data.

Prices (net of promotional and sales discounts) of two fruit items (apples, grapes) and three vegetable items (tomatoes, potatoes, peppers) are computed by dividing total expenditure by quantity purchased (e.g., Huang and Lin, 2007; Lin et al., 2008). These produce items are chosen because they are the five most popular random-weight produce items purchased by Nielsen Homescan panelists in terms of both purchase frequency and expenditures.

Statistical tests (T-tests) are used to compare differences in the mean price between DTC outlets and other retail food stores, including grocery stores and supercenters.[45] Average produce prices are compared for different seasons of the year and across seven regions of the country.

Nielsen Homescan Panel Data

The Nielsen Homescan panel consists of representative U.S. households that provide weekly reports of food purchased for at-home consumption from various retail outlets in at least 10 months of the year. A panel household scans either the UPC or a designated code for non-UPC, random-weight products (e.g., fresh fruits and vegetables, bakery products produced and packaged in the store, meat products cut and packaged in the store) of all purchases. About 32,000 households record their UPC-labeled items, and 8,000 households (Fresh Foods panel) also record random-weight products.

In 2007, Nielsen replaced the Fresh Foods Panel with the Total Sample View, which no longer contains details on the random-weight items. Specifically, after 2006, item characteristics and the quantity purchased are no longer recorded.

Because purchases from DTC outlets would not have UPCs, they would likely be recorded only via the random-weight collection methodology. For this reason, our analysis includes only products purchased as random-weight items in 2006. According to Nielsen, panelists would likely use the store name "fruit stand," which is included in the "all other" retailer type, to record purchases from DTC outlets including farmers' markets, roadside fruit stands, onfarm sales, and other DTC outlets (Nielsen, 2009).

While we are able to identify sales from DTC outlets, we are unable to verify that the items sold at DTC outlets are actually local. For example, some fruit stands may carry both locally grown produce and imported produce, which is sold in order to provide their customers a one-stop shopping experience. Sales of non-local items at DTC outlets may be more prevalent in the winter months, especially for produce with a short storage period. In case studies, analysts are better able to distinguish between locally sourced versus non-local produce at direct marketing outlets. For example, Sommer et al. (1980) restricted their price comparisons to certified farmers' markets only to provide some assurance that vendors were marketing their own produce. Also, unlike case studies, we compare prices at DTC outlets to those at retail food stores over a much broader geographic area rather than stores located near the DTC outlet.

Seasonal Differences in Relative Prices

The price for each produce item varies by retail outlet and also exhibits seasonal variation (table 7). Produce prices at DTC outlets are lower, on average, than prices at grocery stores in all seasons. The U.S. average price discount at DTC outlets as a share of the grocery store price is estimated to range from 8.4 percent for grapes in the winter to 38.4 percent for winter tomatoes. DTC price discounts compared to supercenter prices are smaller than those compared to grocery stores. Only tomatoes and apples exhibit statistically significant discounts in all seasons.

For tomatoes, percentage discounts in DTC prices compared to grocery store prices are estimated to be smallest in the summer (24.6 percent) when grocery store prices are lowest. The largest price discounts for apples occur in the summer (27.5 percent) when grocery store prices are highest. On the other hand, grapes at DTC outlets are estimated to be relatively cheapest in the spring (24.9 percent) when prices at DTC and retail stores are at their lowest. The largest discount relative to supercenters is for winter tomatoes (28.8 percent). DTC apple prices are 13- 14 percent lower than supercenter prices in each season. For peppers, there is no statistically significant difference between prices at DTC outlets and supercenters.

Regional Differences in Relative Prices

Average prices at direct sales outlets also exhibit regional price variation, which may account for differences in relative price comparisons (fig. 11). In most regions, produce at direct sales outlets generally sell at a discount compared to supercenters and grocery stores, and the discounts tend to be larger for direct sales compared to grocery stores (table 8). Price discounts range from 1.1 percent compared to supercenter grapes in the southeast to 48.4 percent relative to grocery store tomatoes in the Rocky Mountain region. Prices at direct marketing outlets tend to be lower in the Rocky Mountain region compared to other regions. Households are estimated to pay the highest price for tomatoes, potatoes, and grapes at direct marketing outlets located in the Far West region compared to the other regions.

Table 7

Average prices for produce by season and type of retail outlet, 2006 (dollars per pound)[1]

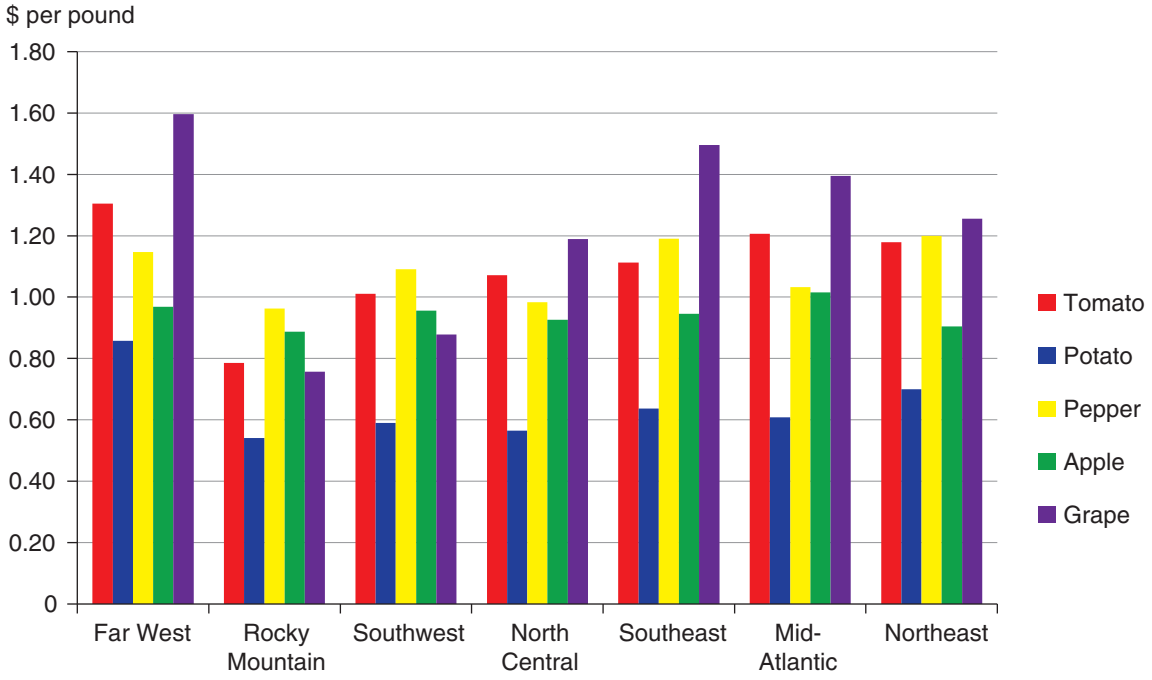
Outlet type	Tomatoes	Potatoes	Peppers	Apples	Grapes
			Spring		
Grocery store	$1.60	$0.81	$1.49	$1.19	$1.48
Supercenter	$1.34	$0.70	$1.06	$1.07	$1.28
DTC outlets	$1.08	$0.69	$1.03	$0.92	$1.11
Percentage difference in direct sales price compared to:					
Supercenter	-19.1	-0.8[3]	-3.0[3]	-14.3	-13.6
Grocery store	-32.4	-14.5	-31	-22.6	-24.9
			Summer		
Grocery store	$1.47	$0.85	$1.48	$1.39	$1.63
Supercenter	$1.34	$0.76	$1.05	$1.18	$1.53
DTC outlets	$1.11	$0.67	$1.10	$1.01	$1.48
Percentage difference in direct sales price compared to:					
Supercenter	-17	-12.9	4.9[3]	-14.1	-3.3[3]
Grocery store	-24.6	-21.8	-25.5	-27.5	-9.3
			Fall		
Grocery store	$2.01	$0.79	$1.54	$1.26	$1.58
Supercenter	$1.73	$0.70	$1.07	$1.17	$1.40
DTC outlets	$1.33	$0.66	$1.12	$1.02	$1.42
Percentage difference in direct sales price compared to:					
Supercenter	-23.2	-6.3[2]	4.3[3]	-13.1	1.9[3]
Grocery store	-34	-16.9	-27.1	-19.1	-9.9
			Winter		
Grocery store	$1.97	$0.80	$1.63	$1.22	$1.68
Supercenter	$1.70	$0.68	$1.11	$1.08	$1.57
DTC outlets	$1.21	$0.65	$1.11	$0.92	$1.54
Percentage difference in direct sales price compared to:					
Supercenter	-28.8	-4.7[3]	0.1[3]	-14.4	-2.1[3]
Grocery store	-38.4	-18.5	-31.9	-24.3	-8.4

[1]Winter months are December, January, and February; Spring months are March, April, and May; Summer months are June, July, and August; Fall months are September, October, and November (*Glossary of Meteorology*, 2nd edition, American Meteorological Society, 2012). All price differences between direct sales outlets and supercenters or grocery stores are statistically significantly different at the 1-percent significance level, unless otherwise noted.
[2]Statistically significant at the 10-percent significance level.
[3]Difference is not statistically significant. DTC = direct to consumer.

Source: Calculated by USDA, Economic Research Service based on Nielsen Homescan data.

Figure 11

Average price at direct sales outlets by region, 2006



Source: Calculated by USDA, Economic Research Service based on Nielsen Homescan data.

Table 8

Average prices for produce by region and type of retail outlet, 2006 (dollars per pound)[1]

Outlet type	Tomatoes	Potatoes	Peppers	Apples	Grapes
			Far West		
Grocery store	$1.70	$0.84	$1.48	$1.21	$1.60
Supercenter	$1.35	$0.62	$0.98	$1.05	$1.32
DTC outlets	$1.30	$0.86	$1.15	$0.97	$1.60
Percentage difference in direct sales price compared to:					
Supercenter	-3.6[4]	37.9	17.1	-7.9[3]	21
Grocery store	-23.4	2.6[4]	-22.8	-19.8	-0.4[4]
			Rocky Mountain		
Grocery store	$1.52	$0.83	$1.17	$1.10	$1.40
Supercenter	$1.39	$0.70	$1.10	$1.04	$1.36
DTC outlets	$0.79	$0.54	$0.96	$0.89	$0.76
Percentage difference in direct sales price compared to:					
Supercenter	-43.5	-22.8[2]	-12.5[2]	-14.6[4]	-44.3
Grocery store	-48.4	-35	-17.7	-19.6[4]	-45.8
			Southwest		
Grocery store	$1.47	$0.83	$1.13	$1.23	$1.42
Supercenter	$1.36	$0.72	$1.06	$1.07	$1.39
DTC outlets	$1.01	$0.59	$1.09	$0.96	$0.88
Percentage difference in direct sales price compared to:					
Supercenter	-25.4	-18.2	2.9[4]	-10.4	-36.7
Grocery store	-31.4	-29.1	-3.5[4]	-22.4	-38.1
			North Central		
Grocery store	$1.61	$0.71	$1.44	$1.18	$1.42
Supercenter	$1.66	$0.68	$1.11	$1.14	$1.41
DTC outlets	$1.07	$0.57	$0.98	$0.93	$1.19
Percentage difference in direct sales price compared to:					
Supercenter	-35.3	-17.1	-11.7[2]	-19.1	-15.5
Grocery store	-33.6	-20.3	-31.6	-21.2	-16.4
			Southeast		
Grocery store	$1.75	$0.79	$1.59	$1.41	$1.74
Supercenter	$1.60	$0.73	$1.05	$1.18	$1.51
DTC outlets	$1.11	$0.64	$1.19	$0.95	$1.50
Percentage difference in direct sales price compared to:					
Supercenter	-30.6	-12.5	13.0[2]	-19.6	-1.1
Grocery store	-36.5	-19.5	-25.1	-32.7	-14.2

continued—

Table 8

Average prices for produce by region and type of retail outlet, 2006 (dollars per pound)[1]—continued

Outlet type	Tomatoes	Potatoes	Peppers	Apples	Grapes
			Mid-Atlantic		
Grocery store	$1.96	$0.83	$1.80	$1.31	$1.67
Supercenter	$1.56	$0.68	$1.06	$1.14	$1.37
DTC outlets	$1.21	$0.61	$1.03	$1.01	$1.40
Percentage difference in direct sales price compared to:					
Supercenter	-22.5	-11	-3.1[4]	-10.9	1.8[4]
Grocery store	-38.6	-26.9	-42.7	-22.6	-16.7
			Northeast		
Grocery store	$1.86	$0.83	$1.73	$1.27	$1.65
Supercenter	$1.79	$0.66	$1.30	$1.14	$1.42
DTC outlets	$1.18	$0.70	$1.20	$0.90	$1.26
Percentage difference in direct sales price compared to:					
Supercenter	-34.3	6.1[4]	-7.5[4]	-20.9	-11.9[3]
Grocery store	-36.5	-16.1	-30.9	-28.6	-23.8

[1]Far West = Alaska, California, Hawaii, Nevada, Oregon, Washington; Rocky Mountain = Arizona, Colorado, Idaho, New Mexico, Montana, Utah, Wyoming; Southwest = Arkansas, Louisiana, Oklahoma, Texas; North Central = Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin; Southeast = Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee; Mid-Atlantic = Delaware, Washington DC, Maryland, New Jersey, Pennsylvania, Virginia, West Virginia; Northeast = Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, Vermont.
All price differences between direct sales outlets and supercenters or grocery stores are statistically significant at the 1-percent significance level, unless otherwise noted.
[2]Statistically significant at the 5-percent significance level.
[3]Statistically significant at the 10-percent significance level.
[4]Difference is not statistically significant.
DTC = direct to consumer.

Source: Calculated by USDA, Economic Research Service based on Nielsen Homescan data.

Environmental Issues Related to Local and Regional Foods

In popular culture, there are many terms used to express the purported environmental benefits of the local food movement—natural, environmentally friendly, pesticide-free, sustainable, and more. Academic and marketing literature often cites environmental benefits of purchasing local foods that include reduced transportation, less processing and packaging, and farmland preservation (Grubinger, 2010; Klavinski, 2013; University of Florida IFAS Extension, 2014). This chapter explores the environmental practices of local and regional food producers in the United States, and finds a much more nuanced story.

Using data from the 2007 and 2012 Censuses of Agriculture and focusing on producers conducting DTC sales[46], we find that conventional producers spend more, on average, for chemical inputs and fertilizers, while DTC farms are more likely to use manure. Between 2007 and 2012, the share of U.S. farms using chemical fertilizers fell, with the biggest changes occurring on fruit/nut and berry farms. The biggest declines occurred on non-DTC farms. In the same time span, the share of farms using chemicals to control weeds increased across the board, with smaller increases occurring on DTC farms in most cases.

Contrary to some perceptions, the literature also suggests that the provision of local foods may actually result in a larger transportation "footprint," in terms of greenhouse gas emissions and energy consumption, than foods marketed through commercial outlets due to transportation inefficiencies. The link between local foods and food waste is even more unclear; an inverse relationship may exist between the amount of food waste and packaging waste.

Onfarm Environmental Effects for Farms With Direct-to-Consumer Sales

Farm production practices can affect soil, water, and air quality, as well as biodiversity. Crop and livestock production can also contribute to climate change through emissions of greenhouse gases (GHG). Conversely, farmers can help mitigate climate change by reducing their GHG emissions and by sequestering carbon in soils and biomass. Weber and Matthews (2008) found that GHG emissions from the production phase account for over 80 percent of the average U.S. household's carbon footprint from food consumption. Onfarm production inputs contributing to GHG emissions include machinery, fertilizers, fuel, and electricity. The use of these inputs, as well as pesticides and other chemicals, may affect soil, water, and air quality, as well as wildlife health and habitat. The U.S. Geological Survey (2007) finds that U.S. agricultural production is associated with the reduction and alteration of wildlife habitats as a result of changes in land use as well as elevated levels of nutrients (Dubrovsky et al., 2010). If nutrients are not properly managed, livestock production can contribute to excess bacteria and pathogens in streams and ground water. Intensive agriculture can hasten soil erosion and the removal of rich organic matter, plant nutrients, and soil particles from surface soils.

[46]The 2012 Census of Agriculture contains certain information about production, marketing, and conservation practices of farmers participating in DTC sales, as well as the number of farms participating in intermediated sales. Because the 2007 Census did not include intermediated sales, we limit our comparisons to those farms with DTC sales. Due to a small sample of DTC farm operator responses in the Agricultural Resource Management Survey (ARMS), we opt for 2012 Census responses.

To explore consumer notions that local foods are grown in a more environmentally "friendly" way, we examine the differences in onfarm input use and conservation practices between DTC and conventional producers. The 2012 Census of Agriculture allows us to compare input use—such as fertilizers, chemicals, irrigation, machinery, equipment, utilities, and fuel—between DTC and non-DTC producers during the 2012 calendar year.

For operations engaged in greenhouse, fruit/nut, and berry production, higher shares of DTC than non-DTC producers apply chemical fertilizers (table 9). At the same time, a higher share of DTC producers apply animal manure across all crop types. DTC producers were less likely to apply pesticides and herbicides to control weeds and insects than were conventional producers, with the exception of chemicals to control insects and weeds in fruit/nut and berry crops.

Comparison of Onfarm Conservation Practices

The land-use impacts of growth in local food systems are largely unknown. That is, if more land goes into production due to increased demand for local food, will things like natural habitats suffer? Despite total agricultural land remaining essentially steady between 1964 and 2007, productive cropland often transitions among idle cropland, pastureland, and forestland (Nickerson et al., 2011).

Table 9
Use of manure and chemicals in crop production, by crop production and marketing types, 2012

	Field crops		Greenhouse		Veg & melons		Fruit & nuts		Berries	
	DTC	Non-DTC	DTC	Non-DTC	DTC	Non-DTC	DTC	Non-DTC	DTC	Non-DTC
Number of farms	14,320	488,368	1,303	1,606	25,409	26,486	16,848	79,906	16,835	13,701
					Dollars					
Average value of chemicals purchased	9,711	23,247	2,887	12,176	4,828	59,511	6,081	24,261	5,256	23,629
Average value of fertilizer purchased	22,564	45,019	12,943	67,163	7,899	82,223	4,706	17,096	5,870	19,591
					Percent					
Farms using:										
Chemical fertilizers	87	88	41	37	74	73	57	53	71	61
Animal manure	63	24	20	11	31	18	17	8	30	14
Chemicals to control insects	33	40	29	31	63	67	50	42	60	52
Chemicals to control weeds	83	88	24	29	63	69	51	51	61	57
Change from 2007										
Farms using:										
Chemical fertilizers	-2	-3	-7	-8	-4	-7	-16	-28	-6	-19
Animal manure	-1	-5	0	2	0	0	0	0	0	0
Chemicals to control insects	1	1	3	-1	15	13	-5	-16	9	4
Chemicals to control weeds	8	13	2	6	19	24	3	0	12	15

DTC = Source: USDA NASS, 2012 Census of Agriculture.

In 2012, USDA offered several land conservation programs—such as the Conservation Reserve Program (CRP) and Wetlands Reserve Program (WRP)[47]—that allow eligible agricultural land owners can participate in environmental conservation and provide ecosystem services. CRP, for example, provides an annual rental payment to farmers for removing environmentally sensitive land from agricultural production and planting vegetation that will improve environmental quality. These conservation programs have increased wildlife populations and reduced soil erosion (Allen and Vandever, 2003; Feather et al., 1999; USDA Farm Services Agency, 2013).

A smaller share of DTC than non-DTC producers were enrolled in government-sponsored land retirement programs in 2012 (table 10). This may be because DTC producers tend to operate on fewer acres and may not have marginal acres to spare for conservation programs.

Producers can also enhance environmental quality by adopting conservation practices such as low-till or no-till practices, filter strips, and the production of renewable energy. A higher share of conventional producers than DTC producers used no-till or conservation tillage in 2012. However, higher shares of DTC producers generated onfarm energy and harvested biomass for bioenergy (table 10).

USDA does provide financial and technical assistance to eligible farmers for adopting conservation practices on working farmland through the Environmental Quality Incentives Program (EQIP). In addition, beginning and limited-resource farmers are eligible for an increased payment rate.

One relatively new aspect of EQIP that may be of particular interest to local foods farmers is its Seasonal High Tunnel Initiative (see box, "Greenhouses and High Tunnels"). While census data do not distinguish between greenhouses and high tunnels—and so no clear link can be made to the High Tunnel Initiative—one particularly striking result is the dramatic increase in the number of DTC farmers using high tunnels or greenhouses to produce tomatoes, vegetables, and herbs between 2007 and 2012. Moreover, both the absolute number and proportionate changes are largest for DTC farmers with less than $75,000 in sales.

Table 10
Participation in conservation practices by marketing type, 2012

	DTC	Non-DTC
Number of farms	144,530	1,964,773
	Percent	
Participants in CRP, WRP, FWP, or CREP	3.9	14.6
Farms with conservation easements	4.0	3.4
Farms using no-till	9.4	12.9
Farms using conservation tillage	6.6	9.2
Farms producing alternative energy	6.9	2.4
Farms harvesting biomass for bioenergy	1.0	0.5

Alternative energy is defined as the generation of energy or electricity on the farm using wind or solar technology, methane digesters, etc. CRP = Conservation Reserve Program; WRP = Wetlands Reserve Program; FWP = Farmable Wetlands Program; CREP = Conservation Reserve Enhancement Program.

Source: USDA NASS, 2012 Census of Agriculture.

[47]The 2014 Farm Bill incorporated WRP into the Agricultural Conservation Easement Program (ACEP).

Greenhouses and High Tunnels

Greenhouses and high tunnels are an important production strategy for some U.S. producers, particularly those who market produce directly to consumers. Greenhouses (or glasshouses) are structures used for growing plants and flowers that allow for greater control of the growing environment. Greenhouses can be made of either plastic or glass, with paved floors and raised beds, and often involve equipment for heating, cooling, and lighting. High tunnels (or hoop houses)—typically a single layer of plastic or woven fabric that can be used raised or lowered as needed—are simpler, less expensive versions of plastic greenhouses. High tunnels most often protect crops grown directly in the soil and do not usually require electricity or fuel to achieve heating and cooling, but take advantage of adjustable sides to change the temperature inside the tunnel (Gu, 2009). On occasion, small space heaters are used in extremely low temperatures to protect crops in high tunnels.

In 2010, USDA's Natural Resources Conservation Service, under the Environmental Quality Incentives Program, began offering financial assistance to farmers for the installation of high tunnels up to 2,178 square feet (NRCS, 2014). According to NRCS, the goal of the initiative is to assist producers to extend the growing season for high-value crops in an environmentally safe manner. (http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/?cid=stelprdb1046250)

ERS analysis of census data indicates that crop producers who use greenhouses or high tunnels (and thus have "protected" crops) consume more energy than producers growing unprotected crops.[1] Among greenhouse and high tunnel users, DTC producers used less utilities and fuel than did conventional producers, however (see

Greenhouse/high tunnel crop producers and energy use by marketing type and size, 2012

				Percent change from 2007	
		DTC	Non-DTC	DTC	Non-DTC
Operations with < $75,000 in total sales					
Number of farms	Tomatoes	3,377	1,172	155	107
	Vegetables & herbs	3,168	1,044	246	108
	Fruits & berries	364	136	247	92
	Mushrooms	378	127	129	31
$/acre	Average utilities	28.25	33.51	6	-7
	Average fuel	31.99	44.10	-19	-18
Operations with > $75,000 in total sales					
Number of farms	Tomatoes	1,271	503	75	64
	Vegetables & herbs	699	357	124	18
	Fruits & berries	110	63	206	70
	Mushrooms	68	139	113	-17
$/acre	Average utilities	85.53	544.31	11	2
	Average fuel	106.68	505.57	-4	-18

Source: USDA NASS, 2012 Census of Agriculture.

[1]In the census analysis, we define greenhouse crops as all food crops, including tomatoes, vegetables, fresh-cut herbs, fruits, berries, and mushrooms, grown under any type of protection,. The 2012 Census does not distinguish between the type of crop protection, whether nursery, greenhouse, cave, or high tunnel.

figure). There is a statistically significant difference in utility and fuel consumption between larger (above $75,000 in annual sales) DTC and non-DTC greenhouse operations as well; conventional producers consumed approximately six times the value of utilities and five times the value of fuel, per acre, compared to DTC producers. Among the smallest farms (with annual sales less than $75,000), DTC producers spent less per acre on fuel and utilities than non-DTC farms, though the magnitude of the difference was smaller. However, the 2012 Census of Agriculture did not distinguish between the use of greenhouses and high tunnels in farmers' responses, so these (scale) differences in energy consumption may be attributed to the differences in energy use of high-input greenhouses versus low-input high tunnels.

One group of farms that is often associated with environmentally friendly farming practices are those certified as organic. Unlike local foods, organic production is well defined and strictly regulated in the United States. Organic production involves agricultural conservation practices that, according to USDA's Agricultural Marketing Service (2000), integrate cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity (e.g., the elimination of synthetic pesticide use and reduction of nonsynthetic pesticide use).

If considerable overlap exists between local and organic producers, we might assume that local food is grown differently from conventionally marketed food. But based on 2012 Census data, while some local food is produced organically, certified organic producers do not comprise a large share of DTC producers. In fact, the overlap between local (DTC or intermediated) food farmers and certified and certification-exempt organic farmers is relatively small (7,556 farms, see fig. 12). Only about 5 percent of local foods farms are organic farms, though nearly half of certified organic farms market in local foods outlets. Approximately the same share of farms with DTC sales are certified organic (6,468 farms). Among certified organic or organic-exempt farms marketing locally in 2012, 39 percent participated in DTC outlets, while another 7 percent sold only through intermediated channels.

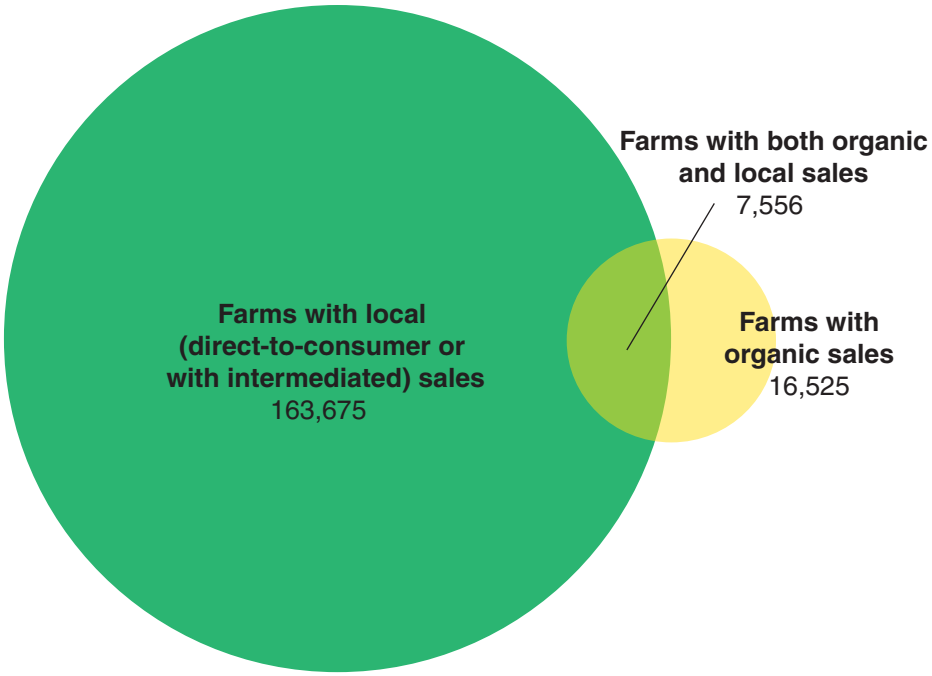
Research has noted that the low supply of and demand for organic produce at farmers' markets was due to a limited number of organic farmers, limited awareness about organic production, and negative perceptions about organic product pricing (Kremen et al., 2004). On the other hand, focusing on intermediated sales, Dimtri and Oberholtzer (2009) find that nearly half (48 percent) of organic fruits and vegetables were sold in local or regional marketing channels in 2007.

While the numbers are small, DTC producers are more likely than non-DTC producers to use the environmentally friendly management practices ascribed to organic production.[48] Indeed, among farms that are exempt from organic certification requirements (most likely due to having less than $5,000 in sales for 2012), many more DTC farms than non-DTC farms claim to be producing according to USDA National Organic Program standards (table 11).

In addition to typical conservation practices in agricultural production, farms may offer opportunities for recreation and natural amenities. Onfarm recreation and agritourism includes hunting, fishing, horseback riding, Christmas tree sales, pick-your-own produce, and petting zoos. In the

[48]The 2012 Census of Agriculture asked if the operation had: (1) production of organic products according to the USDA's National Organic Program (NOP) standards or acres transitioning into USDA NOP production, (2) USDA NOP certified organic production, (3) USDA NOP organic production exempt from certification (typically less than $5,000 in sales), (4) acres transitioning into USDA NOP production, and (5) production according to USDA NOP standards but neither certified nor exempt. USDA considers only farm operations that are certified (2) or exempt (3) to be organic operations.

Figure 12
Intersection between 2012 local and organic production



Note: Local defined as farms with DTC or intermediated sales. Organic defined as certified organic or organic-exempt farms.
Source: USDA Economic Research Service using data from USDA, National Agricultural Statistics Service, 2012 Census of Agriculture.

Table 11
Characteristics of organic producers, by marketing type, 2012

	DTC	Non-DTC
Number of certified organic producers	4,107	8,664
Number of certification-exempt organic producers	2,361	1,393
Percent of farms certified or certification-exempt organic	4.5	0.5
Number of transitioning organic producers	1,236	2,004

Note: Organic producers are defined as farm operations that indicated a positive total value of crop, livestock, and livestock products (including eggs and milk) sold as USDA NOP certified or certification-exempt organic.

Source: USDA NASS, 2012 Census of Agriculture.

context of local foods production, Low and Vogel (2011) found that DTC farms are often near densely populated urban areas, particularly in the Northeast and West Coast regions. As of 2013, the preservation of farmland by State programs totaled 2.4 million acres at a cumulative cost of over $3.6 billion (http://www.farmlandinfo.org/sites/default/files/FIC_State_PACE%2009-2013_0.pdf). Many of these acres are in or near urban areas (where farmland is most vulnerable to development pressures). Their protection may complement local foods programs:

- Local foods outlets in urban areas require nearby farms, and the preservation of farmland helps secure the existence of such farms.

- Demand for local foods can enhance the markets available to local farms, possibly increasing their financial viability.

In addition, farmland preservation programs do more than encourage food production—they can also provide rural amenities such as open space, agrarian cultural heritage, and recreational opportunities. Brown and Reeder (2007) note that onfarm recreation and agritourism can benefit both farmers and surrounding communities by offering urban and suburban residents the opportunity to experience preserved agricultural land and related natural amenities, such as forests, streams, and wildlife

That said, the relationship between rural amenities and farmland preservation is not straightforward. The public's notions about what rural amenities farmland protection should provide, and what farmland protection programs actually focus on, are not always in sync. For example, an increased interest in local foods may reduce the provision of other rural amenities provided by "farmland" (Hellerstein et al., 2002).

Environmental Effects from the Farm to the Fork… and to the Landfill

Once produce is harvested or livestock is slaughtered, it is usually stored, transported, and distributed before reaching consumers. Each of these activities uses energy to some degree and may affect other environmental indicators.

Transportation

The premise of local food is minimizing the distance between agricultural producers and food consumers. As a result, many researchers have focused on the environmental effects of "farm to fork" transportation. Claims about reductions in fuel use and GHG emissions during transportation of local food are numerous, but more recent research finds that transportation accounts for a small portion (11 percent) of lifecycle GHG emissions from conventional agricultural production. Additionally, the *mode* of transportation and other energy used along the supply chain may be more important environmentally than transportation distance (Avetisyan et al., 2013; Weber and Matthews, 2008). By weight, inland water and rail transportation are associated with fewer GHG emissions than truck transportation.

Various efficiencies are achieved from economies of scale in food transportation. King et al. (2010) find that transportation fuel use is more affected by the structure and size of the food supply chain than by distance traveled. They also find that fuel use per unit is often less in supermarket supply chains than in local supply chains due to larger, more efficient loads. In the United Kingdom, Coley et al. (2009) find that a supply chain in which consumers travel to the farm to purchase produce causes more GHG emissions than a supply chain of large food retailers. These findings suggest that local produce transportation may be more environmentally damaging than transportation for non-local produce.

Processing, Packaging, and Food Waste

According to Canning et al. (2010), processing, packaging, and selling food uses more than ten times as much energy as the transportation of food. Even as early as the 1970s, 75 percent of food grown on U.S. farms was processed in some way before it was consumed (Hendrickson, 2008). As

a result, food packaging has become increasingly energy intensive, especially with the popularity of individually wrapped, single-serving portions. Packaging for both food and non-food products represented one-third of U.S. municipal waste in the 1990s (Ackerman, 1996), and has likely grown since then. Ackerman cites an inverse relationship between the amount of food waste and packaging waste. If a household produces more waste from fresh foods by discarding inedible portions, it is most likely producing less waste from commercially prepared or packaged foods. Alternatively, food processing reduces total waste compared to fresh foods because inedible portions are often collected by processing plants and used for other purposes instead of being discarded by the household (Marsh and Bugusu, 2007).

An additional source of waste for both conventional and local foods is food loss and food waste. Many lifecycle assessments ignore disposal in landfills, which is an important stage in the lifecycle of food products in a "cradle to grave" analysis. According to U.S. EPA (2014), food waste is the largest source of municipal solid waste (MSW) and the largest source of biomass for MSW bioenergy. A reduction in the amount of food waste can have significant economic and environmental benefits, such as a reduction in the use of resources associated with agricultural production, in the release of methane from landfills, and in disposal costs. If claims that local foods use less processing and packaging are correct, then evidence shows that local foods would create more food waste from spoilage and less efficient home preparation. For more information on general postharvest food loss and waste at the retail and consumer levels, see Buzby et al. (2014).

Policies Supporting Local and Regional Food Systems

In recent years, Federal, State, and local policies have expanded to include programs supporting local and regional food systems. At the national level, these policies are set through overarching farm legislation, approximately every 5 years. The most recent, the Agricultural Act of 2014 (2014 Farm Bill, Pub.L. 113-79), was signed into law on February 7, 2014, and includes a number of policies and provisions related to local and regional food. Most notably, support for intermediated marketing channels is greatly increased. Policies and provisions enacted in the 2008 Farm Bill are generally continued or expanded. A number of States have recently passed legislation to address access to and expansion of farmers' markets and urban agriculture. At the regional and local levels, zoning and regulation, fiscal incentives, and institutions are used to strengthen local food systems. This growing investment across all levels of government may fuel continued collaboration, aiding the development of local and regional food systems.

New and Expanded Federal Policies for 2014

The 2014 Farm Bill provides support for several new and significantly revamped programs that promote the production and marketing of food locally and regionally, but also access to healthy foods.

Expanded Marketing Programs

The ***Farmers' Market Promotion Program*** (FMPP, Sec. 10003), created in 2002, has been renamed the Farmers' Market and Local Food Promotion Program and its scope expanded. While the FMPP supported marketing exclusively through DTC outlets (e.g., farmers' markets, CSAs), the new program includes intermediated channels such as farm-to-institution, food hubs, and other businesses that process, distribute, aggregate, or store locally or regionally marketed food products. This new component is implemented through the ***Local Food Promotion Program*** (LFPP, Sec. 10003), which offers planning and implementation grant funds to eligible entities with a 25-percent match (USDA ARS, 2014). The overall program receives a three-fold increase in mandatory funding, providing $30 million per year for 2014-18, split equally between DTC and intermediated marketing, with an additional $10 million in annual appropriations for 2014-18 (USDA ERS, 2014).

The scope and funding for the ***Specialty Crop Block Grants*** (SCBG, Sec. 10010) program also expanded in 2014. The 2014 Farm Bill authorizes multistate projects under this program for the first time. SCBG is administered through State departments of agriculture and regularly includes funding for projects related to locally and regionally marketed food (particularly fruit and vegetable production). Its flexible scope allows funding support for a variety of local food projects such as farm to school programs, food safety training, food hubs, and marketing research, thus providing a broad base of support for the development of local and regional food systems. Annual mandatory funding increased from $55 million to $72.5 million for 2014-17 and $85 million per year thereafter.

Expanded Production Programs

The ***Value-Added Producer Grant*** program (Sec. 6203), which is designed to help farmers develop farm-based value-added products (e.g., cheese, jam, packaged meats, sausages), was reprioritized to better target small and midsized family farms as well as beginning, socially disadvantaged, and veteran farmers. Annual mandatory funding has increased from $15 million to $63 million for 2014-

18, with $40 million in appropriations authorized annually. The program also sets aside funding for local and regional food supply networks.

Several improvements to rural development programs that may benefit local and regional food producers are also included in the 2014 Farm Bill. The Rural Business Opportunity Grant and the Rural Business Enterprise Grant programs are consolidated under the ***Rural Business Development Grants*** program (Sec. 6012), which is authorized for up to $65 million in annual funding for 2014-18 (no mandatory funding has been provided). While these grants do not target local food producers, local food projects have historically taken advantage of these programs.

Outside of the 2014 Farm Bill, USDA recently expanded the ***Farm Storage Facility Loan*** program, which provides low-interest financing to food producers to purchase storage and processing equipment.[49] Under the enhanced program, 23 new categories of equipment for fruit and vegetable producers are now eligible for financing, including cold-storage facilities, sorting bins, wash stations, and other food safety-related equipment (USDA FSA, 2014).

SNAP and Local Foods

Several changes in the 2014 Farm Bill specifically address access to locally and regionally marketed food by SNAP participants. Based on the success of pilot programs, the new ***Food Insecurity Nutrition Incentive*** Grant program (Sec. 4208) offers grants to fund programs (e.g., coupons and vouchers) that incentivize increased consumption of fruits and vegetables among SNAP participants, with priority given to projects involving DTC marketing channels and other locally and regionally marketed food. According to a recent study by USDA's Food and Nutrition Service, low-income survey respondents who knew that some farmers' markets provided incentives for those using EBT were 40 times more likely to shop at farmers' markets (Karakus et al., 2014). Congress provided a total of $100 million in mandatory funding over FYs 2014-18, and authorized an additional $5 million to be allocated in annual appropriations.

Additionally, the 2014 Farm Bill addresses several issues that will enable SNAP benefits to be used in more DTC outlets. One measure exempts farmers' markets and other DTC outlets from having to pay all EBT equipment and implementation costs, which are often prohibitively expensive for small markets (National Sustainable Agriculture Coalition, 2014), although no explicit provisions regarding wireless EBT devices are included in the statute (Sec. 4011). SNAP benefits can now be used to participate in CSA ventures as well. The Farm Bill also authorizes a pilot project to test online and mobile technologies for use with EBT purchases, which could further reduce SNAP transaction costs for local retailers (Sec. 4011).

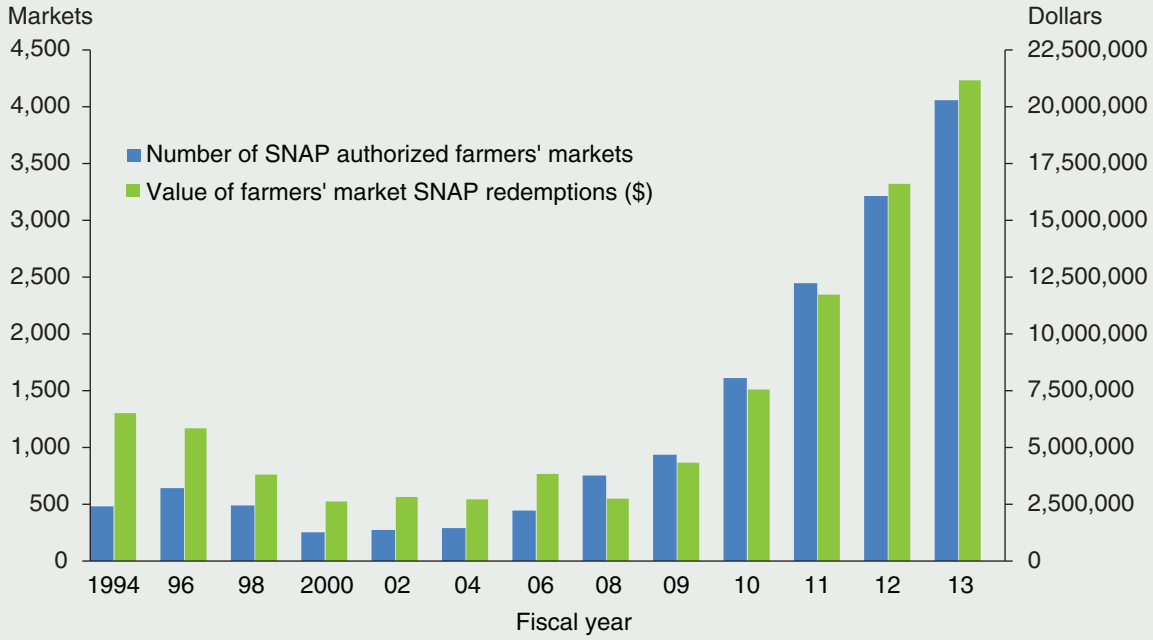
In a related provision, the Act authorizes USDA to establish ***Healthy Food Financing Initiative*** (HFFI, Sec. 4206) to provide grants and loans to retail food projects in underserved communities, expanding healthy food access. The program would prioritize funding for projects that support regional food systems and locally grown foods, among other goals. While HFFI did not receive any mandatory funding, it is authorized for up to $125 million in appropriations, which would be available until expended, but to date, have not been appropriated.

[49]For the final rule, see: http://www.fsa.usda.gov/Internet/FSA_Federal_Notices/fsflsecreq.pdf

SNAP Redemptions at Farmers' Markets

The 1996 Farm Bill required replacement of the SNAP paper coupon system (i.e., food stamps) with an electronic benefit transfer (EBT) debit card system. The change was rolled out State by State and completed in 2004. In 1996, SNAP participants redeemed $5.8 million in food stamps at 643 farmers' markets. By the EBT conversion deadline in 2004, however, SNAP transactions at farmers' markets had declined to $2.7 million, with only 289 markets nationwide accepting SNAP (see figure). USDA regulations currently require State agencies to provide free, hard-wired EBT terminals to markets that conduct $100 or more in monthly SNAP transactions but, according to the Community Food Security Coalition, many markets lack the telephone line and electricity necessary to accommodate these devices (Briggs et al., 2010). Wireless EBT technology was still relatively new in the early 2000s, so wireless devices were often too expensive for small markets. State agencies may also use administrative program funds to provide wireless terminals to farmers' markets, but few States have elected to do so due to the higher cost of these devices. In recent years, however, SNAP redemption in farmers' markets has increased as more affordable wireless EBT machines have become available and States have passed legislation to provide funding for these devices at farmers' markets.

SNAP/EBT authorized farmers' markets and total annual value of redemptions, 2000-13



Sources: Briggs et al. (2010); USDA FNS (2014).

The ***Community Food Projects*** grant program (Sec. 4026), which supports community-based food projects in low-income communities, received a considerable increase in funding. The new act provides $9 million in mandatory funding annually for FYs 2015-18, representing an 80-percent increase over annual funding in the 2008 Farm Bill.

Program Evaluation Legislation

The 2014 Farm Bill also includes provisions to establish a data infrastructure to facilitate analysis of local food systems. The act requires USDA (Sec. 5105) to develop crop valuation methods to further facilitate lending to producers marketing locally. USDA is also tasked with implementing a device for local producers to establish price history. The act also includes an initiative requiring USDA to collect data on local food production and marketing, to facilitate data sharing, and to monitor the effectiveness of programs designed to promote local food systems (Sec. 10016). No mandatory funding was authorized for this provision, so startup funding must be arranged through an annual appropriations act.

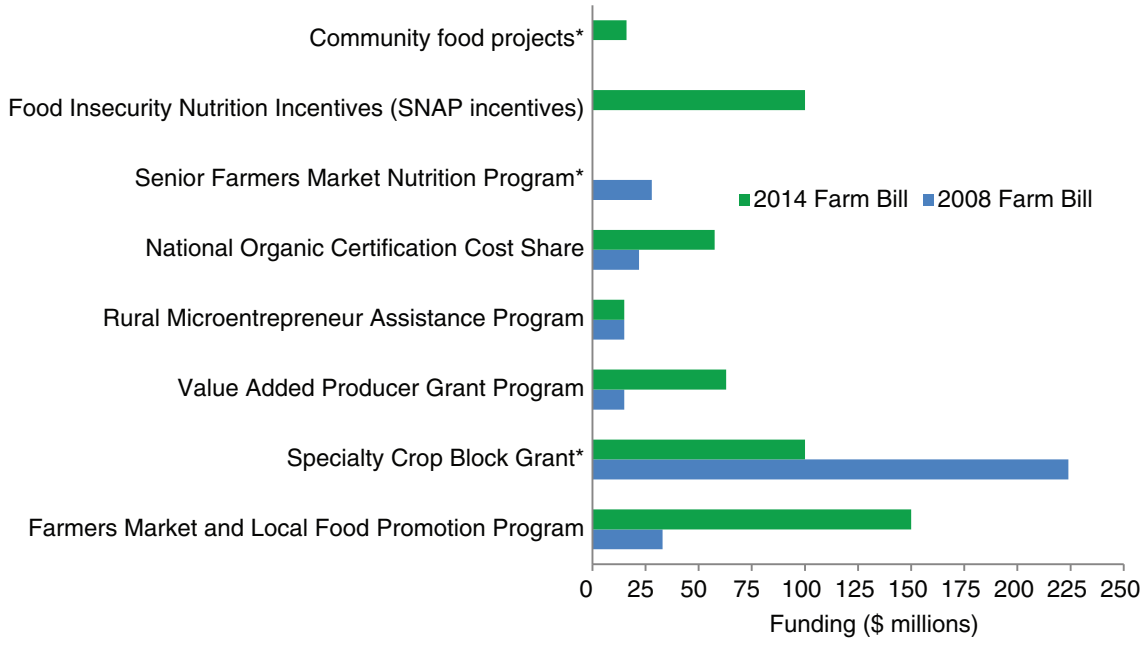
Reauthorized Federal Policies

In addition to new and expanded Federal programs, the 2014 Farm Bill reauthorizes many programs from the previous Farm Bill that support local and regional food systems, with only minor modifications or changes to spending levels. Overall, the new Farm Bill represents an additional $501.5 million investment over the next 5 years (fig. 13) in programs that may affect local and regional food systems. The reauthorized programs generally address issues of food access and food production.

Reauthorized Food Access Programs

The ***Senior Farmers' Market Nutrition Program*** (Sec. 4203) remains unchanged for 2014. This program provides low-income seniors with coupons and vouchers that can be used for eligible

Figure 13
Five-year total spending levels in the 2008 and 2014 Farm Bills for select programs related to locally and regionally marketed food



*Permanently funded programs. Figures represents increases over previous farm act levels only.
Source: National Sustainable Agriculture Coalition, 2014.

foods at farmers' markets, CSAs, and roadside stands. The program is permanently authorized and receives mandatory funding of $20.6 million annually.

Similarly, the ***Fresh Fruit and Vegetable Program***, which provides fruit and vegetable snacks to school children throughout the day, is a permanently authorized and funded national program. The 2014 Farm Bill maintains the $50-million annual minimum requirement for USDA fresh fruit and vegetable acquisitions for schools (Chite, 2014). While this provision does not explicitly prioritize locally and regionally produced food, an accompanying pilot program has been authorized to address this (Sec. 4214).

Reauthorized Food Production Programs

The ***National Organic Certification Cost-Share Program*** (Sec. 10014) helps organic farmers offset the cost of annual certification, which may benefit organic local and regional producers. In the 2014 Farm Bill, mandatory funding for this program increased to $11.5 million annually for 2014-18—more than double the amount from the 2008 Act.

The ***Rural Microentrepreneur Assistance Program*** (RMAP), which was created by the 2008 Farm Bill, provides grants and direct loans to organizations that provide microloans, of up to $50,000 each, to rural microenterprises for a variety of purposes. The 2014 Farm Bill maintains mandatory funding levels for RMAP at $3 million annually as in the previous act (Sec. 6203). Similarly, support was renewed for the Farm Service Agency (FSA) ***Microloan*** program. This program, a modification of the FSA Operating Loan Program, is designed to serve farmers, particularly those who are smaller and less established; the program features streamlined loan applications and flexible eligibility requirements. The maximum loan amount is $35,000, and the funds can be used for all approved operating expenses (Sec. 5106).

Also, in the 2008 Farm Bill, the Local and Regional Food Enterprise Loan account was established within the ***Business and Industry (B&I) Guaranteed Loan Program*** (reauthorized by the 2014 Farm Bill, Sec. 6010). The larger B&I program provides Federal guarantees of commercial loans to rural businesses. The purpose of this subprogram is to support development of local food system infrastructure (businesses that process, distribute, aggregate, store, and market foods produced either instate or transported less than 400 miles from the origin of the product). The program also has the authority to fund projects in urban areas if they support farm and ranch income and expand healthy food access in underserved communities. The 2008 Act mandated that at least 5 percent of B&I funds be appropriated to local and regional food enterprises and the 2014 Farm Bill maintains this 5-percent floor. Overall funding for the B&I Loan program is set through the annual appropriations act, and in May 2014, USDA announced that $48 million in loan guarantees is available for local food projects.

National Farm to School Program

School districts are encouraged to source locally produced food for school meals. The Healthy-Hunger Free Kids Act of 2010 (Pub.L. 111-296) created a Farm to School Program within USDA to increase access to local foods by schools. Operated by the Food and Nutrition Service (FNS), USDA's program includes grants, training/technical assistance, and research. The grant program provides up to $5 million in annual funding to help school districts plan and implement farm to school programs to source locally and regionally produced food products for school meals.

Additionally, the USDA conducted the first-ever nationwide Farm to School Census, documenting farm to school activities in school year 2011-12 (results of this census are detailed in the consumer section of this report). Most recently, a new pilot project authorized in the 2014 Farm Bill will allow up to eight States additional flexibility for using USDA Foods entitlement dollars to purchase locally sourced, if desired, unprocessed fruits and vegetables using geographic preference. Furthermore, in the last decade, many States have passed legislation supporting to school programs (National Farm to School Network and Vermont Law School Center for Agriculture and Food Systems, 2014). Nonprofit organization like the National Farm to School Network also aid in the procurement of locally produced food for school meals.

Know Your Farmer, Know Your Food

Know Your Farmer, Know Your Food (KYF2) is a USDA-wide initiative to strengthen USDA's support for local and regional food systems. Since 2009, KYF2 has helped foster the connection between farmers and consumers and serves as a clearinghouse for information on USDA programs available to support local and regional food systems. The initiative is carried out through a task force of USDA employees representing all agencies in the Department, through which USDA integrates programs and policies to promote local and regional food systems. In 2012, the initiative launched a map of USDA investments in local and regional food systems called the *Compass*; projects supported by other federal Departments were added in 2013. Data on the *Compass* are pulled from over 30 grant and loan programs and updated annually. KYF2 also provides an online repository of tools and resources to help farmers, consumers, and other stakeholders take advantage of local and regional food systems at http://www.usda.gov/knowyourfarmer.

State and Substate Local Food Policies and Programs

At the State level, local and regional food policies are often tied to State actions to promote healthy communities and access to healthy food (Winterfeld et al., 2012). Recent legislation in many States has focused on expansion of food access and urban agriculture.

State Support for Increased Access to Local Food

Several States have adopted legislation to provide financial incentives for food retail outlets, some of which include local food retailers, to locate in areas with low access to healthy food with the goal of increased food access[50] (Winterfeld et al., 2012). For example, in 2011, the District of Columbia established the Healthy Food Retail Program to provide grants and loans to farmers' markets, corner stores, and other small food outlets that sell fresh produce. Participants are encouraged to accept SNAP benefits and must agree to retail produce for at least 3 years. California passed a law in 2011 that created the California Healthy Food Financing Initiative[51] to expand access to healthy food in underserved communities, although the initiative is not limited to local and regional food.

[50]For more information on how USDA measures food access, see the Food Access Research Atlas at http://www.ers.usda.gov/data-products/food-access-research-atlas.aspx.

[51]This program is separate from the Federal HFFI program included in the 2014 Farm Bill. Funding for California's program is provided through a public-private partnership.

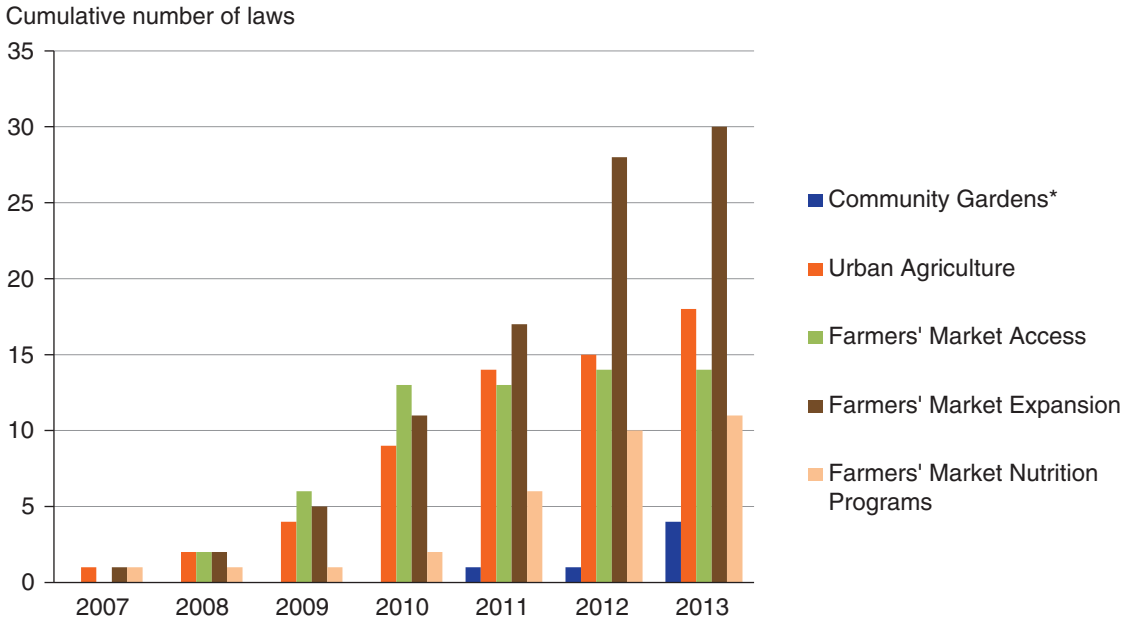
In recent years, farm to school programs have received considerable support at the State level, with the goal of increasing food access and awareness[52] (Winterfeld et al., 2012). For example, in 2011, Oregon unanimously passed a law appropriating $200,000 to establish a grant program that provides funding of up to 15 cents per lunch to schools to use Oregon-grown, processed or manufactured food in school meals and to provide education related to local agriculture. Missouri established the Farm to Table Advisory Board to investigate options to use locally grown food in schools and State institutions and to promote awareness of the connection between local food and healthy eating. New Jersey established the annual "Jersey Fresh Farm to School Week," organized by the Department of Agriculture and Department of Education, which includes a variety of programs to encourage the use of locally marketed food products.

State Legislation on Farmers' Markets

Farmers' markets are another target for State legislation, including access, market expansion, and nutrition programs (fig. 14). According to the National Conference of State Legislatures (NCSL), between 2008 and 2012, 11 States passed legislation to help increase the use of EBT machines at farmers' markets (NCSL, 2014a). Most of these programs also have specifically appropriated funds to help farmers' markets purchase wireless EBT machines.

State legislatures have also prioritized expansion of farmers' markets and, more generally, local food systems through various initiatives. According to the National Conference of State Legislatures, in 2012, Florida, Georgia, Mississippi, New York, North Carolina, and South Carolina each appropri-

Figure 14
Recently enacted State-level local food policy legislation by topic and year



*The figure for community gardens legislation does not include pre-existing statutes in six states.
Source: National Conference of State Legislatures, 2014.

[52]These examples represent a small portion of the State activities related to Farm to School. More information can be obtained from the Farm to School Network regional and State leads (http://www.farmtoschool.org/our-network).

ated funds ranging from $50,000 to $7 million for construction, repair, and maintenance of capital infrastructure for farmers' markets (NCSL, 2014a). Between 2008 and 2012, Colorado, Illinois, Louisiana, and Oklahoma each established a committee or task force to support farmers' markets, while Connecticut, Louisiana, and Rhode Island funded grant and marketing programs to promote local agriculture. Some States also provide tax relief for farmers' markets such as sales tax exemptions (Mississippi and Tennessee) and property tax exemptions (Washington).

Another area of State legislation that supports farmers' markets and local food systems is nutrition programs for low-income residents. State programs in this area are typically tied to the federally subsidized Farmers' Market Nutrition Program, Farmers' Market Coupon Program, and Seniors Farmers' Market Nutrition Program (NCSL, 2014a). In 2012, Illinois, Massachusetts, Mississippi, New Jersey, and West Virginia each appropriated State funds for one or more of these programs, ranging in amount from $30,000 to $1.5 million.

State Support for Local Food Infrastructure

Some States have also adopted legislation to support infrastructure for local food production and consumption. Connecticut was the first State to establish a State food policy council[53] in 1997, and by 2011, 12 additional States had done so (Hood et al., 2012). Building on this, Connecticut recently authorized municipalities to create local and regional councils as well to promote and support local agricultural systems. (Winterfeld et al., 2012). New York expanded the New York State Urban Development Corporation Act to allow funds to be used to finance distribution of State produce to institutions in underserved communities. Iowa and Vermont both implemented comprehensive local food programs to promote production, distribution, and marketing of local foods. Both initiatives also established a statewide local food coordinator position to manage the program.

Urban Agriculture and Community Gardens

State legislators have also targeted support to local and regional food systems through statutes and programs focusing on urban agriculture and community gardens. Since 2007, several States and the District of Columbia have passed laws that improve land access for urban agriculture (NCSL, 2014b). Programs provide tax incentives for urban land conversion to agricultural use and urban farming and gardening generally. Many more States have established committees to develop recommendations for expanding local food production.

A few States have specific statutes in their State code related to community gardens that benefit local food systems (NCSL, 2014c). For example, California is authorized to develop programs to support organizations that develop community gardens, lease State land for use as community gardens, provide grants to school districts for school gardens, and allow municipal bodies to dedicate land to community gardens. In the District of Columbia, the Food Production and Urban Gardens Program compiles a list of vacant lots in the city for use as urban and community gardens. In Illinois, community gardens are included in the nutrition programs funded by the State-administered Federal Community Services Block Grant program. Massachusetts State law authorizes the Bureau of

[53]A food policy council is a public-private advisory council—typically comprised of food sector stakeholders, community leaders, and representatives from other public and private sector partners—that works with State, regional, and local government to develop policies and programs that support local and regional food systems.

Agriculture Land Use to obtain both private and public land to provide to groups and organizations for use as community gardens, with priority given to raising food crops.

Other Substate Policies and Programs

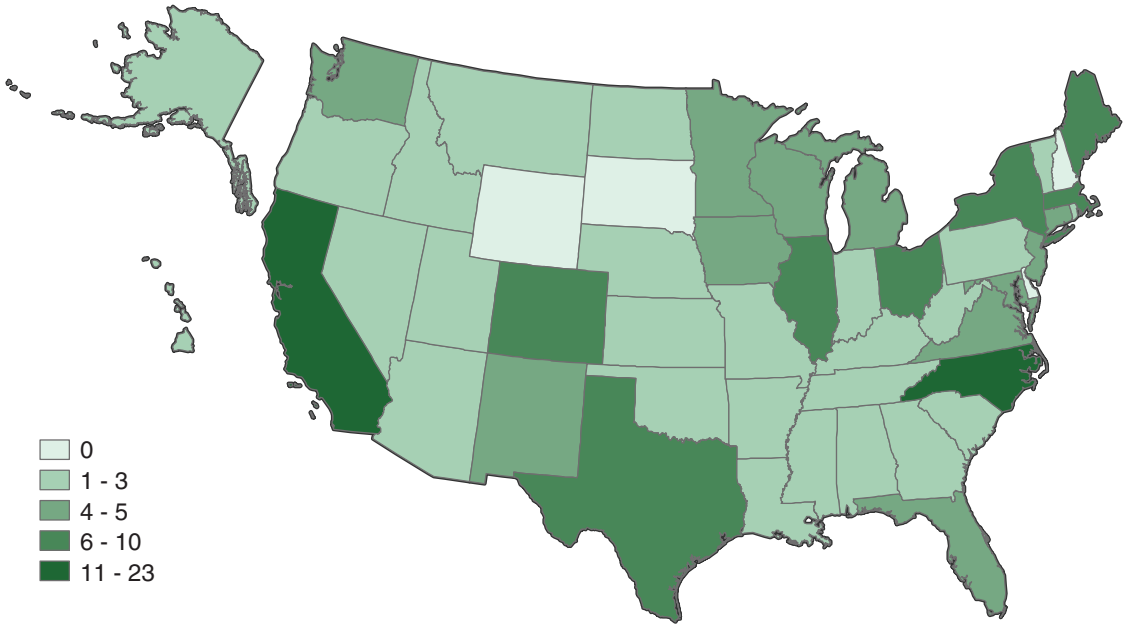
City, county, and regional governments have implemented innovative public policies to support local and regional food systems. Policy instruments employed include official plans, regulations, fiscal incentives, and government institutions and programs. Official government plans guide local investment and community development. According to a report by the Food Systems and Healthy Communities Lab at the University of Buffalo, some local governments have incorporated food systems into their comprehensive or environmental plans, while others have developed stand-alone food system plans (Neuner et al., 2011). Regulatory tools such as permitting, licensing, and monitoring can also help or hinder the development of local and regional food systems by regulating various aspects of production, processing, distribution, consumption, and disposal of food (Neuner et al., 2011). For example, local governments can modify zoning ordinances to permit urban agriculture in cities or to allow farmers' markets in certain districts.

Local governments are also providing fiscal incentives—including loans, grants, or reduced permit and license fees—to local food producers (e.g., urban farms or community gardens), retail stores, or farmers' markets (Neuner et al., 2011). Some cities also provide loans and grants to support mobile vending of fresh produce (e.g., the Green Cart Initiative in New York City). Local government institutions that support local and regional food systems were uncommon in the past, but recently these mechanisms have begun to play a larger role in local food policy. Institutional structures may exist directly within local government agencies, such as a department of planning. Private-public food policy councils have also emerged to address local and regional food policy. In these councils, local government officials and stakeholders work together to develop policies that support local food systems (Neuner et al., 2011). Today, over 150 local and regional food policy councils exist in the United States, in addition to State-level food policy councils established in over half the States (fig. 15).

Government and NGO Collaboration To Support Local Food at the State and Regional Levels

Aside from government legislation, a number of nongovernmental programs and organizations exist to support and promote local and regional food systems. State farmers' market associations typically provide member markets with technical assistance, marketing and promotion services, networking opportunities, assistance with insurance, and general advocacy, according to the Farmers Market Coalition (Wasserman, 2009). As of 2014, associations exist in 26 States. FoodRoutes Network, for example, is a Pennsylvania-based nonprofit organization that promotes local food systems and sustainable agriculture and manages the development of State and local Buy Fresh Buy Local® chapters. Buy Fresh Buy Local® chapters organize outreach events, local food guides, and educational materials to promote locally produced food and farmers. As of 2014, 65 State and regional/local Buy Fresh Buy Local® chapters have been established in 21 States.

Figure 15
State, regional, and/or local food policy councils, 2013



Note: Data exclude Native American tribal councils.
Source: Johns Hopkins Center for a Livable Future, 2014.

Glossary

Agricultural Resource Management Survey (ARMS): USDA's primary source of information on the financial condition, production practices, and resource use of America's farm businesses and the economic well-being of America's farm households. ARMS is a nationally representative survey administered using several phases—sample screener, field-level, and farm-level phases—targeting about 5,000 fields and 30,000 farms each year.

Community Supported Agriculture (CSA): Marketing arrangement in which members purchase shares of a farmer's expected yield before planting. Each week during the growing season the farmer delivers each member's weekly share of food to predetermined locations or packs the share for members to pick up at the farm.

Department of Defense (DOD): U.S. government agency in charge of the three military branches. The DOD Fresh Fruit and Vegetable Program allow schools to use USDA Foods entitlement dollars to buy fresh produce. The program is operated by the Defense Logistics Agency at DOD.

Direct-to-Consumer (DTC) Marketing: Local food marketing arrangement in which producers sell agricultural products directly to the final consumers, such as sales to consumers through farmers' markets, CSAs or farm stands.

Electronic Benefits Transfer (EBT): An electronic system that allows a recipient to authorize transfer of their government benefits from a Federal account to a retailer account to pay for products received. The 1996 Farm Bill required replacement of the SNAP paper coupon system (i.e. food stamps) by an EBT debit card system, which was rolled out on a State-by-State basis and completed in 2004.

Food hub: Regional enterprises that aggregate locally-sourced food to meet wholesale, retail, institutional, and even individuals' demand. They have become key entities in local food systems' infrastructure allowing small and midsized farmers to adapt to increases in demand by outsourcing marketing to them.

Food Safety Modernization Act (FSMA, Pub.L. 111-353): A federal law passed in 2011 calls for sweeping changes to the U.S. food safety system by shifting the focus of Federal regulators from outbreak response to prevention. Part of this legislation obliges FDA to develop science-based and risk-based mandatory microbial food safety practices. This will be the first time that produce growers come under mandatory FDA regulation.

Good Agricultural Practices (GAP): The public food safety education program for produce began in 1998 when the Food and Drug Administration (FDA) published its *Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables*, voluntary guidelines popularly referred to as GAP.

Gross Cash Farm Income (GCFI): Monetary revenue actually received by the farm, including other farm income such as agritourism, custom work, and forest products, but excluding the value of farm production accruing to share landlords and contractors.

Good Handling Practices (GHP): Voluntary standards based on FDA's GAP guidance that outline best agricultural practices to verify that fruit and vegetables are packed, handled, and stored in the safest way, reducing microbial food safety risks associated with fresh produce.

Hazard Analysis and Critical Control Point (HACCP): Management system in which food safety is addressed through the analysis and control of biological, chemical, and physical hazards from raw material production, procurement and handling, to manufacturing, distribution and consumption of the finished product.

Intermediated sales: Sales through non-direct local food marketing channels that in turn sell directly to consumers, such as restaurants, grocery stores, schools, hospitals, or regional food aggregators.

National Organic Program (NOP): The NOP regulates all organic crops, livestock, and agricultural products certified to the USDA organic standards. Organic certification agencies inspect and verify that organic farmers, ranchers, distributors, processors, and traders are complying with the USDA organic regulations.

Supplemental Nutrition Assistance Program (SNAP): Federal program administered by USDA FNS that offers nutrition assistance to eligible, low-income individuals and families. FNS works with State agencies to ensure that those eligible for nutrition assistance can access benefits.

Special Supplemental Nutrition Program for Women, Infants, and Children (WIC): Federal program administered by USDA FNS that provides Federal grants to States for supplemental foods, health care referrals, and nutrition education for low-income pregnant, breastfeeding, and non-breastfeeding postpartum women, and to infants and children up to age five who are found to be at nutritional risk.

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Appendix: Variability in the 2008-11 ARMS Data and Developing Synthetic Estimates of Total Local Food Sales

The problem in estimating the total value of local food sales in the U.S. is twofold. First, although ARMS has generated annual estimates of the value of total local food sales since 2008, the annual estimates exhibit significant year-to-year variation. The ARMS estimates of the number of farms selling local foods through intermediated marketing channels are lower than the Census counts. Second, the 2012 Census of Agriculture benchmarks the number of local food farms using DTC and intermediated marketing channels, but only the value of sales through DTC marketing channels and not the value of local food sales through intermediated marketing channels.

To address this problem, we develop a synthetic estimate of the total value of sales, drawing on the strengths of both ARMS and the Census. The 2012 Census data provide geographically representative benchmark counts of local food farms. The ARMS estimates provide more detail on the farm and farm operator, as well as the value of total local food sales.

This appendix is divided into two sections. The first section discusses sources of variation in the annual ARMS estimates and compares these estimates to the 2012 Census count of the number of local food farmers. The second section discusses the method for deriving our synthetic estimate and provides the synthetic estimates of total local food sales by farm size and marketing channel options, and by marketing channel options and farm production type.

Variation in the Annual ARMS Estimates, 2008-11

Beginning in 2008, the Agricultural Resource Management Survey (ARMS) has been surveying annually farmers who report producing and selling food commodities for human consumption through DTC and through intermediated marketing channels. For the 2008-11 period, ARMS estimated that, on average, 146,200 farmers marketed food locally, but annual estimates of local food farmers range from 107,200 (2008) to 231,900 (2010) (appendix table 1). Over this same period, annual sales of local foods were estimated to be almost $4.0 billion, on average, but annual estimates of local food sales ranged from $4.8 billion (2008) to $2.8 billion (2011).

This variation is likely due to: (i) growth and innovation in local food marketing channels have moved faster than the lead-time needed to adapt the ARMS questionnaire; and (ii) its mission and sample design are not geared to collecting data on small, niche sectors. ARMS surveys used two different methods to estimate local food sales, one in 2008 and 2009 and another in 2010 and 2011. In the 2008 and 2009 ARMS questionnaire, farmers were asked to identify specific market channels they used, but report only total local food sales *as a share total gross farm sales*. Consequently, in 2008 and 2009, separate totals for DTC sales and intermediated sales could not be estimated, forcing us to report local food sales using the three discrete categories: sales through DTC channels *only*, through intermediated marketing channels *only*, or through *both* types of marketing channels. In the 2010 and 2011 ARMS, respondents were asked to report the value of local food sales linked to specific marketing channels. Differences between the 2008 and 2009 estimates and the 2010 and 2011 estimates suggest farmers may have overstated their local food sales when reporting sales as shares of total gross farm sales.

The mission of ARMS is to provide an annual national-level quantitative snapshot of the financial condition, production practices, and resource use of America's farm businesses and the economic well-being of America's farm households. Although the ARMS multiframe, stratified design is a geographically representative sample of about 30,000 farms, its scope requires it to oversample the larger farms and farms in the 15 core States.[54] Consequently, the sample may contain relatively few farms doing certain activities, and estimates of those activities may be subject to considerable error. Thus, if a region contains a large number of local food farms but ARMS obtains data only on a small number of them, then the estimate of the number of local food farms and local food sales could vary from the actual totals. A more refined survey targeting local food farms is the appropriate data collection instrument.

A recent marketing channel innovation illustrates the difficulty of using ARMS as a blunt instrument to collect farm level data on local foods. For the first time, the 2011 ARMS asked farmers to report separately food sales to institutions such as schools, hospitals, and universities. ARMS results show no locally marketed food sold through these marketing channels. Yet, the USDA Farm to School Census of public school district food authorities recorded $385 million in farm to school sales for the 2011-12 school year (see pp. 39-42 for more results from the Farm to School Census).[55] This discrepancy may have arisen because, according to the Farm to School Census, 75 percent of farm to school sales occurred in the Northeastern States, a region from which the 2011 ARMS sampled very few farms.[56]

Except for the 2008 ARMS, the estimates of marketing channels use by local food farmers in the ARMS estimates differ relative to the 2012 Census of Agriculture. The 2009-11 ARMS shares of local food farms using exclusively DTC marketing channels are 8-11 percentage points higher than the 70 percent share of these local food farms in the 2012 Census. The 2009-11 ARMS shares of local food farmers using intermediated marketing channels exclusively are 5-9 percentage points lower than the 14 percent share of these local food farms in the 2012 Census (appendix table 1). Since local food farms using DTC marketing channels exclusively have the lowest value of local food sales per farm relative to other marketing channels, the apparent over representation of these farmers and under representation of farmers using intermediated marketing channels imply that ARMS estimates of total local food sales may be too low.

Developing the Synthetic Estimates of Total Local Food Sales

We develop a synthetic estimate of the value of local food sales by accepting the 2012 Census local food farm counts and multiplying that number of farms by the ARMS estimates of local food sales

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[54]The core agricultural States sampled by ARMS are Arkansas, California, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Carolina, Texas, Washington, and Wisconsin. Each farm in the ARMS is given a calibrated weight based on farm size, production specialty, region, and other criteria. For a particular year, the sum of the number of ARMS farms times their population weights equals the total number of farms benchmarked by the National Agricultural Statistics Service (NASS). NASS benchmarks annual ARMS totals based on Census. The ARMS population weights are currently being recalibrated to the 2012 Census figures.

[55]Note that this figure includes locally manufactured food and locally produced food marketed through conventional distributors, neither of which would have been captured by ARMS. But three quarters of farm to school districts reported buying local fruits and vegetables, and 4 in 10 reported buying directly from producers, suggesting that a different sampling design might have been more likely to capture some of these sales.

[56]Beginning 2013, ARMS survey design was changed to increase sample coverage among very small farms and expand somewhat its geographic representativeness. Hence, it is anticipated that these improvements will reduce variation in future ARMS estimates of farmer participation in local and regional food systems. These data are not yet available.

per farm by marketing channel type, in which the sales per farm are averages of the pooled 2008-11 ARMS data (table 4). This approach relies on the assumption that ARMS estimates of farm structure expressed as shares or averages per unit are good estimates; that they do not exhibit the wide variation estimates of farm counts do. The synthetic estimates represent an alternative approximation of the value of the local foods sector, an alternative that is likely more accurate than ARMS estimates.[57] The synthetic estimates for each market channel option, when expressed as shares of total local food sales, are very close to the original shares of local food sales reported in Low and Vogel (2011), which used 2008 ARMS data (appendix table 1).

Census data on the number of farms by farm size, type of marketing channel employed, and production type allows us to generate two-way estimates of local food sales. The Hadamard product of the 2012 Census farm counts by farm size and marketing channel and the ARMS average estimates of local food sales per farm by farm size and market channel yields synthetic estimates of total local food sales for small, midsized, and large local food farmers using specific market channel options.[58] These estimates are converted to shares of total local food sales by farm size and used in figure 5 (appendix table 2). The Hadamard product of the 2012 Census farm counts by farm size and farm production type and the ARMS average estimates of local food sales per farm by farm size and farm production type yields synthetic estimates of local food sales by farm size and farm production type. These estimates are also converted to shares of total local food sales by farm size and used in figure 6 (appendix table 3).

More disaggregated synthetic estimates of local food sales introduce measurement error such that the sum total of local foods sales in one two-way disaggregation does not equal the other. Instead, these two estimated totals, $5.8 billion in local food sales when disaggregated by market channel option and farm production type and $6.6 billion when disaggregated by farm size and market channel option, bookend the initial 2012 estimate of $6.1 billion in table 4 (appendix tables 3). Therefore, for the figures 5-6, the $6.1 billion estimate is used to scale the disaggregated totals, while retaining the information on farm structure as expressed as shares of local food farmers by farm size, market channel option, and farm production type.

[57]Developing trend measures of local and regional foods sales using data currently collected at the farm gate is still not possible.

[58]The Hadamard product is the matrix multiplication analog of basic multiplication: $a \cdot b = c$. It is a binary operation that takes two matrices of the same dimensions, and produces another matrix where each element ij is the product of elements ij of the original two matrices: $(\mathbf{A} \circ \mathbf{B})_{i,j} = (\mathbf{A})_{i,j} \cdot (\mathbf{B})_{i,j} = \mathbf{C}_{i,j}$. The two-way disaggregation of the number of local food farms and the local food sales per farm are 3×3 matrices for which element by element multiplication equals total local food sales for each ij^{th} element in **C** in appendix tables 3 and 4.

Appendix table 1

Number of local food farms and value of direct sales by marketing channel type, 2008-2011 ARMS and 2012 Census of Agriculture

Item	Year				2008-11 average	2012 Census of Agriculture*
	2008	2009	2010	2011		
				Number of farms		
All farms reporting the value of their direct marketing sales	107,229	130,574	231,946	115,201	146,238	163,675
Direct to consumer sales only	71,248	104,150	186,915	93,691	114,001	115,304
Direct to consumer and intermediated market channel sales	22,603	14,707	34,003	13,490	21,201	25,756
Intermediated marketing channel sales only	13,378	11,717	11,028	8,020	11,036	22,615
				Percent		
All farms reporting the value of their direct sales	100	100	100	100	100	100
Direct to consumer sales only	66	80	81	81	78	70
Direct to consumer and intermediated market channel sales	21	11	15	12	14	16
Intermediated marketing channel sales only	12	9	5	7	8	14
				$ millions		
Value of direct marketing sales:	4,806	4,448	3,744	2,819	3,954	*6,113*
Direct to consumer sales only	887	1,456	1,241	647	1,058	*1,152*
Direct to consumer and intermediated market channel sales	1,199	1,787	1,195	1,107	1,322	*1,612*
Intermediated marketing channel sales only	2,720	1,205	1,307	1,065	1,575	*3,349*
				Percent		
Value of direct marketing sales:	100	100	100	100	100	*100*
Direct to consumer sales only	18	33	33	23	27	*19*
Direct to consumer and intermediated market channel sales	25	40	32	39	33	*26*
Intermediated marketing channel sales only	57	27	35	38	40	*55*

*Synthetic 2012 estimates (italics) of the total value of local food sold through each marketing channel type (see calculations in Table 4).
Source: USDA, Economic Research Service/National Agricultural Statistics Service, Agricultural Resource Management Surveys (ARMS), 2008-2011; Economic Research Service analysis of USDA, National Agricultural Statistics Service, 2012 Census of Agriculture data.

Appendix table 2

Developing synthetic 2012 estimates of local food sales by market channel option and farm size

Item	Farm size class: GCFI under $75,000	GCFI - $75,000 to $349,999	GCFI - $350,000 or more	All
2012 Census - local food farms using:		*Number of farms*		
Direct-to-consumer channels only	102,826	8,743	3,735	115,304
Direct-to-consumer and intermediated marketing channels	19,503	4,401	1,852	25,756
Intermediated marketing channels only	16,269	3,466	2,880	22,615
All local food farms	138,598	16,610	8,467	163,675
multiplied by		*dollars*		
2008-11 ARMS - local food sales per farm using:				
Direct-to-consumer channels only	4,338	45,635	112,661	–
Direct-to-consumer and intermediated marketing channels	12,542	85,831	456,965	–
Intermediated marketing channels only	8,979	150,857	1,100,977	–
/10^6 =		*millions of dollars*		
Synthetic 2012 estimate of local food sales by market channel:				
Direct-to-consumer channels only	446	399	421	1,266
Direct-to-consumer and intermediated marketing channels	245	378	846	1,469
Intermediated marketing channels only	146	523	3,171	3,840
Total local food sales	837	1,300	4,438	6,574
Share statistics for figure 5:		*percent*		
All local food farms	84.7	10.1	5.2	100.0
Total local food sales	12.7	19.8	67.5	100.0
Share statistics for figure 5:				
2012 Census - local food farms using:		*percent*		
Direct-to-consumer channels only	74.2	52.6	44.1	–
Direct-to-consumer and intermediated marketing channels	14.1	26.5	21.9	–
Intermediated marketing channels only	11.7	20.9	34.0	–
All local food farms	100.0	100.0	100.0	
Synthetic 2012 estimate of local food sales by market channel:		*percent*		
Direct-to-consumer channels only	53.3	30.7	9.5	–
Direct-to-consumer and intermediated marketing channels	29.2	29.1	19.1	–
Intermediated marketing channels only	17.5	40.2	71.4	–
Total local food sales	100.0	100.0	100.0	

GCFI = gross cash farm income.

Source: USDA, Economic Research Service/National Agricultural Statistics Service, Agricultural Resource Management Surveys (ARMS), 2008-2011; Economic Research Service analysis of USDA, National Agricultural Statistics Service, 2012 Census of Agriculture data.

Appendix table 3

Developing the synthetic estimates of local food sales by market channel option and farm production type

Item	Farm production type: Field and other crops	Vegetables, fruit, & nuts	Livestock & livestock products	All
2012 Census - local food farms using:		*Number of farms*		
Direct-to-consumer channels only	20,536	29,611	65,157	115,304
Direct-to-consumer and intermediated marketing channels	5,231	12,685	7,826	25,742
Intermediated marketing channels only	10,135	5,645	6,835	22,615
All local food farms	35,902	47,941	79,818	163,661
multiplied by		*dollars*		
2008-11 ARMS - local food sales per farm using:				
Direct-to-consumer channels only	11,576	17,530	6,150	–
Direct-to-consumer and intermediated marketing channels	27,352	74,961	49,923	–
Intermediated marketing channels only	84,572	257,030	122,256	–
/10^6 =		*millions of dollars*		
Synthetic 2012 estimate of local food sales by market channel:				
Direct-to-consumer channels only	238	519	401	1,158
Direct-to-consumer and intermediated marketing channels	143	951	391	1,485
Intermediated marketing channels only	857	1,451	836	3,144
Total local food sales	1,238	2,921	1,627	5,786
Share statistics for figure 6:		*percent*		
All local food farms	21.9	29.3	48.8	100.0
Total local food sales	21.4	50.5	28.1	100.0
Share statistics for figure 6:				
2012 Census - local food farms using:		*percent*		
Direct-to-consumer channels only	17.8	25.7	56.5	100.0
Direct-to-consumer and intermediated marketing channels	20.3	49.3	30.4	100.0
Intermediated marketing channels only	44.8	25.0	30.2	100.0
Synthetic 2012 estimate of local food sales by market channel:		*percent*		
Direct-to-consumer channels only	20.5	44.8	34.6	100.0
Direct-to-consumer and intermediated marketing channels	9.6	64.0	26.3	100.0
Intermediated marketing channels only	27.3	46.2	26.6	100.0

GCFI = gross cash farm income.

Source: USDA, Economic Research Service/National Agricultural Statistics Service, Agricultural Resource Management Surveys (ARMS), 2008-2011; Economic Research Service analysis of USDA, National Agricultural Statistics Service, 2012 Census of Agriculture data.