

What Influences Produce Growers' On-Farm Expenditures for Food Safety? A Colorado Investigation of the Relationships among Farm Scale, Value of Sales, Market Channel, and Expenditure Levels

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One in six Americans gets sick each year from largely preventable foodborne illnesses (CDC 2015; US FDA 2014), and the public health costs of such illnesses are estimated to exceed \$93.2 billion a year, or \$350 per resident (Scharf 2015). In an effort to address the public health costs of foodborne illnesses, the Food Safety Modernization Act (FSMA) was signed into law on February 4, 2011, marking the first major overhaul of the U.S. regulatory system for food safety since the 1930s, and requiring a major shift in regulatory focus from detection to prevention (Hassanein 2011). For the first time, farmers who grow fresh produce known to be susceptible to bacterial contamination must adhere to mandatory federal produce safety standards—standards designed to reduce or eliminate microbial contamination of fresh produce from the farm to the consumer—including standards for agricultural production and postharvest water, worker hygiene, food contact surfaces, temperature controls, and animals in the growing area. Yet there is concern that small and mid-scale producers, particularly those selling through locally-oriented and diverse market channels, will be adversely impacted by this regulation in terms of compliance and reporting costs (Holcomb et al. 2013).

Given concern for the financial viability of small and mid-scale producers, as well as evidence that a growing share of these farms are selling through locally-oriented markets with often ill-defined food safety requirements (Low et al. 2015), we focus our attention on the relationship between food safety expenditures, farm scale, gross sales, and market channel selection. Using the results from a survey of 52 Colorado (CO) produce growers administered from October 2013 to March 2014 by CO State University Extension, we analyzed total on-farm food safety expenditures, as well as key food safety expenditure categories to better understand how future outreach might be most effectively targeted to improve farm-scale efficiency in implementing and managing food safety programs.

Previous Research

Evidence of the adverse public health effects and the social costs related to preventable foodborne illnesses (Almaza and Nesmith 2004; Calvin et al. 2004; Palma et al. 2010) have motivated policymakers to establish a set of standards that signify a product has been produced and handled in a safe manner. This is particularly salient given the increasingly global nature of food supply chains, and the diffuse nature of governance with a wide range of actors involved across state and federal agencies, each with varying food safety and protection standards.

There is agreement that the absence of a uniform standard has resulted in an additional cost burden to producers (e.g. Paggi et al. 2013; Henson and Humphrey 2008). With the exception of limited markets controlled by a few vertically-integrated firms, producers “continue to face their market as price takers. As such...producers [are] required to comply with whatever food

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safety-based standards their buyers require if they wish to be active market participants” (Paggi et al. 2013, 462). Calvin et al. (2004) examined the economics of food safety and found that growers who adopt more stringent food safety practices do so to maintain markets and to reduce risk, but that implementing additional food safety practices does not result in higher prices. Hardesty and Kusunose (2009) similarly report the unlikelihood that growers in California would receive a price premium for adhering to the costly standards enacted through the Leafy Green Marketing Agreement.

FSMA and small-scale growers

As Congress debated FSMA throughout the 2010 session, a point of contention focused on whether the costs of complying with the additional regulatory requirements of the new food safety law would place a disproportionate financial and management burden on small-scale producers. The advocacy work of a broad-based coalition of 128 national, state and local organizations resulted in an amendment to the Produce Safety Rule (known as the Tester-Hagan Amendment) that granted qualified exemptions to small-scale, locally-oriented producers (Hassanein 2011).² The FDA estimates that 76,000 farms will receive a qualified exemption based on sales of less than \$500,000, and that about 34,000 farms with sales of \$25,000 or less will be exempt from the Produce Safety Rule (Holcomb et al. 2013).

Despite the passage of the Tester-Hagan Amendment, FSMA has left many small and mid-scale farms unsure of regulatory requirements and the costs associated with compliance in several ways, particularly those selling through locally-oriented markets. First, there is increasing evidence that the majority of local food moves through intermediated markets (Low and Vogel 2011). Producers selling through intermediated markets are significantly more likely to be profitable (Park et al. 2014), which raises important questions about the impact of the proposed exemptions. Furthermore, although larger scale retailers are transparent about their food safety requirements for producers, many local foods marketing channels (e.g. food hubs) may not have clearly defined rules and regulations, thus making it difficult for producers to determine requirements and costs (King et al. 2010). Second, although producers who are exempt from FSMA may have opportunities to sell through niche markets (e.g. farmers’ markets), many of these outlets are seasonal, and support a limited volume of produce sales. FSMA may, therefore, become an additional barrier for those looking to scale up (Palma et al. 2010; Paggi et al. 2013).

Costs associated with food safety implementation

Questions about the costs associated with food safety compliance were raised as FSMA was debated in Congress, and continued throughout the rulemaking process (e.g. Becot et al. 2012; Paggi et al. 2013). The FDA (2013) did provide cost estimates—an average of \$11,430 per covered farm—that range between \$88 and \$30,566 depending on farm size. However, Holcomb et al. (2013) explicitly questioned the assumptions and data used by the FDA to generate their estimates, and called for more reliable data to estimate regional costs of regulatory compliance by commodity and by market channel.

² Small-scale, locally oriented producers are defined as farms or facilities that sell fifty percent or more of their product locally, directly to the end user (consumers, restaurants, or grocery stores within the same state or 275 miles), and that have less than \$500,000 in annual sales (Hassanein 2011).

To date, only a handful of case studies have looked at the farm-level costs for produce growers who must comply with FSMA, or other similar types of food safety regulations, and none looks specifically at costs by market channel. In large part this paucity of research is due to the fact that obtaining the requisite data is difficult and further complicated by farm heterogeneity and the unique cost structure associated with each farm (Paggi 2008). Two studies (Woods and Thornsbury 2005; Hardesty and Kusunose 2009) examined the impact of adopting Good Agricultural Practices and complying with the Leafy Green Marketing Act. The first showed much higher per acre costs for small scale growers compared to those operating at a larger scale—\$288 an acre and \$66 an acre. The second, focused on large-scale growers, found capital costs averaged \$21,490, or \$1,360 per acre. In addition, growers reported that their seasonal variable food safety costs doubled after implementation of the LGMA—from an average of \$24.04 per acre in 2006 to \$68.23 in 2007—representing almost one percent of growers' average revenues.

The limited case study evidence points to two key issues: 1) the variability of costs associated with implementing a food safety program; and 2) the differential impacts of adhering to food safety regulations depending on farm size. None of the previous literature examines the relationship between food safety compliance costs and market channel selection. Findings from a USDA Economic Research Service (ERS) report examining the structure, size and performance of 15 food supply chains in five U.S. states point to the potential for additional mandatory food safety requirements to pose significant problems for transforming direct market supply chains into intermediated supply chains. They state this may have long-term negative implications for small-scale producers more likely to participate in these channels (King et al. 2010). Examining the relationship between food safety compliance costs and market channel selection is an important and timely area of inquiry.

Approach

Colorado's fresh produce industry is very diverse, ranking 14th nationally for the quantity of vegetables, melons, potatoes, and sweet potatoes that it produces (USDA NASS 2012), and generating nearly \$300 million for growers at the farm gate. In addition, Colorado growers have been much more focused on food safety since the 2011 Listeriosis outbreak that originated in southeastern Colorado—the third-deadliest foodborne illness outbreak in the history of the U.S. The combination of the importance of the agricultural sector to the state's economy and the scrutiny experienced as part of the aftermath of the Listeriosis outbreak makes it compelling to conduct this research in Colorado.

This study examines data collected from a survey of produce growers conducted by Colorado State University Extension from October 2013 through March 2014 by mail, with additional responses gathered in person. Enumerators (Extension staff or contractors hired for this purpose) targeted a sample of 653 farms from each of 32 counties distributed across the state, in 7 regions. The researchers developed lists of all produce growers in each region, and sent a survey to each grower, with a stamped, addressed envelope to be returned to Extension. After two weeks, enumerators called each grower who had not yet returned the survey. Two to three attempts were made to reach each producer, and enumerators resent the survey by mail after one month. Enumerators obtained 52 useable surveys from produce growers in 13 counties (a response rate of 8%).

In order to understand where growers were making investments in food safety, and areas requiring additional investment based on changing regulatory and buyer requirements, the

survey asked respondents to estimate their costs related to on-farm food safety for 2013 in seven different expenditure categories:

- 1) training for managers, workers, volunteers and others involved in growing and handling fresh produce;
- 2) changing labor requirements given new food safety requirements to document, monitor, clean and sanitize, and conduct recall exercises;
- 3) monitor the quality of water, soil and soil amendments for the presence of human pathogens or indicator organisms (i.e., generic *E. coli*, total coliforms) and any other associated costs;
- 4) disposable supplies related to food safety on the farm, and in packing and processing areas (e.g. cleaning supplies and sanitizers);
- 5) capital improvements made to enhance food safety in 2013 (and in prior years) for production, processing or packing;
- 6) annual costs of maintaining any improvements made, or of renting equipment or facilities; and
- 7) changes in marketing products to buyers (e.g. food safety education or traceability, third-party audits).

Results

Sample Overview

There was widespread heterogeneity among the growers surveyed in terms of scale of production and marketing. Growers reported acreage planted in fruits and vegetables that varied from one-tenth of an acre to 2,500 acres. Average total acreage planted in 2012 was 163 acres, and 174 acres in 2013 (median acres planted was the same in 2012 and 2013—4.9 acres overall). The 2012 Census of Agriculture (USDA 2012) showed that the average farm size in vegetable production in Colorado was 109 acres, and average farm size in fruit production was 8 acres. Given the variation in farm size, surveyed farms were classified into four different size categories for analysis. Table 1 presents the number of farms in each size category, and average and median acreage planted for 2013. The greatest variation in farm size is found among those farms with over 100 planted acres, which ranged from 148 to 2,500 acres in fruits and vegetables.

Respondents were asked about the different types of crops they grow, based on categories of crops listed in the proposed Produce Safety rule. In the rule, these are known as covered (their production and handling will be regulated under FSMA) and non-covered (those not regulated under FSMA). On average, growers reported 7.3 categories of covered crops in 2013, up from 4.2 in 2012 (these categories included broccoli, cabbage, cauliflower; carrots, radishes; cucumber; garlic, onions, scallions, celery; green beans, snow peas; lettuce, spinach, leafy greens; herbs; melons (cantaloupe, watermelon, honeydew); peppers (bell, chile); squash (zucchini, summer); tomatoes; and tree fruit, berries, grapes). Growers reported an average of 3.9 non-covered crops in 2013, nearly unchanged since 3.8 the year prior. A greater number of covered crops planted entails more complex postharvest handling for the grower, including higher labor, supply and packaging costs.

As is consistent with previous research, we find widespread heterogeneity in total on-farm food safety expenditures, as well as across individual expenditure categories. Accordingly, we report the data in average and median values by farm size, by sales level and by market channel.

Across all farm sizes, the largest single expenditure category was additional labor costs, which is attributable to the increased time that workers must spend monitoring, documenting, cleaning and sanitizing as part of implementing a farm food safety plan. The smallest farms (those under one acre) spent the most, per acre, on added labor hours. They also spent the most, per acre, on capital improvements to their operations (such as fencing to deter wildlife, installing hygiene facilities, or building new packing lines). Farms between 1 and 10 acres spent the greatest amount maintaining capital improvements, and the least on soil and water testing. Both worker training costs, as well as expenses on additional labor hours, decreased on a per acre basis as farm size increased. For example, the smallest farm sizes reported per acre worker training expenses of nearly \$440 per year, while the largest farms reported spending only \$14 per acre per year on average.

Table 1: On-farm food safety costs, average costs per acre, by farm size

Farm size in 2013	1 acre or less	More than 1, less than 10 acres	10-100 acres	Greater than 100 acres	All farms
Number of farms (Percent)	11 (21.2)	19 (36.5)	10 (19.2)	12 (23.1)	52
Mean acres (SD)	1.2 (0.74)	4.0 (1.39)	53.5 (21.05)	705.1*** (735.72)	174.7 (450.83)
Median acres	1.2	4.0	53.5	405.0	4.9
FSMA crop diversity	9.4	9.0	5.9	4.0	7.3
Number of market channels	2.6	2.7	2.5	1.8	2.4
Have a food safety plan (%)	54	53	10***	83	52
Conducted a 3 rd party audit (%)	9	21	20	92***	33
Food safety costs (per acre):					
Total costs/ acre (average \$)	4,969	4,824	690	519	3,066
Worker training	437	150	33	14	157
Added labor	2,350	1,225	172	54	990
Testing (soil & water)	56	22	0.83	32	27
Supplies	364	648	84	209	378
Improvements	900	870	201	46	558
Maintenance	239	1,614	179	68	690
Marketing	623	297	20	95	266

*Significant differences in mean values compared to all others at $p < 0.10$; *** at $p < 0.01$

Grouping farms by sales provides another perspective on the variable nature of food safety expenditures across this sample. Farms with sales ranging between \$250,000 and \$500,000 per year reported the highest overall per acre expenditures at \$8,341, compared to farms with sales exceeding \$500,000 per year who reported the lowest expenditures at just under \$1,000 per acre per year, on average (Table 2). These farms also reported the highest maintenance and other recurrent costs for food safety infrastructure, while the largest farms had the smallest per acre maintenance costs. Per acre worker training costs generally decreased as value of sales increased, and were highest for those farms reporting less than \$25,000 in annual sales.

The largest farms—defined both in terms of total cultivated acres and 2013 gross sales—reported the lowest total per acre food safety expenditures. Median total expenditures on food safety for

those farms with sales over \$500,000 per year was \$535 per acre, while median per acre costs for farms over 100 acres was \$206 for 2013, indicating that sales may be less of a determinant of cost management efficiency than scale of operation.

Table 2: Farm characteristics, by total value of sales

Sales category	Under \$25,000	\$25,000-\$249,999	\$250,000-\$500,000	Greater than \$500,000
Number of farms (Percent)	13 (26%)	18 (36%)	6 (12%)	13 (26%)
Mean acres (SD)	1.6 (0.93)	12 (20.7)	83.7 (75.5)	525.5*** (712)
Median acres	2.0	4.25	58.5	280
FSMA crop diversity	9.8	9.2	7.3	3.4***
Number of market channels	2.1	2.9	2.7	2.4
Have a food safety plan (%)	46	56	33	62
Conducted a 3 rd party audit (%)	15	22	33	69
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Total food safety costs/ acre (average \$)	3,638	2,732	8,341	994
Total food safety costs/acre (median \$)	616	887	880	535

***Significant differences in mean values compared to all others at $p < 0.01$

Diversity of FSMA-covered crops planted (an indicator of more complex food safety planning and monitoring) was highest on the smallest farms, and those reporting the lowest annual sales values (Tables 1 and 2). Our data showed that crop diversity decreased with both farm size as well as annual sales. Additionally, the incidence of food safety plans appears highest among those farms with more than 100 acres (83%), as well as among those farms with sales over \$500,000 (62% of which have a food safety plan). Most of these large farms—in terms of size and sales value—have conducted third party audits (92% of farms over 100 acres and 69% of those with sales over \$500,000).

Over half of all small-scale growers (those with less than ten cultivated acres) reported they had a food safety plan in place, but less than one-fifth had conducted a third party audit of any kind. Farms reporting the least degree of food safety planning were mid-size—between 10 to 100 acres. Only 10% of these farms had a food safety plan, while 20% had conducted a third party audit. Growers who did not report using any food safety practices during 2012 and 2013 typically had small-scale operations (under 10 acres), and less than \$25,000 in annual sales.

Results by market channel

Farms were asked to report the percent of their sales by market channel—direct-to-consumer (e.g. farmers' markets) and intermediated/wholesale (e.g. restaurants, farm-to-school). Based on their responses, we classified producers as selling through direct-to-consumer only channels (DTC), intermediated only channels, or diversified channels (if they sold produce through both DTC and intermediated markets). Additionally, we calculated the number of different types of marketing channels through which they sold their products. Average farm sizes were largest for farms in intermediated markets, while the average farm size of those in diversified markets was

much more variable (149 acres, standard deviation 495 acres), as were DTC farms where average farm size was 7.7 acres, standard deviation 15.8 (Table 3).

Overall, DTC farms had the lowest sales levels, with only 9% generating \$250,000 or more annually, compared to diversified farms (28% at or above \$250,000), intermediated farms with 78%, and 46% of diversified farms. No DTC farms in our sample reported sales over \$500,000 per year (Table 3). Most interestingly, farms in DTC markets reported \$4,651 in food safety expenditures per acre (\$588 in median expenditures), while those in intermediated markets reported the lowest total per acre expenditures at \$2,904 (with a median value of \$931). Farms in diversified markets reported average annual per acre expenditures on food safety at \$3,107, with a median value of \$1,053.

Table 3: Farm characteristics by market channel, 2013

Market channel	Direct to consumer	Diversified	Intermediated
Mean acres (SD)	7.7 (15.8)	54.9 (494.9)	314.3 (490.9)
Median acres	4	4.4	70
FSMA crop diversity	10.1	8.3	2.4**
Have a food safety plan (%)	36	54	56
Conducted a 3 rd party audit (%)	0**	38	44
Sales above \$250,000 per year (%)	9	28	78
Sales above \$500,000 per year (%)	0	46	55
Total average food safety costs per acre (average \$)	4,651	3,107	2,940
Total food safety costs per acre (median \$)	587	1,053	931

**Significant differences in mean values compared to all others at $p < 0.05$

DTC farms also reported the greatest diversity in crops covered under FSMA, yet only 36% had a food safety plan and none reported having conducted a third party audit. Among intermediated farms, 56% reported having a food safety plan and 44% had conducted a third party audit. Similar to intermediated farms, 54% percent of diversified farms had a food safety plan, but only 39% had conducted a third party audit.

Discussion

This study examined food safety expenditures with respect to size of operation, gross value of farm sales, food safety planning, and market channel selection, using data from a 2014 survey of 52 CO produce growers. Given the implementation of the Food Safety Modernization Act, it is both timely and important to understand relationships between farm size, market channel and expenditures for on-farm food safety practices. Issues with small sample size and heterogeneity in the data limit the types of inferences and analyses that can be conducted; however, a profile of CO's fruit and vegetable producers, and their food safety practices and expenditures, begins to emerge. The results confirm that, for CO, there are indeed economies of scale to be realized from food safety expenditures made on the largest operations, especially those over 100 acres. Overall, those operations of 10 acres or less may have higher expenditures since they have a smaller land base over which to spread costs, and they tend to be much more diversified (more than twice as much as the largest farms, on average). The implication is that there are costs

they will necessarily bear under FSMA, which may be more financially and administratively burdensome to them than to larger operations.

The fact that 50% of farms with 10 to 100 acres of fruit and vegetable production are operating without a food safety plan (10% have a complete plan and 40% have one in progress) indicates that food safety planning and implementation have yet to be fully adopted by all scales of fruit and vegetable production and signals the need for ongoing outreach and education in this area. These findings are directly in line with research from Holcomb et al. (2013) and Harrison et al. (2013) calling for additional training programs and food safety research, specifically to support small-scale local food systems participants.

One finding from this study is that farms selling through diversified market channels may have risk exposure beyond that of DTC-only farms and those operating only in intermediated markets. Our study results show they have high overall costs of food safety, a smaller land base compared to intermediated-only farms, highly diversified cropping operations, with moderate food safety planning in place. This is a key point as producers are frequently encouraged to sell products through many different market channels as a way to spread risk and even out income streams. However, given the implementation of FSMA and the need to invest heavily in new and potentially expensive practices, this points to the difficulty some producers encounter in managing costs and achieving efficiency across diverse buyer expectations. While this set of conditions should improve in the years following FSMA implementation, over the next 4 to 6 years we can likely expect lower profit margins for produce growers and upward pressure on produce prices as growers try to manage escalating food safety costs.

It should be noted that this analysis is based on a survey administered throughout CO, using multiple methods to increase the response rate (mailings, email contact, phone and in-person follow-up). Even so, the response rate is low. Part of the low response rate is directly related to farmers' lack of willingness to acknowledge and address food safety on their farms. Several farmers who were contacted about the survey refused to participate because they believed food safety did not apply to their operations. Therefore, while our findings are informative for future research, extrapolation to larger populations or those in other states should be done cautiously. Fortunately, at this time USDA's ERS is researching how the produce industry nationally will be impacted under FSMA. These national-level findings will provide further insight into practices and expenditures incurred by operations similar to those found in CO, and allow us to refine our knowledge about the impact of FSMA on fruit and vegetable growers, as well as to develop tools and outreach programming to assist those growers in managing on-farm food safety costs and maintaining overall financial viability.

References:

- Almaza, B.A. and M.S. Nesmith. 2004. Food safety and certification regulations in the United States. *Journal of Environmental Health* 66:10-14.
- Becot, F., V. Nickerson, D. Conner, and J. Kolodinsky. 2012. Costs of food safety certification on fresh produce farms in Vermont. *HortTechnology* 22:705-714.
- Calvin, L., B. Avendaño, and R. Schwentesius. 2004. The economics of food safety: The case of green onions and Hepatitis A outbreaks. U.S. Department of Agriculture, Economic Research Service, VGS-305-01.
- Centers for Disease Control (CDC). 2015. Estimates of foodborne illness in the United States, 2011. <http://www.cdc.gov/foodborneburden/index.html>.

- Hardesty, S. and Y. Kusunose. 2009. Growers' compliance costs for leafy greens marketing agreement and other food safety programs. University of California Small Farm Program Research Brief.
- Harrison, J.A., J.W. Gaskin, M.A. Harrison, J.L. Cannon, R.R. Boyer, and G.W. Zehnder. 2013. Survey of food safety practices on small to medium-sized farms and in farmers markets. *Journal of Food Protection* 11:1989-1993.
- Hassanein, N. 2011. Matters of scale and the politics of the Food Safety Modernization Act. *Agriculture and Human Values* 28:577–581.
- Henson, S.J. and J. Humphrey. 2008. Understanding the complexities of private standards in global agrifood chains. Paper presented at the workshop: Globalization, Global Governance and Private Standards, University of Leuven.
- Holcomb, R.B., M.A. Palma and M.M. Velandia. 2013. Food safety policies and implications for local food systems. *Choices*.
- King, R., M. Hand, G. DiGiacomo, K. Clancy, M. Gomez, S. Hardesty, L. Lev, and E. McLaughlin. 2010. Comparing the structure, size, and performance of local and mainstream food supply chains. U.S. Department of Agriculture, Economic Research Service, ERR-99.
- Low, S.A. and S. Vogel. 2011. Direct and intermediated marketing of local foods in the United States. U.S. Department of Agriculture, Economic Research Service, ERR-128.
- Low, S.A., A. Adalja, E. Beaulieu, N. Key, S. Martinez, A. Melton, A. Perez, K. Ralston, H. Stewart, S. Suttles, S. Vogel, and B.B.R. Jablonski. 2015. Trends in U.S. local and regional food systems. U.S. Department of Agriculture, Economic Research Service, AP-068.
- Martinez, M., Hand, M., Da Pra, M., Pollack, S., Ralston, K., Smith, T., Vogel, S., Clark, S., Lohr, L., S. Low, and C. Newman. 2010. *Local food systems: concepts, impacts, and issues*. USDA Economic Research Service, Economic Research Report No. 97.
- Paggi, M. 2008. An assessment of food safety policies and programs for fruits and vegetables: Food-borne illness prevention and food security. Presented at North American Agrifood Integration Consortium Workshop V: New Generation of NAFTA Standards, Austin, TX.
- Paggi, M.S., F. Yamazaki, L. Robera, M. Palma, and R. Knutson. 2013. Domestic and trade implications of leafy green marketing agreement type policies and the food safety modernization act for the Southern produce industry. *Journal of Agricultural and Applied Economics* 34:453-464.
- Palma, M.A., L.A. Ribera, M. Paggi, and R. Knutson. 2010. Food safety standards for the U.S. fresh produce industry. *Policy Issues: Insights on food, farm, and resource issues*.
- Park, T., A.K. Mishra, and S.J. Wozniak. 2014. Do farm operators benefit from direct to consumer marketing strategies. *Agricultural Economics* 45:213-224.
- Scharf, R L. 2015. State estimates for the annual cost of foodborne illness. *Journal of Food Protection* 6:1064-1243.
- The University of Minnesota. 2012. Costs of food safety: leafy greens food safety cost study final report. Driven to Discover.
- U.S. Food and Drug Administration (US FDA). 2014. FSMA final rule for produce safety. <http://www.fda.gov/Food/guidanceregulation/FSMA/ucm334114.htm>.
- U.S. Department of Agriculture, Census of Agriculture (USDA NASS). 2012. 2012 Census Publications. <http://www.agcensus.usda.gov/Publications/2012/>.
- Woods, M. and S. Thornsby. 2005. Costs of adopting Good Agricultural Practices (GAPs) to ensure food safety in fresh strawberries. University of Michigan, Department of Agricultural, Food, and Resource Economics, Agricultural Economic Report Series No. 10934.