The Journal of Extension

Volume 60 | Number 2 Article 20

6-16-2022

The Adoption of Food Safety Practices and the Implications of Regulation for Small Scale Farms

Elizabeth Canales
Mississippi State University, elizabeth.canales@msstate.edu

Juan Silva
Mississippi State University, JSilva@foodscience.msstate.edu

Joy Anderson
Mississippi State University, joy.f.anderson@msstate.edu

Recommended Citation

Canales, E., Silva, J., & Anderson, J. (2022). The Adoption of Food Safety Practices and the Implications of Regulation for Small Scale Farms. *The Journal of Extension, 60*(2), Article 20. https://doi.org/10.34068/joe.60.02.20

The Adoption of Food Safety Practices and the Implications of Regulation for Small Scale Farms

Cover Page Footnote

This material is based upon work supported by the Mississippi Department of Agricultural and Commerce - Specialty Crop Block Grant Program.

JOURNAL OF Extension

Feature Article

Volume 60, Issue 2, 2022

The Adoption of Food Safety Practices and the Implications of Regulation for Small-Scale Farms

Elizabeth Canales[1], Juan Silva[1], and Joy Anderson[1]

AUTHORS: [1]Mississippi State University.

Abstract. In this article we examine the adoption of food safety practices among produce growers in the south and discuss implications of food safety regulations in the U.S. Produce growers have adopted standard food safety practices to varying degrees, but there is still an adoption gap, particularly among small scale operations. Market-driven and regulatory food safety enforcement continues to tighten, and this can further hinder market access for small scale producers.

INTRODUCTION

Fresh produce has often been linked to cases of foodborne illness, making food safety a top priority for the produce industry due to the economic and public health impacts (IFSAC, 2018). The food industry has adopted various private food safety standards to manage risks in the supply chain for fresh produce. For producers to gain access to larger markets such as wholesale, foodservice, and retail, they generally need food safety certifications, third-party audits, or food safety trainings (e.g., Produce Safety Alliance food safety training). Buyer enforcement of food safety standards varies, with some markets imposing stricter standards than others. Some examples of third-party audits or certifications are the Good Agricultural Practices (GAP) certification (e.g., USDA GAP, Global G.A.P.) and the California Leafy Green Marketing Agreement (LGMA).

In addition to market-driven initiatives, the Produce Safety Rule (PSR) of the Food Safety Modernization Act (FSMA) gives the FDA authority to regulate fresh produce. Under this rule, the FDA has issued food safety standards for the growing, harvesting, packing, and holding of fresh produce with compliance dates beginning in 2018 for large farms (FDA, 2020a). FSMA shifts the focus from simply responding to food safety issues to preventing them starting at the farm level. Most small and medium scale farmers selling directly to consumers are exempt from the PSR. However, that does not preclude buyers from requesting adherence to the practices included in this rule. Anecdotal evidence suggests that some buyers have started requesting growers to adhere to the minimum food safety standards included in the PSR. The lack of adherence to food safety programs can limit grower access to markets, which could primarily impact small-scale producers who lack the capital and infrastructure to adopt practices at the level demanded by some markets.

Some direct-to-consumer outlets do not regulate or require any third-party food safety audits for producers. A study by Harrison et al. (2013) found that few farmers markets request food safety information from vendors. For many, the fact that the PSR exempts most small- and medium-scale farms means these farmers are left with no food safety inspection. The adoption of food safety practices can be costly and given that no audit or certification is required by some outlets, there are fewer economic incentives for small-scale producers to pursue certifications and invest in third-party audits. Although most food safety incidents are associated with large-scale operations, industry leaders representing large-scale interests are concerned about the safety of food produced by small-scale producers that sell through direct-to-consumer market channels (Parker et al., 2016). As direct-to-consumer channels continue to grow in importance, there will be pressure for these channels to provide improved food safety assurances.

In this article, we review the adoption of on-farm food safety practices with a focus on small-scale producers and operations with direct-to-consumer sales. We discuss some insights about producers' views and perceived barriers as well as implications of tighter food safety regulations for small produce operations.

METHODS AND RESULTS

We report the adoption of food safety practices using data from a fruit and vegetable growers survey. The survey was administered during in-person Extension food safety workshops in Mississippi in 2018 and 2019. Growers were asked to complete the survey at the beginning of the workshop. The link to an online version of the survey in Qualtrics was also shared with other growers following a snowball sampling approach. The practices examined are based on standard GAP that are part of the requirements in the PSR. The sample (n=79) consists of growers from Mississippi, Alabama, and Arkansas, making the sample more representative of the deep South. Fifty-six percent of the growers had average annual sales less than $25,000 and 21% had sales between $25,000–$100,000. Overall, 77% of the operations in the survey are considered low-sales small farms (i.e., farm with sales of less than $100,000 (USDA, 2019)). On average, the share of direct-to-consumer sales was 62%, with more than half of the operations having a share of direct-to-consumer sales above 80%. Thus, this sample is weighted toward small-scale farms selling through direct-to-consumer market channels.

Figure 1 depicts the level of adoption of food safety practices for small scale operations (<$100,000 revenue) and for operations with a large share (50% or more) of direct-to-consumer sales. We then examine the association between farm characteristics and the adoption of on-farm food safety practices using logit regression, an approach commonly used to model binary dependent variables. The factors we examine are farm size (log of fruit and vegetable acreage), the share of direct-to-consumer sales, whether the operation grows leafy greens, and if the operation is organic/sustainable (this category includes designations of certified organic, in transition to certified organic, and sustainably or naturally grown certified operations). We include these variables because there are concerns among stakeholder groups that adoption of food safety practices in the PSR and other food safety programs could be onerous for small-scale and organic or sustainable operations (Adalja and Lichtenberg, 2018a). Because the parameters from a logit regression are not easily interpreted, we report the marginal effects on the probability of adoption of these practices in Table 1. These marginal effects represent the change in the probability that a farmer would use or adopt a particular practice given a one unit change in the independent variables.

As observed in Figure 1, basic food safety practices have been adopted to various degrees by produce growers, yet there is a still a significant gap in the adoption of standard practices. Similar adoption gaps are reported by Adalja and Lichtenberg (2018a). The adoption of these practices is generally lower among small farms and operations with a higher share of direct-to-consumer sales. Only 56% of small operations provide food safety training to their employees, and 61% provide equipped toilets and hand washing stations. Like the adoption of other agricultural practices, size has a positive correlation with practice use (Table 1). A 1% increase

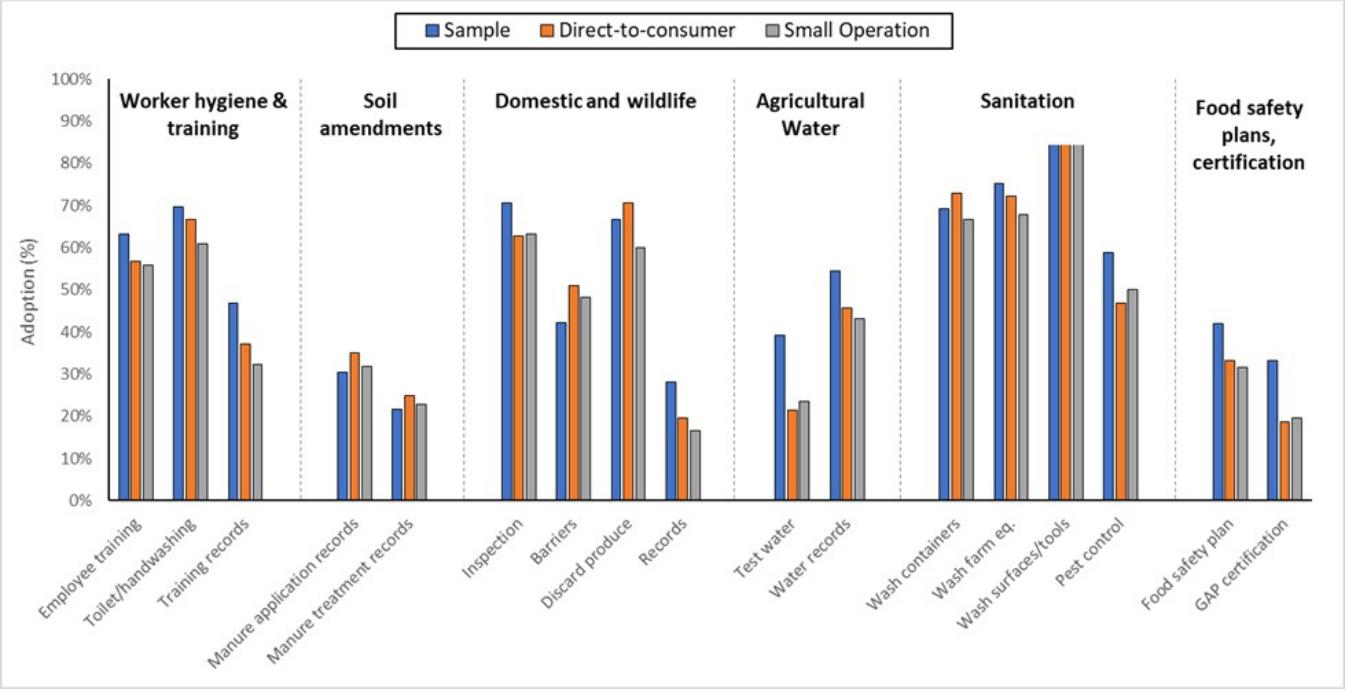

Figure 1. On-farm use of conservation practices.. Small operations are low sales farms with <$100,000 in revenue, and direct-to-consumer are operations with a share of direct-to-consumer sales of 50% or more.

Table 1. Marginal Effects on Probability of Practice Use

	Worker hygiene & training			Domestic and wildlife				Ag. water		Sanitation				Plans and cert.	
	Employee training	Toilet/ handwashing	Training records	Inspection	Barriers	Discard produce	Records	Water testing	Water records	Wash containers	Wash farm eq.	Wash surfaces, tools	Pest control	Food safety plan	Certified/ third-party audit
Log Acreage[1]	0.064*	0.065*	0.048*	0.028	-0.005	0.036	0.037	0.088*	0.049*	0.018	0.020	0.047*	0.082*	0.043	0.043*
	(0.027)	(0.028)	(0.027)	(0.029)	(0.031)	(0.027)	(0.024)	(0.026)	(0.026)	(0.024)	(0.027)	(0.024)	(0.027)	(0.028)	(0.023)
Organic/ sustainable[2]	-0.158	0.038	0.016	0.001	-0.040	-0.282*	0.031	-0.305*	-0.283*	-0.197	0.278**	0.000*	-0.258*	-0.211	-0.013
	(0.123)	(0.111)	(0.125)	(0.118)	(0.136)	(0.125)	(0.130)	(0.125)	(0.125)	(0.142)	(0.117)	0.000	(0.116)	(0.131)	(0.119)
Share of direct-to-consumer sales[1]	-0.001	-0.002	-0.003*	-0.002	0.002	0.000	-0.002	-0.003*	-0.005*	0.001	-0.002	0.000	-0.003*	-0.004*	-0.004*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Leafy Greens[2]	0.127	-0.012	0.118	-0.043	0.017	0.028	0.043	-0.122	0.258*	0.365*	-0.190*	0.160	0.068	0.000	0.120
	(0.119)	(0.106)	(0.121)	(0.113)	(0.130)	(0.121)	(0.120)	(0.114)	(0.116)	(0.121)	(0.109)	(0.122)	(0.119)	(0.129)	(0.114)
N	74	74	74	73	73	73	73	46	66	69	68	46	69	69	68

Note. The number of observations vary due to the number of missing values.

**,* indicates statistical significance at the 5% and 10% significance level, respectively. Standard errors are in parenthesis.

[1] Values can be interpreted as the percentage point change in the likelihood of adoption given a one percentage change in acreage or one percentage point increase in the share of direct-to-consumer sales.

[2] Values can be interpreted as the percentage point change in the likelihood of adoption for organic/sustainable farms compared to conventional farms, or for leafy green growers compared to growers who do not grow leafy greens, respectively.

in acreage is associated with a 6 percentage point increase in the likelihood that an operation provides hygiene and food safety training to its employees and a 5 percentage point increase in the probability of keeping training records (Table 1). While operations may provide some hygiene training, not all of them keep records of those trainings. We found that farms with a larger share of direct-to-consumer sales are less likely to keep training records. Wholesale and retail buyers generally require a third-party audit, on-site visits, or food safety records from the farm, and those requirements are not as prevalent in direct-to-consumer market channels (Harrison et al., 2013).

In our sample, only 23 respondents reported using animal-based soil amendments, and of those, only 30% and 22% keep records of manure treatment or application dates, respectively (Figure 1). Due of the low number of respondents using soil amendments, we did not include these practices in the logit regression analysis reported in Table 1. Inspection for domestic and wildlife intrusion was 63%, and the use of barriers to prevent contamination was 51%, for small operations. As shown in Figure 1, a higher percent reported discarding produce suspected of contamination due to animal contact (71%). We did not find statistical differences in the use of these practices across the different types of operations (Table 1).

Two of the practices with the lowest levels of adoption were related to water testing and recordkeeping, with 21% and 24% use respectively among small farms and operations with a large share of direct-to-consumer sales (Figure 1). Agricultural water is an important risk factor in the produce industry, as it has been identified as the source of contamination in multiple high-profile outbreaks (FDA, 2019; Cooley et al., 2007). We found that farm size is associated with an increase in the probability of water testing and keeping test records—a 1% increase in acreage is associated with an 8 percentage points increase in the likelihood of water testing and a 5 percentage point increase in the likelihood of recordkeeping (Table 1). We observe a negative association pattern between practice usage and direct-to-consumer sales for water testing and water recordkeeping. Some small-scale operations use municipal water or public water systems and may not need to test their agricultural water. However, while these growers receive or can request public water test reports, many do not maintain these records. As expected, due to compliance with some organic certification requirements, organic producers are more likely to test their agricultural water and maintain test records (Table 1). Operations that grow leafy greens are also more likely to keep water test records. Leafy greens have been associated with large, publicized foodborne outbreaks linked to agricultural water (Marshall et al., 2020) which may be why we see this result.

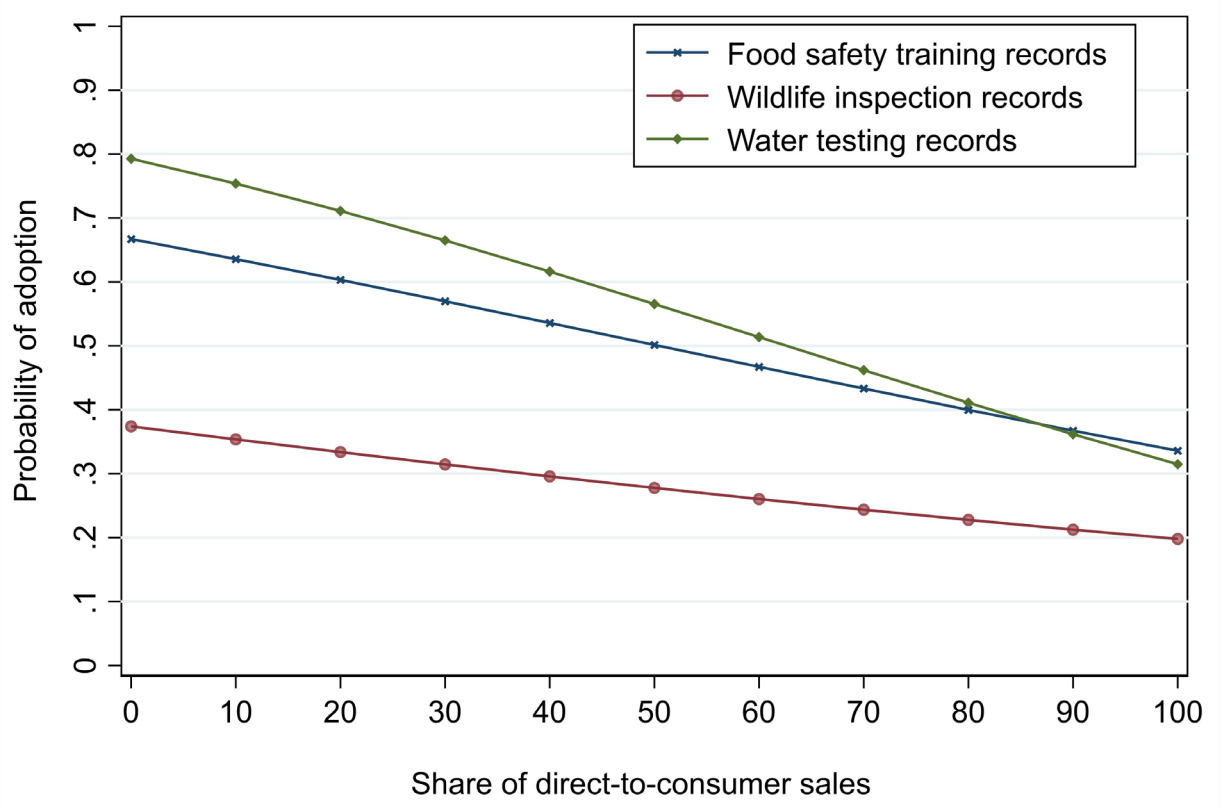

Figure 2. Probability of keeping food safety records for producers selling through direct-to-consumer outlets.

Larger operations are also more likely to wash surfaces and equipment that come in contact with produce. The likelihood of doing so increases by around 4 percentage points for each 1% increase in acreage (Table 1). Operations with leafy greens are also more likely to sanitize harvest containers, which is likely due to the risk associated with leafy greens. Pest control programs for packing or storage buildings are more likely to be adopted by larger and/or organic operations and less likely to be adopted by operations with a larger share of direct-to-consumer sales.

Implementing food safety practices can be costly, and farm size plays a significant role in the dynamics of adoption. Compliance with private or regulatory food safety standards could be burdensome, particularly for small-scale farms. Previous studies have found that per-acre food safety costs decrease as farm size increases, indicative of the presence of economies of scale (Adalja and Lichtenberg, 2018a; Hardesty and Kusunose, 2009).

FOOD SAFETY RECORDS

It is important to note that while producers may have adopted some food safety practices, the measures implemented may not be as robust as necessary to pass a farm audit or inspection. For example, food safety recordkeeping is lacking, as our results suggest. While producers use some practices, they are less likely to keep records to demonstrate compliance. As is seen in Figures 1 and 2, this issue is more prevalent among small-scale operations and producers selling through direct-to-consumer market channels.

Records are a key component of any regulatory and private food safety program. Records are key in demonstrating food safety efforts and compliance and in tracing outbreaks. The lack of records also makes traceback and root cause analysis difficult. From a risk management perspective, it is vital to communicate to producers the importance of maintaining good, sortable records. For many small growers selling directly to consumers, the lack of market enforcement provides no incentive to maintain records of food safety practices, yet documenting food safety measures can help protect producers from potential liability. As the industry increases efforts to improve traceability and the quality of records maintained along the supply chain, there will be a greater push for producers to improve their records and to move from a paper-based system to a sortable electronic-based system in order to improve the speed of tracing and identification of potential safety issues. For shorter supply chains (e.g., direct-to-consumer or retailers working within a state), tracing issues could be dealt with faster due to the simplicity of the supply chain. However, buyers and consumers could demand that small producers provide better food safety and traceability assurances similar to those of the broader food supply chain.

BARRIERS AND DRIVERS TO ADOPTION OF FOOD SAFETY PRACTICES

When we evaluate responses regarding farmers' motivations for not pursuing a GAP certification or third-party food safety audit, we find that the scale of production and the lack of market enforcement are the main forces at work. Many small-scale growers also perceive that there are low returns to pursuing a certification. For example, 45% of respondents in our survey disagree that having a food safety certification pays off and around 60% believe that food safety certification should not be required for small scale producers. Increasing growers' awareness of risks and the benefits of prevention is important from an economic point of view, as the cost of an outbreak far surpasses the cost of prevention (Ribera et al., 2012).

Farmers were asked to rank perceived barriers to the adoption of on-farm food safety practices. Figure 3 shows the percentage of respondents who ranked the listed barriers as the first or second main challenges to implementing food safety practices. Economic factors such as implementation cost and a lack of resources were reported as the main limiting factors. Studies have found that expenditures on food safety practices can be more burdensome for small producers due to economies of scale (Adalja and Lichtenberg, 2018a). Time constraints also play a role and may be an issue particularly for small- and medium-scale operations that do not have a dedicated professional food safety staff, as food safety tends to be juggled alongside other farming tasks. Limited knowledge was not often ranked as the main barrier to adoption but was ranked second by several producers. In general, the problem does not seem to be the lack of awareness of food safety concepts (Parker et al., 2016), but resource constraints and cost barriers that inhibit implementing food safety practices.

Beyond certifications, the adoption of individual food safety practices among non-certified operations is also largely driven by buyers' requirements (Figure 4). Although small scale producers may not need to be certified when selling through local or direct-to-consumer market channels, the lack of a certification or third-party audit significantly limits their access to new markets (Figure 4), and this may hinder their ability to grow their operation and expand sales.

DISCUSSION

THE FUTURE OF FOOD SAFETY ENFORCEMENT AND REGULATION

In 2020, the FDA published a footprint for a "New Era of Smarter Food Safety," which outlines the FDA's future approach to food safety. This new approach puts emphasis on the promotion of a food safety culture, better recordkeeping and traceability, and technology-enabled food safety systems (FDA, 2020d). The goal of this plan is to use modern approaches (e.g., technological tools, analytical techniques)

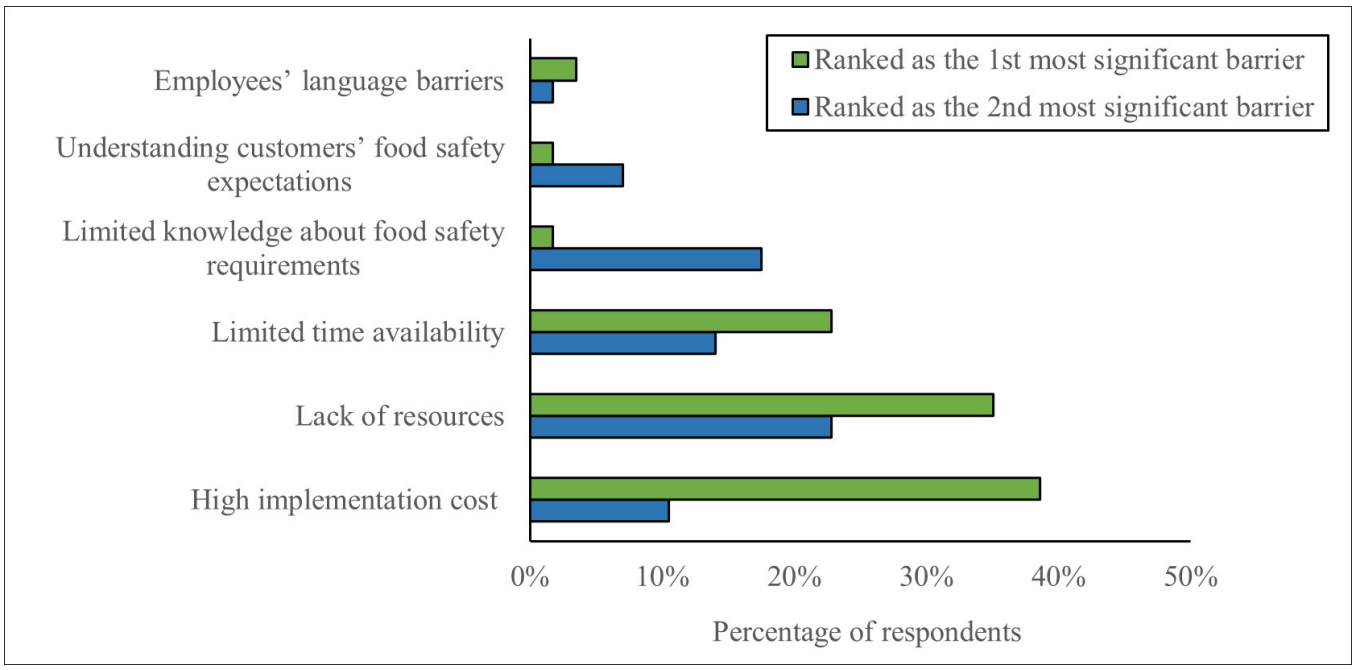

Figure 3. Ranking of perceived barriers to the adoption of on-farm food safety practices.

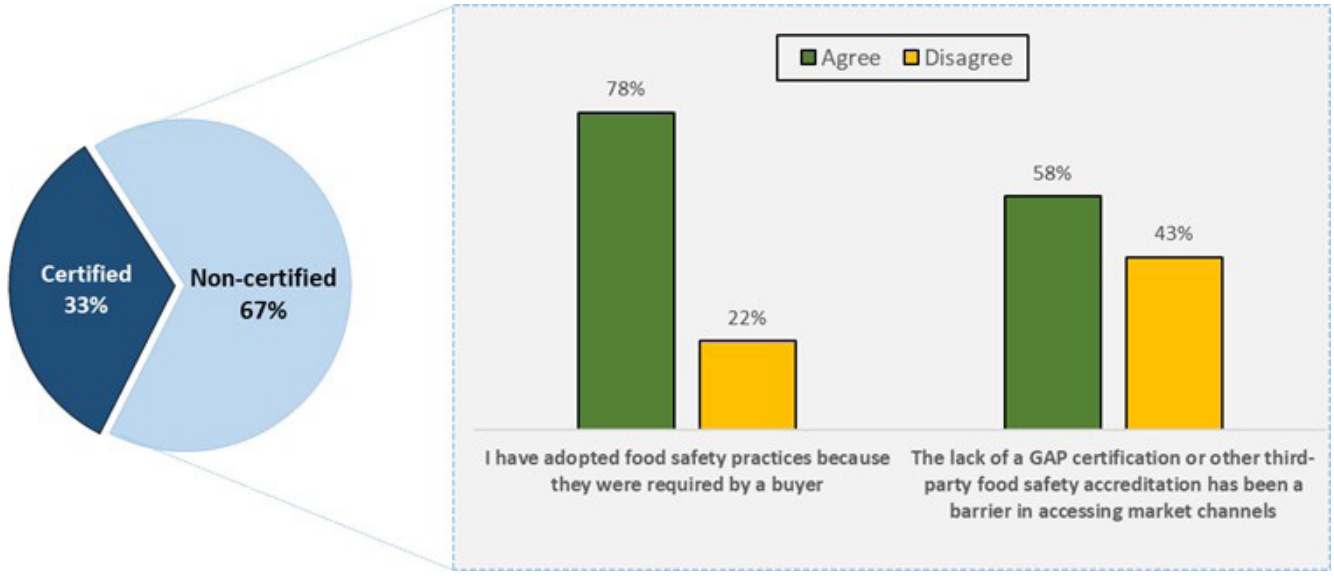

Figure 4. Food safety certification and market access.

to allow for real-time visibility of the food supply chain, focus on prevention, and improve the ability of the industry to identify and predict issues.

In 2020, the FDA also proposed the "Requirements for Additional Traceability Records for Certain Foods" rule as part of FSMA. The proposed rule was published in the Federal Register in September 2020 with the public comment period ending in February 2021. The compliance date is expected to be two years after the final regulation is effective (FDA, 2020c.). This rule heightens traceability recordkeeping requirements for operations that manufacture, process, pack, or hold high-risk products. Some examples of produce on the proposed rule's Food Traceability List include cucumbers, fresh herbs, melons, sprouts, tomatoes, leafy greens, tropical tree fruit, and fresh-cut fruits and vegetables (FDA, 2020b). While this proposed regulation does not rule out paper records, companies within the supply chain need to be able to provide electronic spreadsheets containing necessary traceability information (e.g., lot codes, receiving and shipping dates, and information regarding internal traceability programs) to allow for a rapid trace of products throughout the supply chain. Because of the lower volume produced by very small farms (i.e., farms with annual produce sales lower than $25,000) and farms selling directly to consumers, these operations will be exempt from the recordkeeping requirements applicable to food growers (FDA, 2020b). But if they are not exempt, subsequent entities buying from these small farms would still need to keep records of the foods produced by these operations. Thus, it is possible that small farms will face pressure to comply with stricter food safety and traceability recordkeeping requirements. There are also industry-led efforts to improve traceability within the produce supply chain. For example, the LGMA requires its members to have a traceability system in place and continues to tighten food safety requirements (Horsfall, 2020; Ward, 2020).

As the regulatory examples and the industry trends discussed above demonstrate, food safety regulations and private standards are not likely to ease but are likely to become more rigorous. The produce industry will continue to take steps to prevent foodborne outbreaks and ensure the safety of the supply chain. The adoption of elevated standards and emerging technological tools will likely impose structural barriers for small and medium scale producers for which the needed capital investment could be overly burdensome and unjustified given their scale of operation, the requirements, and the lesser complexity and risks of more localized markets. Yet as the industry moves in that direction, there is a need to develop scale-appropriate approaches that small-scale operations can adopt to make progress towards new industry demands.

IMPLICATIONS AND OUTREACH NEEDS

Increasing regulatory oversight is concerning to many produce stakeholders. A 2019 state of the vegetable industry survey reported that food safety rules are a main concern for 40% of produce stakeholders (Miller, 2019). The wider adoption of food safety private standards and the move towards more rigorous requirements and regulations can impact small and medium-scale farmers for whom it may be more difficult to access markets, as these practices and audits are more widespread and enforced. For example, a study simulating the effect of FSMA suggests that this program could result in market share losses for small growers that have to incur additional costs to comply with the rule (Bovay and Sumner, 2018). As regulatory agencies, buyers, and consumers demand higher levels of food safety compliance and transparency, some local market outlets (e.g., farmers markets) may also increase their food safety efforts by requiring food safety information and training from vendors. It is important to develop scale-appropriate approaches to food safety and education programs (Parker et al., 2016) to ensure the food produced and sold by local small-scale producers is safe in a way that allows these producers and markets to stay competitive.

Insights from our survey and other published articles (Rodrigues at al., 2020; Strohbehn et al., 2018) suggest that farmers need additional assistance in translating regulations into actionable items, navigating the food safety requirements of different buyers and markets, adopting practical tools, and receiving hands-on training to develop their food safety program. Recordkeeping was identified as an area where additional effort is needed. Education covering risk analysis and the value of maintaining good records beyond regulatory compliance is important. The adoption of scale-appropriate electronic recordkeeping (e.g., Excel-based templates) could be encouraged, and hands-on training could be provided to develop or adapt existing tools to the specific needs of each farm. Education involving peer-to-peer learning opportunities and on-farm site visits is needed to help producers learn scale-friendly cost-effective ways to improve food safety. Engaging local markets (e.g., managers of farmers markets) in training efforts and food safety initiatives could also be beneficial, as these outlets would also benefit from a reduction in food safety risks (Harrison et al., 2013).

REFERENCES

Adalja, A., & Lichtenberg, E. (2018a). Produce growers' cost of complying with the Food Safety Modernization Act. *Food Policy, 74*(C), 23-38. www.doi.org/10.1016/j.foodpol.2017.10.005

Adalja, A., & Lichtenberg, E. (2018b). Implementation challenges of the food safety modernization act: Evidence from a national survey of produce growers. *Food Con-*

trol, 89, 62-71. https://doi.org/10.1016/j.foodcont.2018.01.024

Bovay, J., & Sumner, D. A. (2018). Economic Effects of the U.S. Food Safety Modernization Act. *Applied Economic Perspectives and Policy*, *40*(3), 402-420. https://doi.org/10.1093/aepp/ppx039

Cooley, M., Carychao, D., Crawford-Miksza, L., Jay, M. T., Myers, C., Rose, C., Keys, C., Farrar, J., & Mandrell, R. E. (2007). Incidence and Tracking of Escherichia coli O157:H7 in a Major Produce Production Region in California. *PLoS ONE*, *2*(11), e1159. https://doi.org/10.1371/journal.pone.0001159

Hardesty, S. D., & Kusunose, Y. (2009). Growers' compliance costs for the leafy greens marketing agreement and other food safety programs. University of California Small Farm Program Research Brief. https://ucanr.edu/sites/sfp/files/143911.pdf.

Harrison, J. A., Gaskin, J. W., Harrison, M. A., Cannon, J. L., Boyer, R. R., & Zehnder, G. W. (2013). Survey of food safety practices on small to medium-sized farms and in farmers markets. *Journal of Food Protection*, 77(11), 1989-1993. www.doi.org/10.4315/0362-028X.JFP-13-158

Horsfall, S. (2020). *Survey shows detailed traceability systems are in place on LGMA member farms.* California LGMA. https://lgma.ca.gov/news/traceability-systems

Interagency Food Safety Analytics Collaboration (IFSAC) (2018). *Foodborne illness source attribution estimates for 2016 for Salmonella, Escherichia coli O157, Listeria monocytogenes, and Campylobacter using multi-year outbreak surveillance data, United States.* U.S. Department of Health and Human Services, CDC, FDA, USDA-FSIS. https://www.cdc.gov/foodsafety/ifsac/pdf/p19-2016-report-triagency-508.pdf

Marshall, K. E., Hexemer, A., Seelman, S. L., Fatica, M. K., Blessington, T., Hajmeer, M., Kisselburgh, H., Atkinson, R., Hill, K., Sharma, D., Needham, M., Peralta, V., Higa, J., Blickenstaff, K., Williams, I. T., Jhung, M. A., Wise, M., & Gieraltowski, L. (2020). Lessons learned from a decade of investigations of Shiga toxin–producing Escherichia coli outbreaks linked to leafy greens, United States and Canada. *Emerging Infectious Diseases* 26(10), 2319-2328. www.doi.org/10.3201/eid2610.191418

Miller, C. (2019). *Which issues have your attention? [2019 state of the vegetable industry].* Growing Produce. https://www.growingproduce.com/vegetables/which-issues-have-your-attention-2019-state-of-the-vegetable-industry/

Parker, J. S., DeNiro, J., Ivey, M. L., & Doohan, D. (2016). Are small and medium scale produce farms inherent food safety risks? *Journal of Rural Studies, 44,* 250-260. https://agris.fao.org/agris-search/search.do?recordID=US201600195504

Ribera, L., Palma, M., Paggi, M., Knutson, R., Masabni, J. G., & Anciso, J. (2012). Economic analysis of food safety compliance costs and foodborne illness outbreaks in the United States. *HortTechnology, 22*(2), 150-156. https://doi.org/10.21273/HORTTECH.22.2.150

Rodrigues, C., Oleson, B., & Dunn, L. L. (2020). Food safety needs assessment for Georgia specialty crops. *Journal of Extension*, *58*(4), 1-8. https://tigerprints.clemson.edu/cgi/viewcontent.cgi?article=1074&context=joe

Strohbehn, C. H., Enderton, A., Shaw, A. M., Perry, B., Overdiep, J., & Naeve, L. (2018). Determining What Growers Need to Comply with the Food Safety Modernization Act Produce Safety Rule. *Journal of Extension*, 56(7), 1-9. https://tigerprints.clemson.edu/joe/vol56/iss7/14/

U.S. Food and Drug Administration (FDA). (2020a, December). Food Safety Modernization ACT (FSMA). https://www.fda.gov/food/guidance-regulation-food-and-dietary-supplements/food-safety-modernization-act-fsma.

U.S. Food and Drug Administration (FDA). (2020b, September). *Requirements for additional traceability records for certain foods.* Federal Register Vol. 85, No. 1853. https://www.federalregister.gov/documents/2020/09/23/2020-20100/requirements-for-additional-traceability-records-for-certain-foods

U.S. Food and Drug Administration (FDA). (2020c). *Proposed rule: Requirements for additional traceability records for certain foods at-a-glance.* https://www.fda.gov/media/142303/download

U.S. Food and Drug Administration (FDA). (2020d). *New era of smarter food safety blueprint: Modern approaches for modern times.* https://www.fda.gov/food/new-era-smarter-food-safety/new-era-smarter-food-safety-blueprint

U.S. Food and Drug Administration (FDA) (2019). *Outbreak investigation of E. coli: Romaine (November 2018).* https://www.fda.gov/food/outbreaks-foodborne-illness/outbreak-investigation-e-coli-romaine-november-2018

U.S. Department of Agriculture (USDA) (2019, March). *USDA small farm definitions.* Livestock and Poultry Environmental Learning Community. https://lpelc.org/usda-small-farm-definitions/

Ward, A. (2020). *CA LGMA updates food safety practices.* California LGMA. https://lgma.ca.gov/news/ca-lgma-updates-food-safety-practices