

Online Supplementary Material

Preharvest food safety and conservation challenges facing US produce growers:
Results from a national survey

May 11, 2023

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Appendix A. Additional Tables

Table A1. Management of Production Water

Classification ^a	N	Proportion of respondents that reported use					
		Water Testing			Water Treatment		
		Once monthly or more	At least yearly, less than monthly	Never	Always	Sometimes	Never
Water Source (N=204)							
Surface water (touching produce)	127	0.276	0.685	0.024	0.346	0.417	0.228
Surface water (<i>not</i> touching produce)	30	0.033	0.600	0.333	0.067	0.167	0.767
No surface water used	47	0.064	0.191	0.213	0.064	0.043	0.489

Note: The response rate for water source is reported in parentheses.

^a (no. of respondents)

Table A2. Self-Reported Risk Assessment of Wildlife

Classification ^a	N	Proportion of respondents that reported “high risk”						
		Birds	Rodents	Large mammals	Reptiles	Domestic animals	Live-stock	Draft animals
All Farms	209	0.172	0.258	0.249	0.086	0.077	0.148	0.038
Revenue in US\$ (N=199)								
<25K	19	0.105	0.263	0.316	0.053	0.000	0.105	0.000
25-250K	57	0.158	0.246	0.263	0.088	0.070	0.140	0.070
250-500K	30	0.233	0.233	0.233	0.133	0.100	0.167	0.033
500K-1M	28	0.250	0.321	0.143	0.179	0.143	0.179	0.036
1-5M	47	0.170	0.255	0.298	0.043	0.085	0.149	0.021
5M+	18	0.167	0.278	0.222	0.056	0.056	0.167	0.056
Organic Prod. (N=193)								
Any	124	0.169	0.298	0.250	0.089	0.089	0.185	0.040
None	69	0.188	0.188	0.290	0.087	0.072	0.101	0.043
FV Acreage (N=200)		*						*
[0%,25%)	61	0.115	0.180	0.180	0.049	0.066	0.115	0.016
[25%,50%)	59	0.085	0.271	0.288	0.051	0.085	0.119	0.017
[50,75%)	49	0.347	0.327	0.245	0.184	0.122	0.245	0.020
[75%,100%)	31	0.226	0.355	0.355	0.097	0.032	0.161	0.161
Wildlife Habitat (N=196)								
Most	67	0.149	0.313	0.343	0.104	0.090	0.194	0.030
Some	89	0.225	0.281	0.236	0.079	0.067	0.135	0.067
None	40	0.150	0.200	0.200	0.100	0.100	0.150	0.000
Grazing Land (N=196)								
Most	27	0.222	0.296	0.259	0.074	0.111	0.222	0.037
Some	97	0.186	0.299	0.268	0.103	0.082	0.175	0.052
None	72	0.167	0.236	0.264	0.083	0.069	0.111	0.028

Note: The response rates for each classification are reported in parentheses. For each classification group, separate Pearson's chi-squared tests of independence were conducted using the count data underlying each column of proportions reported. A single asterisk (*) indicates $p \leq 0.05$ for each test.

^a (no. of respondents)

Table A3. Estimated Coefficients for Probit Models of Food Safety Practices

	Water testing	Treat soil amendments	Monitor wildlife	Deter wildlife	Hygiene practices	Employee training	Sanitize tools	Record-keeping
Intercept	-0.5524 (0.5448)	-0.2949 (0.5396)	0.2314 (0.5560)	-0.0381 (0.5649)	0.7403 (0.6940)	-0.8070 (0.5478)	-1.4430** (0.5867)	-0.5205 (0.6011)
Any Organic (0/1)	-0.2144 (0.2167)	0.2696 (0.2081)	-0.3212 (0.2095)	0.1074 (0.2169)	-0.1844 (0.2206)	0.2505 (0.2121)	0.0242 (0.2185)	0.0719 (0.2305)
Revenue \$25K to \$500K	0.6100 (0.4117)	-0.0216 (0.4025)	-0.3242 (0.4225)	-0.0479 (0.4311)	-0.5067 (0.5743)	0.3228 (0.4109)	0.3488 (0.4298)	-0.5044 (0.4364)
Revenue > \$500K	0.6136 (0.4495)	-0.0168 (0.4394)	-0.1589 (0.4575)	0.2105 (0.4672)	-0.7458 (0.5963)	0.6091 (0.4484)	0.7027 (0.4707)	-0.0103 (0.4760)
Produce Acreage % (0 to 1)	-0.0007 (0.0035)	-0.0035 (0.0034)	-0.0029 (0.0034)	-0.0044 (0.0035)	-0.0045 (0.0037)	-0.0017 (0.0035)	-0.0010 (0.0036)	-0.0043 (0.0038)
DTC Sales % (0 to 100)	-0.0073* (0.0040)	-0.0035 (0.0040)	0.0006 (0.0040)	-0.0006 (0.0042)	0.0032 (0.0044)	-0.0000 (0.0040)	0.0075* (0.0042)	-0.0025 (0.0045)
Bordering Wild Hab. = Most	0.8059*** (0.2930)	0.6205** (0.2878)	0.5153* (0.2869)	0.9806*** (0.3041)	0.9748*** (0.3020)	0.8696*** (0.2946)	1.2462*** (0.3044)	0.5094 (0.3186)
Bordering Wild Hab. = Some	0.7347*** (0.2539)	0.4353* (0.2517)	0.5165** (0.2523)	0.3994 (0.2508)	0.0709 (0.2510)	0.1750 (0.2508)	0.6018** (0.2702)	0.1912 (0.2890)
AIC	244.3515	262.5968	257.7457	239.0482	230.3903	255.5503	240.4008	214.2525
Log Likelihood	-114.1758	-123.2984	-120.8729	-111.5241	-107.1951	-119.7752	-112.2004	-99.1263
Num. obs.	184	184	184	184	184	184	184	184

Note: Each column is a separate regression model. Robust standard errors are reported in parentheses. Asterisk (*), double asterisk (**), and triple asterisk (***) indicate significance at the 10, 5 and 1 percent level, respectively.

Table A4. Estimated Coefficients for Probit Models of Buffer Usage

	Bare ground or dirt	Mowed grass	Low risk crops	Noncrop vegetation	No buffer use
Intercept	-1.3072* (0.6847)	-0.6554 (0.5593)	-0.8708 (0.5788)	-0.4784 (0.5928)	-2.3762** (0.9456)
Any Organic (0/1)	0.1200 (0.2195)	0.1774 (0.2143)	0.1809 (0.2131)	0.6295*** (0.2414)	-0.1595 (0.3166)
Revenue \$25K to \$500K	0.6297 (0.5643)	-0.0151 (0.4078)	0.2173 (0.4462)	0.1344 (0.4426)	-0.1786 (0.6658)
Revenue > \$500K	0.9832* (0.5910)	-0.0745 (0.4470)	0.7173 (0.4788)	-0.5636 (0.4930)	0.3143 (0.6847)
Produce Acreage % (0 to 1)	-0.0032 (0.0037)	-0.0065* (0.0035)	0.0020 (0.0035)	-0.0064* (0.0039)	0.0099* (0.0052)
DTC Sales % (0 to 100)	-0.0054 (0.0043)	-0.0029 (0.0041)	0.0027 (0.0041)	-0.0034 (0.0043)	-0.0028 (0.0066)
Bordering Wild Hab. = Most	0.3066 (0.3022)	1.0810*** (0.3106)	-0.4204 (0.2908)	0.3294 (0.3040)	0.5075 (0.5289)
Bordering Wild Hab. = Some	0.4404* (0.2647)	0.7714*** (0.2773)	0.0486 (0.2513)	-0.2205 (0.2740)	0.6761 (0.4822)
AIC	233.2363	248.1012	249.7578	213.9831	104.2711
Log Likelihood	-108.6182	-116.0506	-116.8789	-98.9915	-44.1356
Num. obs.	184	184	184	184	184

Note: Each column is a separate regression model. Robust standard errors are reported in parentheses. Asterisk (*), double asterisk (**), and triple asterisk (***) indicate significance at the 10, 5 and 1 percent level, respectively.

Table A5. Estimated Coefficients for Probit Models of Wildlife Habitat Control

	Clear buffers	Expand buffers	Low-risk crops	Fallow fields	Wildlife corridors	Drain or fill in ponds	Clear veg. near water	Clear veg. near fields
Intercept	-0.3336 (0.5448)	-0.1715 (0.6120)	-0.6617 (0.5537)	-0.6001 (0.6180)	-0.4381 (0.5727)	-1.1363 (0.7313)	0.1161 (0.6199)	0.1872 (0.5661)
Any Organic (0/1)	0.2277 (0.2108)	0.4317** (0.2188)	0.2583 (0.2125)	0.0392 (0.2166)	0.4246** (0.2128)	0.5950** (0.2366)	0.3109 (0.2145)	0.1545 (0.2135)
Revenue \$25K to \$500K	-0.2033 (0.4084)	-0.2566 (0.4787)	-0.2881 (0.4136)	0.0789 (0.4870)	0.0033 (0.4320)	0.2017 (0.5997)	0.1608 (0.4874)	-1.0206** (0.4216)
Revenue > \$500K	0.1002 (0.4462)	-0.1923 (0.5093)	0.1059 (0.4484)	0.4793 (0.5136)	-0.2713 (0.4690)	0.5923 (0.6226)	0.0251 (0.5194)	-0.8729* (0.4584)
Produce Acreage % (0 to 1)	0.0020 (0.0035)	0.0026 (0.0036)	0.0056 (0.0035)	0.0004 (0.0036)	-0.0014 (0.0035)	0.0004 (0.0039)	-0.0036 (0.0036)	-0.0002 (0.0035)
DTC Sales % (0 to 100)	-0.0049 (0.0040)	-0.0063 (0.0044)	0.0020 (0.0040)	-0.0077* (0.0043)	-0.0079* (0.0041)	-0.0050 (0.0047)	-0.0101** (0.0043)	-0.0037 (0.0041)
Bordering Wild Hab. = Most	0.5186* (0.2878)	-0.5038* (0.2944)	-0.0756 (0.2884)	0.0658 (0.2955)	0.4268 (0.2928)	-0.2377 (0.3040)	-0.3531 (0.2885)	0.5477* (0.2991)
Bordering Wild Hab. = Some	0.6213** (0.2534)	0.0158 (0.2507)	0.1568 (0.2531)	0.2754 (0.2566)	0.4409* (0.2568)	-0.0706 (0.2617)	-0.1961 (0.2503)	0.5204* (0.2658)
AIC	252.0145	240.4272	256.5855	239.8862	250.5661	218.0829	246.6432	250.6121
Log Likelihood	-118.0073	-112.2136	-120.2927	-111.9431	-117.2830	-101.0414	-115.3216	-117.3061
Num. obs.	184	184	184	184	184	184	184	184

Note: Each column is a separate regression model. Robust standard errors are reported in parentheses. Asterisk (*), double asterisk (**), and triple asterisk (***) indicate significance at the 10, 5 and 1 percent level, respectively.

Table A6. Estimated Coefficients for Probit Models of Wildlife Direct Deterrence

	Deer fencing	Plastic fencing	Fencing around water	Mechanical traps	Poison bait	Hunt or shoot animals	Mylar strips or cannons
Intercept	-0.6062 (0.5656)	0.1032 (0.6209)	0.6144 (0.6445)	-0.5128 (0.5602)	-0.6212 (0.6196)	-0.4935 (0.5794)	-1.9001*** (0.5980)
Any Organic (0/1)	0.1288 (0.2190)	0.4209* (0.2175)	0.4400** (0.2233)	0.2540 (0.2143)	-0.5914** (0.2301)	-0.1022 (0.2160)	-0.0048 (0.2224)
Revenue \$25K to \$500K	-0.2094 (0.4179)	-0.2335 (0.4863)	-0.6957 (0.5056)	-0.1518 (0.4159)	0.3623 (0.4814)	-0.5656 (0.4252)	0.4382 (0.4254)
Revenue > \$500K	0.0409 (0.4571)	-0.1910 (0.5182)	-0.7242 (0.5348)	0.0930 (0.4533)	0.8538 (0.5239)	-0.1069 (0.4644)	1.0779** (0.4718)
Produce Acreage % (0 to 1)	-0.0010 (0.0036)	-0.0010 (0.0037)	-0.0002 (0.0037)	-0.0080** (0.0035)	-0.0108*** (0.0041)	0.0004 (0.0035)	-0.0007 (0.0036)
DTC Sales % (0 to 100)	-0.0051 (0.0042)	-0.0142*** (0.0045)	-0.0169*** (0.0049)	0.0055 (0.0040)	-0.0088* (0.0045)	0.0023 (0.0041)	0.0039 (0.0042)
Bordering Wild Hab. = Most	1.6487*** (0.3213)	0.0228 (0.2913)	-0.1416 (0.2957)	0.5717* (0.2943)	1.0413*** (0.3379)	1.0597*** (0.3041)	1.2908*** (0.3224)
Bordering Wild Hab. = Some	0.8120*** (0.2669)	0.4280* (0.2541)	-0.2354 (0.2556)	0.5470** (0.2620)	0.4266 (0.3017)	0.4814* (0.2731)	0.7047** (0.2939)
AIC	236.0456	233.1507	235.5286	252.5341	210.1486	239.7625	231.2391
Log Likelihood	-110.0228	-108.5754	-109.7643	-118.2670	-97.0743	-111.8812	-107.6196
Num. obs.	184	184	184	184	184	184	184

Note: Each column is a separate regression model. Robust standard errors are reported in parentheses. Asterisk (*), double asterisk (**), and triple asterisk (***) indicate significance at the 10, 5 and 1 percent level, respectively.

Table A7. Estimated Coefficients for Probit Models of Conservation Practices

	Maintain hedgerows	Preserve natural areas	Maintain veg. buffers	Adjust operation time	Use bird/bat houses	Plant flowers	No practices
Intercept	0.0879 (0.5616)	0.2834 (0.5475)	-0.1652 (0.5463)	-1.4622** (0.5898)	-0.7297 (0.5625)	-0.7283 (0.5807)	-2.1455** (0.9069)
Any Organic (0/1)	0.0534 (0.2171)	0.2818 (0.2129)	-0.0259 (0.2133)	0.5505** (0.2211)	0.6882*** (0.2201)	0.0220 (0.2204)	-0.6199 (0.5165)
Revenue \$25K to \$500K	-0.7563* (0.4245)	-0.3529 (0.4153)	-0.0361 (0.4070)	0.3479 (0.4395)	-0.2161 (0.4147)	-0.2321 (0.4312)	0.2369 (0.5972)
Revenue > \$500K	-0.4773 (0.4644)	-0.4700 (0.4526)	0.4953 (0.4453)	0.9390* (0.4802)	0.0054 (0.4512)	-0.1364 (0.4693)	0.7389 (0.8178)
Produce Acreage % (0 to 1)	0.0010 (0.0036)	-0.0025 (0.0035)	-0.0077** (0.0035)	-0.0062* (0.0036)	-0.0022 (0.0035)	0.0010 (0.0036)	-0.0037 (0.0077)
DTC Sales % (0 to 100)	-0.0102** (0.0042)	-0.0083** (0.0041)	-0.0029 (0.0040)	0.0062 (0.0041)	-0.0014 (0.0041)	0.0109*** (0.0041)	0.0270*** (0.0100)
Bordering Wild Hab. = Most	1.2216*** (0.3087)	1.0274*** (0.3020)	0.6038** (0.2941)	0.3887 (0.2983)	0.6073** (0.2939)	0.4845 (0.2946)	-1.3703* (0.7425)
Bordering Wild Hab. = Some	0.9182*** (0.2646)	0.3137 (0.2499)	0.6427** (0.2580)	0.4902* (0.2668)	0.2085 (0.2597)	0.0960 (0.2664)	-0.9578 (0.6499)
AIC	238.3363	250.7930	246.7625	242.6885	250.9221	233.3971	63.3573
Log Likelihood	-111.1682	-117.3965	-115.3813	-113.3443	-117.4611	-108.6985	-23.6787
Num. obs.	184	184	184	184	184	184	184

Note: Each column is a separate regression model. Robust standard errors are reported in parentheses. Asterisk (*), double asterisk (**), and triple asterisk (***) indicate significance at the 10, 5 and 1 percent level, respectively.

Appendix B: Survey Filtering Criteria

In total, 2,142 respondents completed the survey. To ensure that responses represent current fruit and vegetable growers several filtering criteria were used. Responses were filtered out if the respondent:

- selected “No” when asked if they grew produce or specialty crops (N=694 removed);
- reported having 0 acres under produce or specialty crops (N=434 removed);
- reported revenue below \$10,000 or exceeding values reported in the peer-reviewed literature for a given region (e.g., Calvin et al. (2017)¹ reported only 7 growers in California with annual revenue near \$200 million; N= 228 removed)
- reported unrealistic expenditures relative to reported revenue (e.g., substantially more employees than revenue could support; N= 341 removed)
- reported reporting an unrealistic farm size (>100,000 acres under production; N=1 removed)
- submitted multiple responses (N=28 removed); duplicate responses were identified by email or by all answers, including free response, being identical
- used an email that was a randomly generated combination of letters and numbers (N=108 removed)

Of the remaining 304 responses, 99 were filtered out since the ReCAPTCHA score was >0.50, indicating a probable false or spam response. After filtering, our final dataset represented 209 growers.

¹ Calvin, Linda, Jensen, Helen, Klonsky, Karen, and Cook, Roberta. *Food Safety Practices and Costs Under the California Leafy Greens Marketing Agreement*, EIB-173, U.S. Department of Agriculture, Economic Research Service, June 2017. <https://www.ers.usda.gov/webdocs/publications/83771/eib-173.pdf?v=0>

Appendix C. Regional Differences

Responses were grouped geographically by US Environmental Protection Agency (EPA) region (US EPA, 2022).² For analyses, contiguous regions with low response numbers were grouped, resulting in combining Regions 6, 7, and 8 (South Central, Midwest, and Great Plains and Rockies) and Regions 9 and 10 (Southwest and California and Pacific Northwest). Separate cross tabulations between binary responses and categorical groupings for EPA region were calculated to summarize grower responses to binary response questions.

Farm characteristics, production, and marketing

Based on the modified EPA regions (Table C1), growers in New England (N=46), New Jersey and New York (N=38), the Southeast (N=42), and the Southwest and West Coast (N=40) each represented approximately one-fifth of respondents. The remaining growers were from the Mid-Atlantic (N=12), the Midwest, Plains, and South Central (N=10), and the Upper Midwest (N=17). We observe larger concentrations of respondents representing small farms in New England, and the Southwest and West Coast (70% and 63% of respondents were small farms, respectively) compared to New Jersey and New York and the Southeast, which had a higher concentration of respondents representing large farms (53% in New Jersey and New York, and 67% in the Southeast).

Programmatic level of food safety management and oversight

Geographic region showed a significant association with four of the five food safety management and oversight activities (Table C2). For example, while most growers reported utilizing employee training programs in the Mid-Atlantic (58%, N=12), New England (65%, N=46), Southeast (64%, N=42), and Upper Midwest (59%, N=17), only 35% of growers in the Southwest and West Coast did (N=40). In no region did a majority of growers report utilizing food safety consulting services, though the Southeast reported much higher usage (48%, N=42) than other regions. A majority of growers in New England, the Southeast, and Upper Midwest reported carrying food safety insurance, while only in the Southeast did a majority of growers report that they had undergone third-party audits (50%, N=42) or had incurred financial losses (50%, N=42).

² US EPA. (2022, February 7). *Regional and Geographic Offices*. <https://www.epa.gov/aboutepa/regional-and-geographic-offices>

Table C1. Regional Distribution of Farms by Revenue Category

Classification ^a	Responses by revenue category (in US\$)							Total
	<25K	25-250K	250-500K	500K-1M	1-5M	5M+	Not reported	
All Farms (N=209)	19	57	30	28	47	18	10	209
Region (N=205)								
Mid-Atlantic	3	4	0	1	2	2	0	12 (6%)
MW, Plains, and S. Central	2	3	1	2	1	1	0	10 (5%)
New England	10	16	6	4	8	0	2	46 (22%)
NJ and NY	3	8	3	4	12	4	4	38 (19%)
Southeast	0	7	6	5	15	8	1	42 (20%)
Southwest and West Coast	0	13	12	10	4	1	0	40 (20%)
Upper Midwest	1	6	1	2	5	2	0	17 (8%)

Note: Not all respondents chose to report classification information. Response rates for each classification are reported in parentheses. In the “Total” column, percentages of total responses are reported in parentheses for each classification group.

^a (no. of respondents)

Table C2. Regional Variation in Food Safety Program Organization

Classification ^a	N	Proportion of respondents that reported use					
		Attended external training	Food safety plan	Consulting services	Food safety insurance	Third-party audits	Financial losses
All Farms	209	0.502	0.402	0.214	0.438	0.282	0.263
Region (N=205)		*		*	*	*	*
Mid-Atlantic MW, Plains, and S. Central	12	0.583	0.417	0.167	0.417	0.250	0.167
New England	46	0.652	0.413	0.109	0.500	0.130	0.196
NJ and NY	38	0.368	0.211	0.030	0.303	0.289	0.263
Southeast	42	0.643	0.548	0.476	0.548	0.500	0.500
Southwest and West Coast	40	0.350	0.400	0.250	0.275	0.225	0.125
Upper Midwest	17	0.588	0.529	0.235	0.706	0.471	0.294

Note: The response rates for each classification are reported in parentheses. For each classification group, separate Pearson's chi-squared tests of independence were conducted using the count data underlying each column of proportions reported. A single asterisk (*) indicates $p \leq 0.05$ for each test.

^a (no. of respondents)

Appendix D. Survey Instrument

Start of Block: Farm Characteristics Screener

Before you proceed to the survey, please complete the captcha below.

Which of the following titles best matches your role within your produce growing operation? (check all that apply)

- Owner
- Operator (growing and/or harvesting)
- Food safety or regulatory compliance director or equivalent
- Other (specify) _____

Does your operation grow vegetables, fruits, or other specialty crops (excluding sprouts) for human consumption?

- Yes
- No

In what state is the main location of your operation?

▼ Alabama ... Prefer not to answer

End of Block: Farm Characteristics Screener

Start of Block: Farm Characteristics

What does your operation do? (check all that apply)

- Growing in field, including high tunnel
- Controlled environment growing (e.g., greenhouse, aquaponics, hydroponics, etc.)
- Animal husbandry

- Field packing
- Packing (other than field packing, e.g., in a packing shed)
- Aggregating (collecting produce from other growers after it has been harvested)
- Processing (e.g., fresh-cut, chopping, peeling, freezing, dehydrating, juicing, boiling, or other value-added processes)
- Cold storage
- Shipping
- On-farm market, on-farm restaurant, or other direct-to-consumer channel
- Other (specify) _____
- Prefer not to answer

In what county is the main location of your operation?

State:

County:

▼ Alabama ... Wisconsin ~ Prefer not to answer

End of Block: Farm Characteristics

Start of Block: Farm Size

Over the last three years, 2016 through 2018, what was the approximate total **annual** revenue and total **annual** expenditures for all farm production?

Please estimate to the best of your knowledge.

Total Annual Revenue (\$) _____

Total Annual Expenditures
(\$) _____

Over the last three years, 2016 through 2018, what was the range of total annual revenue for all farm production?

▼ \$0-\$999 ... Prefer not to answer

Over the last three years, 2016 through 2018, what was the range of total annual expenditures for all farm production?

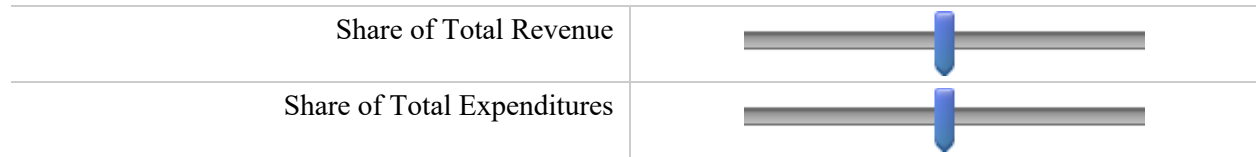
▼ \$0-\$999 ... Prefer not to answer

Page Break

About how much of your total annual revenue and total annual expenditures come from fruit, vegetable, and/or other specialty crops (excluding sprouts)?

Percentage share for fruit, vegetable, and other specialty crop production

0 20 40 60 80 100



In **2018**, how many full-time staff did your operation employ?

Please estimate to the best of your knowledge.

- full time staff _____
- part time staff _____
- unpaid individuals that work on the farm (e.g., family, friends, and volunteers)

What is the total acreage of your operation? (Include owned and leased land)

Please estimate to the best of your knowledge.

- acres _____



What is the range of total acreage of your operation? (Include owned and leased land)

Please estimate to the best of your knowledge.

▼ 0.1 to 0.9 acres ... Prefer not to answer

In **2018**, how many total acres of land were managed or operated by your operation for each of the following uses?

Please estimate to the best of your knowledge.

In-field or high tunnel vegetable or herb production : _____

Orchards, cane, bush berry, or other fruit production : _____

Feed, grain, oilseeds, and dry beans : _____
Fruits, vegetables, or herbs in a greenhouse or controlled environment : _____
Pasture land : _____
Grassland (not for grazing) : _____
Woodland, wetlands, and other non-grass vegetation : _____
Bare ground, fallowed and idled land : _____
Other (e.g., flowers, Christmas trees, timber, etc.) : _____
Total : _____

End of Block: Farm Size

Start of Block: Production & Marketing Info

How would you classify your operation's products?

- Conventional only (i.e. not Certified Organic)
- Certified Organic only
- Both conventional and Certified Organic
- Prefer not to answer



For **2018**, please identify the percentage (%) of all vegetables, fruits, and nuts that your operation sold directly to or sold/marketed through:

_____ **Produce wholesalers and repackers** e.g., distributors, terminal market vendors, packing houses, food hubs

_____ **Grocery retailers** e.g., Safeway, Whole Foods

_____ **Mass merchandisers** e.g., Costco, Wal-Mart

_____ **Processors**

_____ **Foodservice operations** e.g., restaurants, hospitals, schools, hotels

_____ **Direct to consumers** farm stand, farmers market, CSA, U-pick

_____ **Other**

End of Block: Production & Marketing Info

Start of Block: Food Safety Costs

In 2018, what types of preharvest food safety risk mitigation strategies do you employ in your operation? (Check all that apply)

Monitoring, testing and/or treating agricultural water quality

- Treating biological soil amendments (e.g, composting, etc.)
- Monitoring for wildlife intrusion
- Implementing practices to manage domestic animals, birds, and wildlife (e.g., fencing, deterrents)
- Using hygienic practices when handling produce
- Employee food safety training
- Sanitizing equipment, tools, and buildings
- Keeping written food safety records
- Other (specify) _____
- Prefer not to answer

In total, approximately how much did you spend on preharvest food safety risk mitigation in **2018**?

(Include any costs dedicated to food safety mitigation such as money spent on additional training, water testing, recordkeeping, and any new equipment employed to mitigate food safety risks (e.g., fencing or water treatment systems))

Please estimate to the best of your knowledge.

- Preharvest food safety risk mitigation costs (\$)

End of Block: Food Safety Costs

Start of Block: Losses due to Food Safety Issues

Losses Due to Food Safety Issues

The next set of questions will ask about any remedial action you have taken in your operation related to non-crop vegetation. For example, this includes hedgerows, windrows/windbreaks, vegetated swales, and any natural vegetation (woods, meadows, wetlands), but **not** orchard trees, cover crops, or pasture.

Remember, if you stop for any reason, your progress will be saved and you can return to complete the survey later.

Over the last five years, have you incurred any financial losses due to food safety concerns, not including preventative food safety measures (e.g., treatment of irrigation water) or training?

- Yes
- No
- Don't know
- Prefer not to answer

Please estimate the average annual **financial losses**, in dollars, you have incurred due to food safety concerns in the past five years. (Exclude expenditures on preventive food safety measures) *Please estimate to the best of your knowledge.*

Financial losses (\$) _____

In **the past five years**, how many acres of crops annually have you had rejected or excluded and what were the approximate annual costs or financial losses incurred due to either of the following food safety concerns? (Include the cost of any reinspections or additional audits)

Please estimate to the best of your knowledge.

Please enter 0 if you have not had an issue with a particular hazard source.

	Click to write Column 1	
	Acreage rejected (acres)	Costs and losses(\$ USD)
Concerns with wildlife or other animal intrusion		

Concerns with preharvest water quality		
Concerns with non-crop vegetation		

Did you receive any payment, reimbursement or other compensation to off-set these losses?
Please estimate to the best of your knowledge.

- Insurance payout (\$) _____
- Other compensation (\$) _____

Did your insurance premiums increase due to the insurance payout?

- Yes
- No
- Don't know
- Prefer not to answer

Do you have any comments you would like to add related to remedial actions and non-crop vegetation?

End of Block: Losses due to Food Safety Issues

Start of Block: Animal Intrusion / Non-Crop Vegetation

Managing Animal Intrusion and Wildlife Habitat The next set of questions will ask about how your operation manages food safety risks related to animal intrusion.

Remember, if you stop for any reason, your progress will be saved and you can return to complete the survey later.

In **2018**, how much of your fruit, vegetable, or other specialty crop production area (e.g., fields, orchards, etc.) bordered hedgerows, woodlands, wetlands, or other terrestrial wild lands and wildlife habitat?

- Most of my production area (greater than 50%)
- Some of my production area (less than 50%)
- None my production area (0%)
- Prefer not to answer

In **2018**, how much of your fruit, vegetable, or other specialty crop production area (e.g., fields, orchards, etc.) bordered lands used for grazing or raising livestock? (Including hobby farms)

- Most of my production area (greater than 50%)
- Some of my production area (less than 50%)
- None of my production area (0%)
- Prefer not to answer

Does your operation actively provide or maintain wildlife habitat on land it manages by using any of these practices? (check all that apply)

- Maintain hedgerows, windbreaks, or shelterbelts
- Preserve natural areas (e.g., forest, wetlands, or native grasslands)
- Maintain vegetative buffers along waterways

- Adjust operation timing (e.g., delay mowing field margins to protect ground-nesting birds)
- Use bird houses or bat houses (including owl boxes and raptor perches)
- Plant flowers or provide nesting habitat (e.g., dead or rotting logs) for native pollinators
- Other (specify) _____
- My operation does not take any specific steps to provide or maintain wildlife habitat on land it manages
- Prefer not to answer

During the growing season, what **level of food safety risk** do you believe that each of the following factors poses to your operation?

	High Risk	Low Risk	Insignificant Risk	Unsure	N/A or Prefer not to answer
Birds entering growing areas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rodents entering growing areas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Deer, moose, or other large animals entering growing areas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Frogs, snakes, etc. entering growing areas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Domestic animals such as dogs entering growing areas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Livestock grazing or sheltering near growing areas.

Working animals (e.g., plowhorses, etc.)

In **2018**, did any of the following people **raise a food safety concern regarding animals** (including wildlife and livestock) in or near to your crop production areas? (check all that apply)

- Food safety auditor
- Buyer or customer representative
- State or federal government inspector
- Food safety consultant
- Food safety trainer
- Extension agent or non-profit farm advisor
- Worker or employee
- Other (specify) _____
- No one has raised a food safety concern regarding animals
- Prefer not to answer

Which of the following were identified as food safety risks? (check all that apply)

- Deer

- Birds
- Rodents
- Amphibians
- Cattle
- Other livestock
- Pets
- Other, specify _____
- Prefer not to answer

In 2018, did any of the following people raise a food safety concern regarding non-crop vegetation, including wildlife habitat, near to your crop production areas? (check all that apply)

- Food safety auditor
- Buyer or customer representative
- Government inspector
- Food safety consultant
- Food safety trainer
- Extension agent or non-profit farm advisor
- Other (specify) _____
- No one outside my operation has raised a food safety concern regarding animals
- Prefer not to answer

Over the last five years, did your operation take any of the following steps to manage wildlife habitat to **reduce the potential for animal intrusion** during the growing season?

	Yes	No	Prefer not to answer
Clear a buffer zone around your fields or orchards to increase your ability to detect animal intrusion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Take acreage out of production to create or expand buffer zones	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Plant low-risk crops on fields at risk of animal intrusion (e.g., crops like sweet potatoes that are usually cooked, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fallow fields at risk of animal intrusion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Use wildlife corridors to route animals around or away from fields or groves	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Drain, fill in, or treat farm ponds (e.g., sediment or storage pond)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Clear vegetation from irrigation/drainage ditches or farm ponds	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Remove on-farm non-crop vegetation including trees or shrubs near field edges	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (specify)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What type of buffers do you use? (check all that apply)

- Bare ground or dirt
- Mowed grass
- Crops with low food safety risk (e.g., hay, feed corn, potatoes, etc.)
- Non-crop vegetation (e.g., unmowed grass, etc.)
- I do not use buffers
- Prefer not to answer

How wide of a buffer do you generally aim for? In other words, what is the minimum distance (in feet) you now have between your crops and other (non-crop) vegetation?

buffer width (feet) _____

In last five years, approximately how much did you spend annually to create and/or expand **non-crop** buffer zones around your crop production areas?

Please estimate to the best of your knowledge.

- Costs to expand buffer zones
(\$) _____
- Lost crop revenue, including produce and all other crops
(\$) _____

In the last five years, how much acreage (if any) did you convert from non-crop vegetation to **fruit, vegetable, or other specialty crop production area** or to **bare ground buffer**?

Please estimate to the best of your knowledge.

_____ acres converted **to** fruit, vegetable, or other specialty crop production area

_____ acres converted **to** bare ground buffer

In the last five years, how much acreage (if any) did you convert from fruit, vegetable, or other specialty crop production area to **non-crop vegetation** or to **bare ground buffer**?

Please estimate to the best of your knowledge.

_____ acres converted **to** non-crop vegetation

_____ acres converted **to** bare ground buffer

During the growing season, about how many **hours per week** did you or others in your operation spend **monitoring produce fields or orchards for signs of animal intrusion**?

Please estimate to the best of your knowledge.

Hours per week _____

Over the last five years, did your operation take any of the following steps to actively **keep animals out of crop production areas** during the growing season? (Not including alterations to on-farm habitat)

	Yes	No	Prefer not to answer
Deer fencing around field edges	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Silt/plastic fencing around field edges	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fencing around surface water (e.g., pond, ditch)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mechanical traps	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Poison bait	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hunt or shoot pest animals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Deterrents such as Mylar strips, bird cannons, or other noise-makers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (specify)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

On average, how much did your operation spend **annually** on measures to keep animals (domestic and wild) out of crop production areas?

Please estimate to the best of your knowledge.

Animal deterrent costs (\$) _____

Do you have any comments you would like to add related to managing animal intrusion?

End of Block: Animal Intrusion / Non-Crop Vegetation

Start of Block: Conservation Practices

Managing Conservation Practices The next set of questions will ask about how your operation manages conservation practices. These questions refer to your conservations practices employed over **the last five years** of your operation.

Remember, if you stop for any reason, your progress will be saved and you can return to complete the survey later.

In the last **five years**, has your operation been part of any government or other third-party incentive programs for establishing conservation practices on your farm?

- Yes
- No
- Don't know
- Prefer not to answer

In the last five years, which incentive programs have you participated in? (check all that apply)

- Federally-funded conservation programs (e.g., CREP, etc.)
 - State-funded conservation programs
 - Privately-funded conservation programs (e.g., non-profit programs, etc.)
 - Other programs not listed (specify)
-
- Prefer not to answer

In the last five years, what is the approximate total **annual** monetary benefit of all incentive programs in which you participate?

Please estimate to the best of your knowledge.

- Net Monetary Benefit (\$) _____

Please specify which conservation programs you participated in:

In the last five years, have you employed any independent (self-funded) conservation efforts in your operation?

- Yes
- No
- Prefer not to answer

In the last five years, approximately how much did you spend on conservation practices?

Please estimate to the best of your knowledge.

Conservation costs (\$) _____

In the last five years, have concerns with food safety impaired your conservation efforts?

- Yes
- No
- Prefer not to answer

Do you have any comments you would like to add related to managing conservation practices?

End of Block: Conservation Practices

Start of Block: Agricultural Water

Managing Agricultural Production Water The next set of questions will ask about how your operation manages food safety risks related to agricultural production water. This refers to water used to irrigate produce crops or other water used in the cultivation of produce crops, for example water used for frost protection or to mix pesticide sprays.

Remember, if you stop for any reason, your progress will be saved and you can return to complete the survey later.

In **2018**, what **water sources** did your operation use for preharvest applications? (check all that apply)

	Water that touched harvested portion of the crop	Water that DID NOT touch harvested portion of the crop
	Source used	Source used
Standing surface water (ponds, reservoirs)	<input type="checkbox"/>	<input type="checkbox"/>

Flowing surface water (streams, canals)

Ground water (wells)

Municipal water or other potable water from a public system

Other (specify)

Prefer not to answer

In 2018, did your operation use filter strips, grassed waterways, or other vegetated practices to manage runoff and protect on-farm surface water?

- Yes
- No
- Prefer not to answer

In 2018, how often did your operation test production water for microbial content such as generic *E. coli*?

- More than once a month
- Once per month
- Several times per year
- Once per year
- Never
- N/A - Rely on someone else's water tests
- Prefer not to answer

In **2018**, how many total water samples did your operation test for microbial contamination? Include only water samples taken from sources used to grow or cultivate crops (e.g., irrigation). *Please estimate to the best of your knowledge.*

samples _____

In total, how much did your operation spend to test these water samples, including cost of shipping or travel to labs?

Please estimate to the best of your knowledge.

Total water testing costs (\$) _____

Over the last five years, did your operation treat production water (for irrigation, mixing sprays, etc.) to reduce or eliminate microbial contamination? (do NOT include hand-washing water or water used post-harvest)

- Yes, we always treated our production water
- Yes, we sometimes treated our production water
- No, we never treated our production water
- Prefer not to answer

On average, how much did your operation spend annually to treat production water?

Please estimate to the best of your knowledge.

Water treatment costs (\$) _____

Do you have any comments you would like to add related to managing agricultural production water?

End of Block: Agricultural Water

Start of Block: Food Safety Program Organization

Food Safety Program The next set of questions will ask about staffing and other aspects of your operation's food safety program.

Remember, if you stop for any reason, your progress will be saved and you can return to complete the survey later.

In the last five years, have you or any staff members in your operation attended food safety training that provided information on in-field food safety practices to manage food safety risks associated with wildlife, irrigation water, soil amendments, or worker hygiene (e.g., FSMA Produce Safety Rule training, Good Agricultural Practices (GAPs), etc.)?

- Yes
- No
- Prefer not to answer

What is the approximate total **annual** cost to your operation of attending these preharvest food safety trainings? (Include travel costs)

Please estimate to the best of your knowledge.

- Preharvest food safety training costs (\$)

Do you currently have a food safety plan with a preharvest component for your operation?

- Yes
- No
- Prefer not to answer

In the last **five years**, did your operation hire an outside consultant to develop, update, or implement all or part of your food safety plan?

- Yes
- No
- Prefer not to answer

On average, over the past five years, how much did your operation spend **annually** on food safety consulting services?

Please estimate to the best of your knowledge.

- Food safety consultant costs (\$)

Does your operation carry any form of insurance policy specifically to cover food safety liability, recall costs, or other risks related to food safety?

- Yes
- No
- Prefer not to answer

How much does this insurance policy (or policies) cost per year?

Please estimate to the best of your knowledge.

- Food safety insurance costs (\$)

Do you have any comments you would like to add about your food safety program?

End of Block: Food Safety Program Organization

Start of Block: Food Safety Audit / Certification Status

In **2018**, did you have any third-party food safety audits that covered your operation? (e.g., PrimusGFS, GlobalGAP, USDA GAP)

- Yes
- No
- Don't know
- Prefer not to answer

Please indicate which of the following audits your operation had in 2018. (Check all that apply)

- Primus GFS, GlobalGAP, Safe Quality Food (SQF), CanadaGAP, or British Retail Consortium (BRC)
- USDA GAPs/GHPs, Harmonized GAPs, or other USDA audit service
- Group GAP or other group or cooperative food safety audit
- Other (specify) _____
- Prefer not to answer

How much did your operation **spend** in total on **food safety audits** in **2018**? (Exclude costs of preparing for audits and exclude organic certification audits.)

Please estimate to the best of your knowledge.

- Food safety audit costs (\$) _____

Did anyone else, for example your buyer(s), pay for some or all of your audits?

- Yes
- No
- Prefer not to answer

In which of the following areas have you generally lost points on your food safety audits or had to implement corrective actions to address? (Check all that apply)

- Wildlife
- Water
- Soil
- Cleaning and sanitation
- Worker health and hygiene
- Other (specify) _____
- None of the above**
- Don't know
- Prefer not to answer

Is there anything you would like to add?

End of Block: Food Safety Audit / Certification Status