

3-17-2024

Extending Knowledge on Biosecurity in Small-scale and Backyard Systems in the United States

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Recommended Citation

Di Francesco, J., Itle, A., McConnel, C., Adams, R., Busch, R., Pereira, R. V., Lehenbauer, T. W., Martínez-López, B., & Pires, A. F. (2024). Extending Knowledge on Biosecurity in Small-scale and Backyard Systems in the United States. *The Journal of Extension*, 61(3), Article 9. <https://doi.org/10.34068/joe.61.03.09>

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Cover Page Footnote

Funding for the FARM PPE project was made possible by the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) - National Animal Disease Preparedness and Response Program (NADPRP) through Cooperative Agreement #AP21VSSP0000C034. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the USDA. We thank Bi Thai Nguyen for developing and maintaining the FARM PPE website, and University of California Agriculture and Natural Resources Cooperative Extension farm advisors for facilitating the announcement of the webinars. We also thank Katie Steneroden and Danelle Bickett-Weddle for their invaluable advice and stimulating discussions, which influenced our implementation of outreach tools. We finally thank the USDA, the Center for Food Security & Public Health, and Healthy Farms Healthy Agriculture for excellent resources on biosecurity, which we shared on the FARM PPE website.

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Extending Knowledge on Biosecurity in Small-Scale and Backyard Systems in the United States

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Abstract. The number of small-scale and backyard operations has increased in the United States during the past decade, but there is currently a lack of outreach efforts and readily available educational materials targeting these farming systems. We developed a webinar series on biosecurity to provide training for small-scale and backyard producers, and training tools that can be used by local veterinarians and extension educators to disseminate knowledge and consistent recommendations more effectively. Fewer people attended the webinars than registered, suggesting a gap between interest in biosecurity and commitment to the topic. Participants in the webinar series reported a high level of satisfaction and a significant increase in knowledge.

INTRODUCTION

Extension materials have been developed on biosecurity (including checklists, manuals, and plan templates), but they are generally targeting a specific commodity, such as dairy and/or beef cattle, sheep, swine, and poultry (e.g., see the Center for Food Security and Public Health and the various Secure Food Supply Plan websites [Center for Food Security and Public Health, n.d.]), or the prevention of the introduction of a particular foreign animal disease (e.g., foot and mouth disease). Researchers reviewed the educational materials providing biosecurity recommendations for food animal species available on the websites of national producer organizations, university cooperative extension services, and state departments of agriculture (Moore et al., 2008). They found that biosecurity recommendations varied widely among information sources for a specific commodity and among commodities, which could lead to mixed messages and confusion and, consequently, result in the absence of implementation of the recommendations by producers raising more than one species.

Multiple small-scale and backyard livestock operations exist in the United States, many of which raise multiple animal species and/or grow crops (Pires et al., 2019; U.S. Department of Agriculture Animal and Plant Health Inspec-

tion Service, 2012), yet there is currently a lack of outreach efforts and readily available educational materials targeting small-scale and backyard farming systems (but see Appendix A for examples of existing resources). Additionally, small-scale and backyard livestock operations often face significant barriers in accessing veterinary care (Pires et al., 2019). This limited access to customized technical information on best practices for livestock health management and to veterinary oversight may lead to an increased risk of occurrence of diseases, including zoonoses, with potential spread to commercial farms.

Extension professionals regularly use webinars and online learning resources to reach a wider audience over larger geographical areas. They were particularly useful for providing education during the COVID-19 pandemic, which restricted the organization of in-person workshops, and have been shown to successfully increase the knowledge of participants in various fields, such as financial education (Johnson & Schumacher, 2016) and equine health (Pulec et al., 2016). We consequently developed a webinar series on biosecurity practices to provide training for farmers and training tools that can be used by current networks of local veterinarians and Extension educators to disseminate knowledge and consistent recommendations more effectively to a larger population of small-scale and backyard producers, with the ultimate

goal of improving the awareness and adoption of biosecurity measures in these farming systems.

METHODS AND MATERIALS

WEBINARS

The webinar series was part of the “Capacity Building Using Train-the-Trainer Approach to Improve Biosecurity and Reduce Disease Spread in Small-Scale and Backyard Livestock and Poultry Premises” project, later renamed the “Farm Animal Risk Mitigation Prepare Prevent Evaluate (FARM PPE)” project for simplicity. This project was a multistate (California, Washington, and Colorado) collaboration among researchers and veterinarians from the University of California, Davis, School of Veterinary Medicine; Washington State University College of Veterinary Medicine; Washington State Department of Agriculture; and Colorado State University College of Veterinary Medicine and Biomedical Sciences.

The eight webinars covered a wide range of subjects related to animal health, good husbandry practices, disease prevention, and general and specific biosecurity measures. They were titled (1) “Course Introduction and General Biosecurity Principles”; (2) “Mapping Your Farm and Equipment and Vehicles”; (3) “Visitors (Humans, Vectors, Rodents, Birds, Wildlife)”; (4) “Keep It Clean”; (5) “Animal Health and Welfare”; (6) “Zoonoses”; (7) “Carcass Management and Disposal”; and (8) “Biosecurity Template Overview and Walk-Through.” The goal of the webinar series was to provide guidance and tools to farmers to create a biosecurity plan for their operation, with an option for a subsequent in-person audit by the project team, if the participants so chose. Participants could attend any of or all the webinars.

The webinars took place weekly or every 2 weeks between January 4 and March 1, 2022. They targeted trainers/Extension educators, veterinarians, and farmers and were free for the public to attend, but required registration through the FARM PPE website (<https://farmppe.netlify.app/>) or the link provided in the advertisement flyer (see Appendix B). The webinar series was announced electronically (e.g., social media, e-newsletters, LISTSERVs) to livestock/poultry owners, state and governmental agencies, and Extension and nonprofit organizations. Demographic and general characteristics of registrants, as well as information on their farms and management and biosecurity practices, were collected through the registration survey by using Qualtrics. The survey instruments and protocol in this study were reviewed and exempted by the Institutional Review Board of the University of California, Davis (No. 1830862–1). Copies of the questionnaires are available upon request.

The webinars were presented and recorded through Zoom. All of them involved a PowerPoint presentation; five were held live, and three were prerecorded. The webinar

recordings were archived on YouTube and made publicly available on the FARM PPE website, which allowed individuals to watch them during their own time and provided a valuable way to reach a wider audience. Additional relevant existing resources in relation to each webinar’s topic were also provided on the website.

WEBINAR EVALUATION

To gain feedback and evaluate any increase in knowledge on the topics covered, all registrants were asked to complete an optional online survey through Qualtrics after each webinar. A retrospective pretest-posttest evaluation was used, in which participants were asked to rate their knowledge on a scale of 0 (*not at all* [i.e., no knowledge]) to 4 (*very well* [i.e., very knowledgeable]). Such a retrospective evaluation was chosen for its advantages, including avoiding a response shift bias because the reference was the same for the pretest and posttest rating and assessing more accurately the change in self-reported knowledge (Pratt et al., 2000). The same measurement scale was used to assess webinar satisfaction (i.e., how well the webinars fulfilled the participants’ expectations and needs).

Email reminders were sent regularly to all registrants, and survey links were made available on the FARM PPE website. To encourage participation, individuals who filled out all eight post-webinar surveys were given a certificate of attendance for the course. All post-webinar surveys remained open until May 31, 2022. When a survey was filled out twice by the same person, only the first responses were kept and used for the analyses.

DESCRIPTIVE AND STATISTICAL ANALYSES

Data from the registration and post-webinar surveys were organized in Microsoft Excel and analyzed by using R (version 3.6.1). All percentages were calculated based on the number of respondents for each specific question. For the post-webinar surveys, the difference between median knowledge scores was analyzed for each topic by using the non-parametric two-tailed paired Wilcoxon signed-ranks test to determine whether knowledge significantly increased following the corresponding webinar. The significance level was set at p value < .05.

RESULTS

REGISTRATION SURVEY

One hundred ninety-seven individuals filled out the registration survey. Demographic characteristics of registrants are summarized in Appendix C. Registrants mainly self-identified as female (136/177, 76.8%). They were mostly farmers/ranchers (99/178, 55.6%), educators (34/178, 19.1%), veterinarians (15/178, 8.4%), and/or government employees (15/178, 8.4%); aged between 25 and 54 years old (117/177,

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66.1%); and based in the United States (168/173, 97.1%), in 17 different states, with the majority in California (62/167, 37.1%), Washington (44/167, 26.3%), and Colorado (37/167, 22.2%).

Most registrants were small-scale farmers (79/172, 48.8%), 4-H or FFA members (49/72, 28.5%), backyard producers (44/172, 26.2%), and/or breeders (35/172, 20.3%); located in a rural (94/176, 53.4%) or suburban (33/176, 18.8%) area; and raising livestock/poultry for commercial use (91/168, 54.2%), personal use (89/168, 53%), show purposes (57/168, 33.9%), and/or as pets (51/168, 30.6%) (see Appendix D for details).

Eighty-eight registrants reported purchasing animals in 2021 (88/172, 51.2%). The majority of registrants purchased animals from breeders (56/88, 63.6%), feed stores (20/88, 22.7%), and/or neighbors or friends (19/88, 21.6%), and they housed their animals most of the time in outdoor pens (85/130, 65.4%) and/or on permanent pasture (67/130, 51.5%) (see Appendix E for details). Some registrants (37/160, 23.1%) indicated facing animal health challenges and/or issues with specific diseases in their operations.

Farm biosecurity practices implemented by registrants are detailed in Figure 1. Most registrants reported “always” or “very often” quarantining new and returning animals (86/116, 74.1%), isolating sick animals (109/128, 85.2%), and

asking for health status when buying new animals (89/112, 79.5%). The implementation of rodent control was less frequent, with 55.8% (72/129) of registrants reporting using it “always” or “very often.” Most registrants “never” or “rarely” allowed contact with neighboring animals (110/129, 85.3%), whereas fewer “never” or “rarely” allowed contact between their livestock/poultry and wildlife (51/131, 38.9%) or authorized guests to enter animal areas (62/132, 47%).

WEBINAR ATTENDANCE

Webinar attendance and recording views are described in Table 1. Of the 197 individuals who registered for the webinar series, 29 (14.7%) attended at least one live webinar.

POST-WEBINAR SURVEYS

Fifteen participants filled out all eight post-webinar surveys and received a certificate of completion for the course. The number of participants who answered the “before” and “after” sections of the knowledge evaluation questions are detailed for each topic and webinar in Table 2. The difference between median knowledge scores was significant for each topic (i.e., p value < .05), demonstrating that participant knowledge increased on each topic following the corresponding webinar. Some of the most significant increases in knowledge (i.e., p value < .001) were recorded for the five main disease trans-

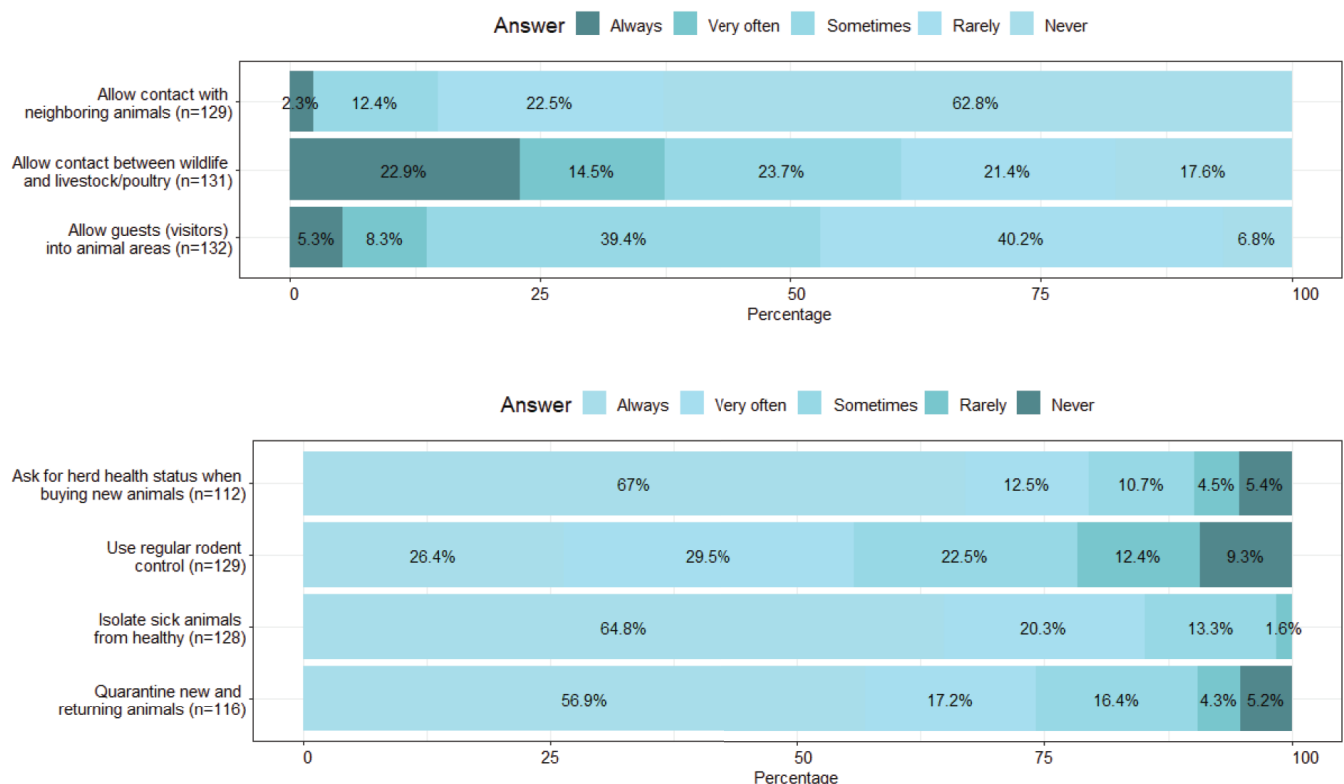


Figure 1. Biosecurity practices implemented by registrants (n = 197).

Table 1. Webinar Attendance and Recording Views

	Number of participants in the live session	Number of views on YouTube as of December 17, 2022
Webinar 1	29	125
Webinar 2	Not applicable (prerecorded)	77
Webinar 3	24	57
Webinar 4	Not applicable (prerecorded)	60
Webinar 5	15	35
Webinar 6	Not applicable (prerecorded)	50
Webinar 7	10	26
Webinar 8	27	37

mission routes, the role of wildlife in disease transmission to livestock/poultry, mitigation steps to decrease attraction of wildlife, how Q fever and salmonellosis are transmitted to humans, and carcass disposal options.

In the survey for webinar 8, among the respondents who did not already have a biosecurity plan for their operation (12/15, 80%), 91.7% (11/12) indicated that they planned to develop one in the near future.

Satisfaction with the webinars was apparent, with 75%–95% of participants indicating that the webinars fulfilled their expectations and needs “well” or “very well,” and none answering “not at all” (see Figure 2). The website, availability of webinar recordings, and additional resources provided were particularly appreciated by the participants (e.g., “I really appreciate that I could watch the recorded sessions at my leisure”; “The links provided to the biosecurity templates on your website are excellent”; “The wealth of downloadable information you provided in conjunction with this webinar is amazing”).

DISCUSSION

When possible, we followed the best practices for webinar planning and delivery (e.g., preenrollment of participants, organization of pre-webinar practice sessions, use of evaluations to make improvements) recommended by Robinson and Poling (2017). All live webinars were held on Tuesdays at 5:30 p.m. PST, after traditional work hours, and included a question-and-answer session at the end to increase participation. They provided a unique platform for participants to discuss with our team of experts issues and challenges they had encountered.

The number of participants who attended the live sessions (10–29; Table 1) was much lower than the number of

registrants ($n = 197$), which might suggest a gap between interest in biosecurity and commitment to the topic and may have been due to the availability of the webinar recordings on the FARM PPE website. Having a high number of “no-shows” is common with webinars. For example, the participation rates recorded among individuals who had pre-registered for the USA Equine Trust and eOrganic webinars were 42% (236/558) and 60% (10,534/17,620), respectively (Formiga et al., 2014; Pulec et al., 2016).

Overall, the number of participants in the live sessions, the number of recording views on YouTube, and the number of people who filled out the post-webinar surveys decreased throughout the webinar series, except for the concluding webinar, “Biosecurity Template Overview and Walk-Through” (see Tables 1 and 2). Interestingly, such a trend was not observed with the USA Equine Trust webinars, which may have been due to their requirement for registering separately for each webinar, to the webinar topics being more specific (e.g., on a particular disease, on sales fraud) rather than all focusing on different elements of the same general topic, and/or to the webinars being delivered pre-COVID-19 pandemic (Pulec et al., 2016). However, a similar decrease in participation was observed for a virtual feedlot short course of seven webinars and has been attributed to possible competing events, work duties, and/or “Zoom fatigue” (i.e., feelings of exhaustion attributed to video conferences that have been increasingly reported during and since the COVID-19 pandemic; Rusche, 2021). The combination of live and pre-recorded webinars may also have contributed to the attrition observed.

In general, the webinar series was a success, with participants reporting a high level of satisfaction and a significant increase in knowledge on each topic evaluated following the corresponding webinar. This increase in knowledge was particularly significant (i.e., p value < .001) for questions on zoonotic disease transmission and on wildlife, which is in line with the low level of participants who indicated “never” or “rarely” allowing contact between their livestock/poultry and wildlife during the registration survey. This lack of knowledge regarding the risks associated with wildlife and the low level of implementation of associated biosecurity practices is worrisome considering the currently increasing outbreaks of highly pathogenic avian influenza, as well as the expanding geographic distribution and increasing abundance of feral pigs in the United States (Centers for Disease Control and Prevention, 2022; McCann et al., 2018).

Some of the limitations of this webinar series included our inability to record the number of webinars watched by each individual and to evaluate its long-term outcomes. Indeed, even though the majority of participants who did not have a biosecurity plan indicated planning to develop one in the near future, we will not be following up with them to find out whether they actually do. Additionally, we could not

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Table 2. Knowledge Evaluation Results by Topic and Webinar

Topic	Number of participants	Group Median	
		Before	After
Webinar 1: Course Introduction and General Biosecurity Principles			
Importance of biosecurity	22	2.5	4
Five main disease transmission routes	22	2	3
Webinar 2: Mapping Your Farm and Equipment and Vehicles			
Importance of separating returning animals	19	3	4
Importance of having an emergency plan to care for the animals in the event of a natural disaster	19	3	3
Concept of line of separation	19	2	4
Importance of limiting access to animal areas	19	3	4
Importance of creating both a property and a community map	19	2	4
Webinar 3: Visitors (Humans, Vectors, Rodents, Birds, Wildlife)			
Role of wildlife in disease transmission to livestock/poultry	19	2	3
Mitigation steps to decrease attraction of wildlife	19	2	3
Risks associated with human visitors	19	2	3
Webinar 4: Keep It Clean			
Cleaning and disinfection (C&D) steps	17	2	4
Safety measures that should be followed during C&D	17	2	3
Proper use of boot baths	17	2	3
Importance of avoiding sharing equipment with neighbors and other operations	17	3	4
Rodent control strategies	15	2.5	3
Importance of removing manure/litter regularly	17	3	4
Webinar 5: Animal Health and Welfare			
Factors that affect host susceptibility to diseases	16	2	3
How to monitor animals for signs of disease	16	2.5	3
Veterinarian-Client-Patient Relationship (VCPR) requirements	16	2	3
Good practices for vaccine handling	15	3	4
Difference between isolation and quarantine	16	2.5	4
Five freedoms of animal welfare	16	2	3.5
Webinar 6: Zoonoses			
The importance of zoonoses	17	3	4
Populations at higher risk of zoonotic diseases	16	3	4
General prevention practices against zoonoses	16	3	3
How Q fever is transmitted to humans	17	1	3
How Salmonellosis is transmitted to humans	17	2	3
Webinar 7: Carcass Management and Disposal			
Importance of necropsies	15	2	4
Reportable diseases	15	2	4
Carcass disposal options	15	2	3
Webinar 8: Biosecurity Template Overview and Walk-Through			
Importance of doing a biosecurity plan	15	2	4
Importance of implementing biosecurity practices	15	3	4

Note. Non-bolded topics had a p value $< .05$ for the nonparametric two-tailed paired Wilcoxon signed-ranks test, and those in bold had a p value $< .001$.

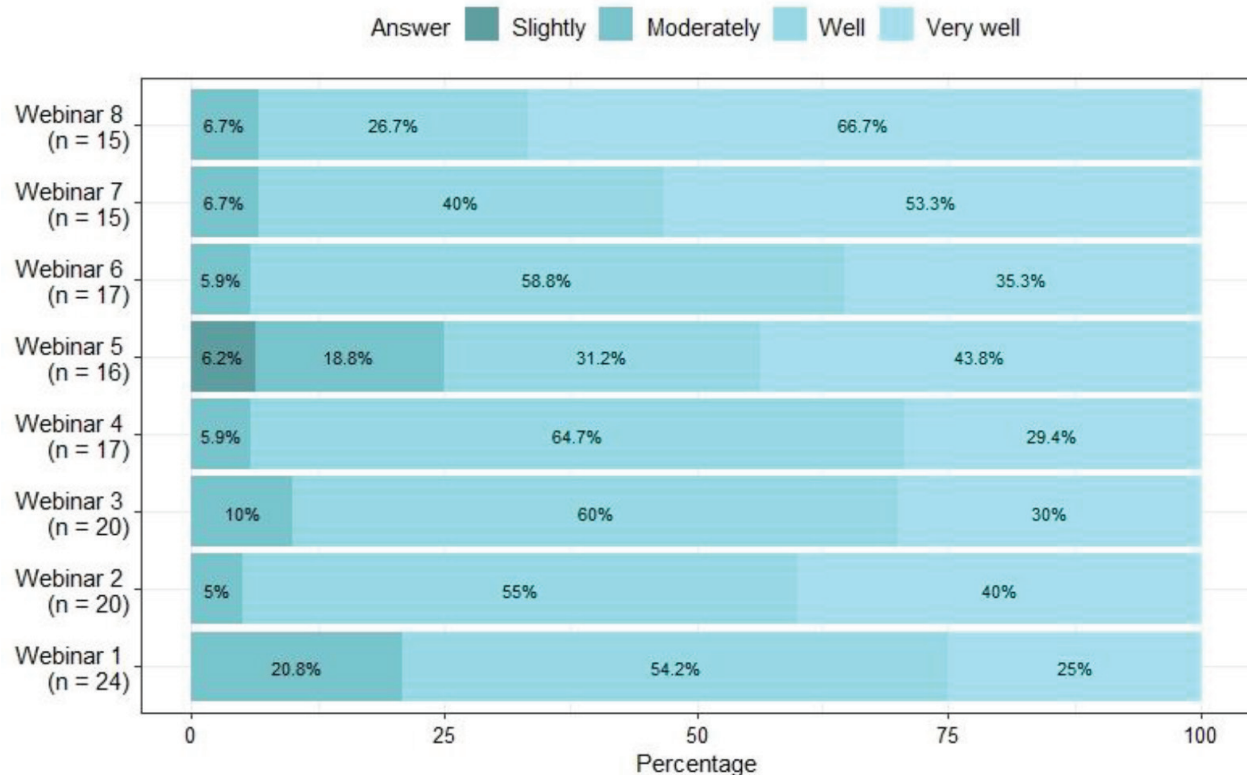


Figure 2. Webinar satisfaction.

determine how the information provided during the webinar series encouraged participants to take action and improve biosecurity measures on their premises and whether they would maintain these changes. Similar limitations have been described for other webinar series (Johnson & Schumacher, 2016).

CONCLUSION AND IMPLICATIONS

This project implemented several levels of training for farmers and educators to maximize efforts and create consistent messaging for small-scale and backyard operations. The sequence of webinars introduced key biosecurity concepts that enabled participating farmers to develop biosecurity plans for their operation, with an option for a subsequent in-person audit by our team of subject-matter experts. The website developed for the project raised awareness and provided easy access to some of the key resources on biosecurity already available. Feedback from participants highlighted the value of providing access to webinar recordings for those who were unable to attend the live sessions.

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APPENDIX A. EXAMPLES OF U.S. EXISTING RESOURCES FOR SMALL-SCALE AND BACKYARD FARMERS

POULTRY

- University of California Cooperative Extension (UCCE) resources for backyard poultry: https://ucanr.edu/sites/poultry/Resources_335/backyard/
- USDA resources for new backyard poultry keepers: https://www.aphis.usda.gov/aphis/newsroom/news/sa_by_date/sa-2020/backyard-poultry-keeper-resources

SWINE

- University of Minnesota Extension resources for small-scale swine production (including alternative and organic swine production): <https://extension.umn.edu/swine/small-scale-swine-production#biosecurity-1311210>

ALL SPECIES

- Cornell Small Farms Program: <https://smallfarms.cornell.edu/about/>
- USDA small and mid-sized farmer resources: <https://www.usda.gov/topics/farming/resources-small-and-mid-sized-farmers>
- Utah State University Extension resources for small farms: <https://extension.usu.edu/smallfarms/>
- Oregon State University Extension Services resources for small farms: <https://extension.oregonstate.edu/smallfarms/resources>
- University of New Hampshire resources for backyard livestock: <https://extension.unh.edu/agriculture-gardens/yard-garden/backyard-livestock>
- UCCE resources for small farms and urban agriculture: https://ucanr.edu/sites/Small_Farms/
- The Center for Food Security and Public Health resources: <https://www.cfsph.iastate.edu/>
- Health Farms Healthy Agriculture resources: <https://www.healthyagriculture.org/>

APPENDIX B. FLYER USED TO ADVERTISE THE WEBINAR SERIES

Keeping Your Livestock Healthy

Animal Health Biosecurity Plans and
Best Management Practices for your Farm

FREE 8-part Webinar Series
*Mapping your Farm, Keeping it clean, Health and Welfare, Diseases Shared between
People and Animals, Managing Mortalities, Create your own Biosecurity plan*



FARM PPE

FARM ANIMAL RISK MITIGATION: Prepare, Plan, Evaluate
January 4th, 2022 – March 1st, 2022
Tuesday Evenings
5:30-6:30 PM PST/ 6:30-7:30 PM MT

Info: <https://farmppe.netlify.app/>
Click [HERE](#) to Register

For more information, email: pireslab@ucdavis.edu



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FARM PPE

APPENDIX C. DEMOGRAPHIC CHARACTERISTICS OF REGISTRANTS (N = 197)

Demographic characteristic	Question description	Frequency (%)	
Gender	<i>Multiple choice (single answer)^a</i>		
	Female	136	(76.8)
	Male	28	(15.8)
	Prefer not to say	13	(7.3)
	No answer	20	-
Country	<i>Open-ended^a</i>		
	United States	168	(97.1)
	Philippines	3	(1.7)
	Mexico	1	(0.6)
	Australia	1	(0.6)
	No answer	24	-
Age	<i>Multiple choice (single answer)^a</i>		
	< 25 years	16	(9.0)
	25–34 years	30	(16.9)
	35–44 years	38	(21.5)
	45–54 years	49	(27.7)
	55–64 years	26	(14.7)
	65–74 years	15	(8.5)
	> 74 years	3	(1.7)
	No answer	20	-
Ethnicity	<i>Multiple choice (multiple answers)^b</i>		
	White	129	(73.3)
	Prefer not to say	22	(12.5)
	Latino or Hispanic	18	(10.2)
	Asian	7	(4.0)
	Other	5	(2.8)
	American Indian or Alaskan Native	3	(1.7)
	Black or African American	3	(1.7)
	Middle Eastern or Arab American	1	(0.6)
	Native Hawaiian or other Pacific Islander	1	(0.6)
	No answer	21	-
Occupation	<i>Multiple choice (multiple answers)^b</i>		
	Beginner farmer/rancher	50	(28.1)
	Experienced farmer/rancher	49	(27.5)
	Other	45	(25.3)
	Educator	34	(19.1)
	Student	18	(10.1)
	Veterinarian	15	(8.4)
	Government	15	(8.4)
	Researcher	8	(4.5)
	Farm employee	7	(3.9)
	NGO/Nonprofit	6	(3.4)
	No answer	19	-

^a Percentage values are rounded and may not total 100%.

^b Participants could select more than one option; therefore, percentages for the variable may exceed 100%.

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APPENDIX D. FARM CHARACTERISTICS OF REGISTRANTS (N = 197)

Farm characteristic	Question description	Frequency (%)	
Type of operation	<i>Multiple choice (single answer)^a</i>		
	4-H or FFA member	49	(28.5)
	Other	49	(28.5)
	Small-scale farmer (livestock only)	46	(26.7)
	Small-scale diversified farmer (vegetables and livestock)	38	(22.1)
	Backyard producer—own production	37	(21.5)
	Breeder	35	(20.3)
	Backyard producer—commercial	8	(4.7)
	No answer	25	-
Location	<i>Multiple choice (single answer)^b</i>		
	Rural	94	(53.4)
	Suburban (periphery of metropolitan area and close to agricultural land or other open space)	33	(18.8)
	Town (city < 250,000 inhabitants and surrounded by a metropolitan area)	19	(10.8)
	Other	13	(7.4)
	Peri-urban	9	(5.1)
	Urban (city > 250,000 inhabitants)	8	(4.5)
	No answer	21	-
Use of livestock/poultry and animal products	<i>Multiple choice (multiple answers)^a</i>		
	Personal use	89	(53.0)
	Sale of livestock (alive)	73	(43.5)
	Show	57	(33.9)
	Pet	51	(30.6)
	Sale of animal products	48	(28.6)
	Other	36	(21.4)
	No answer	29	-

^a Participants could select more than one option; therefore, percentages for the variable may exceed 100%.

^b Percentage values are rounded and may not total 100%.

APPENDIX E. MANAGEMENT PRACTICES OF REGISTRANTS (N = 197)

Management Practice	Question description	Frequency (%)	
Animal purchase	<i>Multiple choice (single answer)^a</i>		
	Yes	88	(51.1)
	No	84	(48.8)
	No answer	25	-
Purchase sources	<i>Multiple choice (multiple answers)^b</i>		
	Breeder	56	(63.6)
	Feed store	20	(22.7)
	Neighbor/friend (not commercial)	19	(21.6)
	Online (Craigslist, swap meetings, etc.)	14	(15.9)
	Commercial farm	14	(15.9)
	Sale yard or livestock auction	7	(8.0)
	Other	7	(8.0)
	Pet store	3	(3.4)
	No answer	109	-
Animal housing	<i>Multiple choice (multiple answers)^b</i>		
	Outdoor pens (i.e., soil or minimal vegetative cover)	82	(63.1)
	Permanent pasture	67	(51.5)
	Indoor pens	33	(25.4)
	Agriculture fields (e.g., orchards, vineyards, crop fields)	24	(18.5)
	Contact with forest or wetlands	14	(10.8)
	Contact with water surfaces (e.g., pond, creek, reservoir)	14	(10.8)
	Rotational/mobile housing (e.g., egg mobiles)	11	(8.5)
	Outdoor pens with solid ground (e.g., concrete, wood)	11	(8.5)
	Other	8	(6.2)
	No answer	67	-

^a Percentage values are rounded and may not total 100%.

^b Participants could select more than one option; therefore, percentages for the variable may exceed 100%.