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Research Article

Assessing Poultry Knowledge and Identifying the Needs of Small Flock Poultry on Tennessee Farms: A County-Based Survey

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Abstract

Background: A sustainable and profitable poultry operation is essential for backyard and small flock producers. **Objective:** This study was designed to identify areas of improvement for backyard and small-scale poultry operations in Tennessee. **Materials and Methods:** A survey was conducted with county agents and 4-H agents (>90 participants total) of Tennessee (TN) to assess backyard and small flock poultry production practices. Non-parametric test was applied where applicable to evaluate results. **Results:** The survey results indicated that balanced feeding and nutrition, bird health challenges, marketing of eggs and meat products and predation issues were the most identified needs. **Conclusion:** Educational outreach programs targeting backyard and small flock poultry producers emphasizing topics relevant to the identified needs will improve overall knowledge of their flock management skills for sustainable small flock poultry production practices.

Key words: Biosecurity, bird health, external anatomy, husbandry, management, poultry products

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INTRODUCTION

One of the rewarding experiences of owning chickens is the farm-to-table lifestyle. For example, an at-home flock can provide a source of fresh and high-quality poultry products and it is an excellent way to teach younger poultry enthusiasts, such as Head, Heart, Hands and Health (4-H) and Future Farmers of America (FFA) youth, about the agricultural industry and the responsibility of owning and caring for livestock. Recently and since the start of the COVID-19 pandemic, we have seen an increase in the number of novice farmers wanting to raise poultry for egg and meat supply. Today, even more than before the pandemic, global food security has become a significant issue and backyard poultry offers many families the opportunity to eat nutritious foods at a time when poultry products are more expensive than ever. It is worth noting that backyard poultry can be a valuable source of protein, especially in areas with limited food sources^{1,2}. Small-scale extensive scavenging, scavenging, semi-intensive and small-scale intensive poultry systems with approximately 20-200 birds are considered backyard poultry³. The terms "small-scale poultry" and "family poultry" are terms related to poultry production systems. A recent USDA report indicated that global imports of pork, poultry and beef increased by 117% from 2001-2021, particularly in developing and emerging markets where production is constrained⁴. This is due to rapid changes in human demography and eating habits, livestock production has increased substantially⁵. This highlights the need for more farmers with the knowledge and capability of livestock production.

Small-scale poultry production systems have been integrated with human livelihoods for thousands of years, enhancing diet, income, food and nutrition security for rural poor people⁶. There are largely chickens used in systems that rely on family labor and available feed resources and the systems can differ from country to country^{3,5}. Free-range poultry systems and crossbred species are common in these areas. Scavenging for feed and simple housing are provided for these birds. In high-income countries, most poultry and pig production is intensive, taking advantage of the high levels to maximize feed conversion ratios. In contrast, in low-income countries such as Bangladesh, Cambodia, India, Myanmar, or Nepal poultry and pigs are mostly raised by small holders under extensive conditions. It can be difficult to access veterinary services for livestock in certain regions of the world, especially in rural areas. Although, poultry flocks are small (60-90%), they cover many rural areas in Africa and Asia^{5,7}.

From the sale of birds and eggs, small-scale poultry production generates income. Proper backyard husbandry and nutritional knowledge are imperative when owning and operating a flock facility. Nutritional education, housing and predator protection education are essential management factors that ensure poultry's well-being and care. In addition, in order to ensure a sound biosecurity plan to prevent diseases, an operation such as small-scale poultry production requires a full commitment, having a proper feeding program for flock health and performance and managing essential husbandry duties. The advantages of backyard farming include poultry that survive harsh and inclement weather conditions, minimal initial investment, quality source animal protein with nutritional security and conservation of biodiversity⁸.

Through a needs assessment survey of county agents, this study aimed to identify areas of improvement for backyard and small-scale poultry operations in Tennessee, so that it provides baseline information for creating outreach educational activities to ensure efficient owning and management of small-scale poultry flocks.

MATERIALS AND METHODS

An online survey was introduced using a *Qualtrics XM* platform. The questionnaire was distributed to county agents and 4-H agents across Tennessee during the year 2022/23. Each response was anonymous upon completion. A total of >90 participants, identified based on their roles in Agricultural and Natural Resources (ANR), registered their answers in the survey and who were involved in some capacity with their small flock and backyard poultry clients. The respondents were asked about basic husbandry practices such as feeding management, anatomy, diseases and poultry breeds. In subjective questions, confidence of each individual was measured, with 0 having the least amount of confidence and 100 having the most confidence. For better understanding the needs of poultry clients across the state, they were surveyed about the type of enquiries they receive from clients in their counties. Furthermore, respondents were asked about future training needs in order to increase their poultry outreach roles for their clientele in terms of small-scale poultry production operations. Lastly, each response was sorted into a spreadsheet for further examination and analysis. A variety of non-parametric tests (Wilcoxon signed-rank test) were used to evaluate results so that top-ranked training needs could be better understood.

RESULTS AND DISCUSSION

Top identified needs: The results identified the top needs as feeding and nutrition, health challenges, marketing of poultry products (eggs and meat) and predation issues (Table 1). Only 17.1% of respondents answered positively when asked if backyard and small flock producers were trained on basic husbandry and management practices (Fig. 1). Only 29.79% said they could not train small flock owners and 53.19% said they could help in training but not assist through the entire process. This indicates that most county agents need more training in basic poultry-rearing husbandry practices, with the most critical areas being feeding and nutrition, health challenges, predation issues and marketing of farm produce. In 2004, the United States Department of Agriculture (USDA) conducted a large-scaled survey in the U.S. called the National Animal Health Monitoring System (NAHMS) Poultry '04 and it was designed to help meet the need of the nations' animal-health information. The nationwide assessment provided a way to examine information related to bird health, backyard flocks, biosecurity practices and live poultry markets. This study showed that better management practices are needed to ensure the proper maintenance of a flock and reduce the risk of diseases⁹.

Some identified 4-H based agent needs: It is imperative that 4-H agents understand the basics of poultry husbandry practices as they run county-based chick chain programs. A successful small flock poultry program requires several key elements, including necessary equipment, management practices and record-keeping. Similarly, the agents expressed a need to understand poultry processing and identify parts of poultry carcasses, such as the breast, thigh, drumstick and wing. They also felt the need to distinguish between commercial table egg layers and broilers based on physical characteristics. Reproduction is another integral aspect of

poultry production. It is possible to improve performance, quality and meat-to-carcass ratio through crossbreeding. The participants felt it was important to gain a better understanding of bird genetics and how it affects productivity as a whole.

External anatomy and performing necropsy: Respondents were asked about their knowledge of the chicken's external anatomy (Fig. 2). A total of 23.1% of the respondents indicated that they were unfamiliar with hackle feathers and 11% were unfamiliar with the shank of the bird. Hackle feathers are feathers that surround the neck of the bird. One will notice that some roosters' feathers will be longer and narrower than hens. The shank is the bottom part of the leg below the hock, just above the foot. The spur is what grows out of the shank. Most other parts of the bird can be easily identified and less

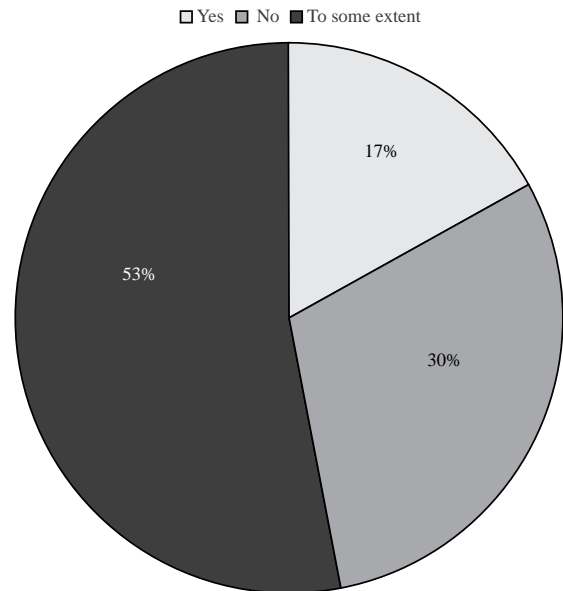


Fig. 1: Agents' ability to train small flock owners on record keeping and routine management practices

Table 1: Survey results (2022) of Extension Agents in TN on most requested topics (in %) they receive for each category (far-left column) from small flock producers¹

Topics	Percentage									
	1	2	3	4	5	6	7	8	9	10
Feed and nutrition	30.77	23.08	17.95	17.95	2.56	7.69	0	0	0	0
Health challenges	17.95	28.21	25.64	10.26	5.13	5.13	7.69	0	0	0
Litter management	2.56	0	5.13	7.69	15.38	5.13	17.95	12.58	15.38	17.95
Housing	7.69	17.95	12.82	30.77	7.69	12.82	2.56	5.13	2.56	0.00
Predation issues	12.82	17.95	12.82	10.26	12.82	12.82	12.82	2.56	2.56	2.56
Breed selection	2.56	2.56	5.13	7.69	30.77	23.08	12.82	5.13	7.69	2.56
Marketing of eggs and meat products	15.38	2.56	17.95	5.13	5.13	7.69	15.38	17.95	5.13	7.69
Hygienic processing	2.56	0	0	0	5.13	5.13	10.26	30.77	33.33	12.82
Ordinances	5.13	7.69	0	7.69	10.26	12.82	2.56	10.26	17.95	25.64
Incubation, hatching and brooding	2.56	0	2.56	2.56	5.13	7.69	17.95	15.38	15.38	30.77

²Ranked in order of most asked questions (1 being most asked and 10 being least asked category)

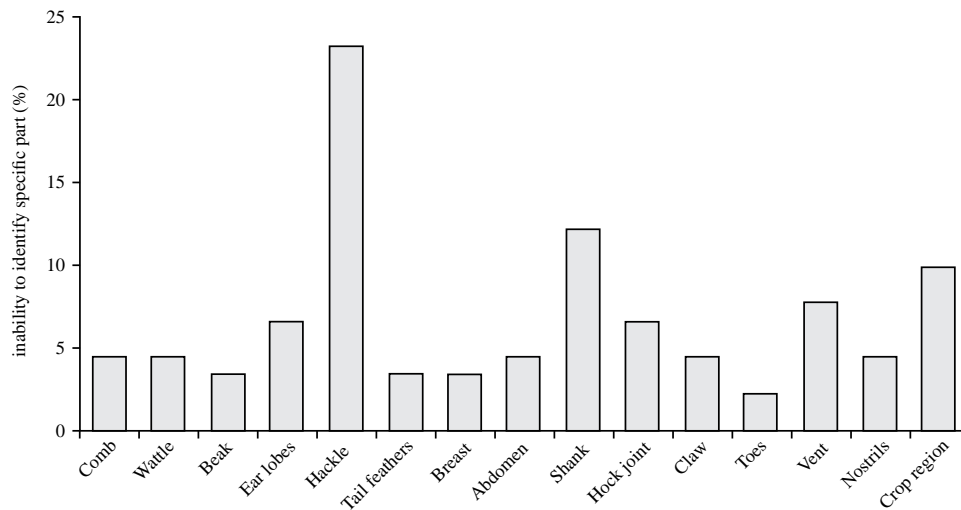


Fig. 2: Agents' ability to identify the external anatomy of a chicken

than 10% of agents indicated they needed more confidence in identifying certain parts such as the toes, comb and nostrils.

When asked about the ability to perform a necropsy on a bird (Fig. 3), 93.62% of respondents said they could not, while the remaining 6.38% said that they could. Necropsy is the term used for the autopsy of a chicken. In a backyard flock, a bird may fall ill and die due to several reasons. Necropsy is used to determine the cause of death or disease in the flock. If one is working with a veterinarian, they may ask the flock owner to perform a necropsy on the bird and/or send samples to a diagnostic lab for further analysis. Performing bird necropsies is also important for identifying trends in a flock, whether it is a higher mortality rate or the onset of illness, so that additional outcomes can be managed.

Knowledge of pathogens and important poultry diseases:

"Poultry in a Pandemic: Get the Facts in Keeping Backyard Flocks" Popa and Popa¹⁰ suggested that as of July 2020, salmonella outbreak strains have infected more than 938 people in 48 states, an increase of over 20% from 2019. In addition, poor husbandry and hygiene practices associated with backyard poultry ownership increase the risk of zoonotic disease transmission¹¹. Furthermore, according to the Centers for Disease Control and Prevention (CDC)¹², 74% of individuals who became ill in 2020 had some contact with backyard poultry.

Routes of transmission of *Salmonella* may involve direct contact with poultry, or indirect contact with contaminated surfaces such as eggs, bedding, structures, or the environment. It is possible for *Salmonella* to present as a subclinical infection that goes unnoticed. In 2014, results of a survey on *Salmonella* knowledge, attitudes and practices

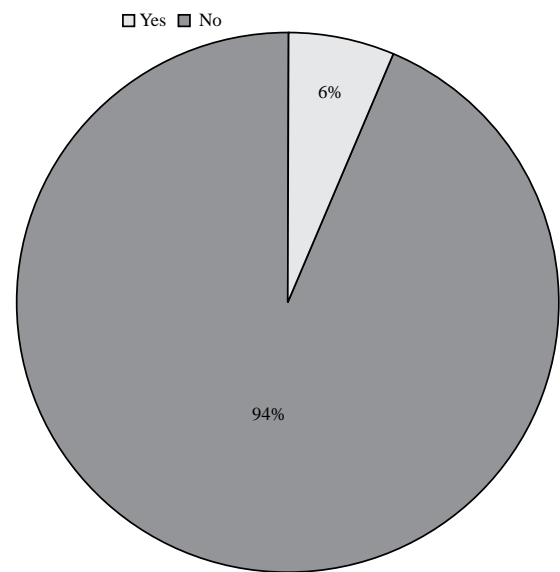


Fig. 3: Agents' ability to perform necropsy on birds

conducted in Seattle, Washington addressed the knowledge gap. The study focused on bird health, biosecurity, husbandry and hygiene practices within their small flock production. While some participants had some common knowledge of the risk of *Salmonella*; about 1 and 4 participants performed practices that could potentially increase zoonotic diseases. The findings were snuggling, eating and drinking and touching their face once handling the birds. The results of the study encouraged more education and outreach programs to help improve husbandry and hygiene care practices in a backyard setting¹¹. Additionally, in a study Elkhoraibi *et al.*¹³ examined

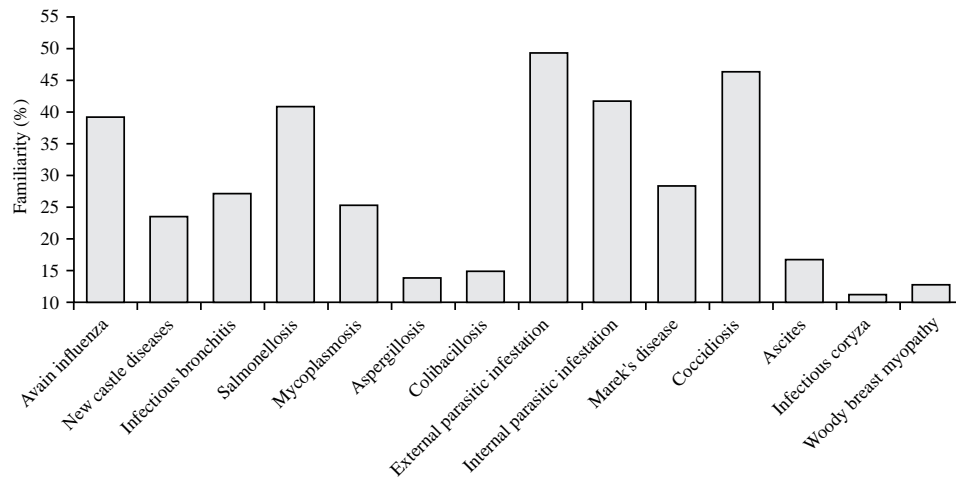


Fig. 4: Agents' familiarity with poultry diseases

the lack of knowledge of poultry diseases and zoonotic risks associated with small flock production focused on feed storage in California. There were 38 questions in the anonymous survey, using both an online survey platform and hard copy surveys and 242 responses were analyzed. According to the findings, there is a gap in knowledge between the use of antibiotics and access to veterinary oversight. This would help reduce the risk of flock disease. According to the study, backyard and small flock farmers can improve their husbandry practices with well-rounded services and to help reduce risk of potential disease in California and other states¹³.

Backyard farms can serve as sources and vectors of pathogens. The introduction of economically significant animal diseases must be prevented or controlled¹⁴. In 2002-2003, the Exotic Newcastle Disease outbreak originated in backyard poultry flocks and spread to approximately 1.2 million birds on commercial farms¹⁵. Newcastle Disease (NDV) is a global problem that presents itself primarily as an acute respiratory disease. The disease's severity depends on the host immunity, the type of virus and how much virus the bird is exposed to. There is a similarity between NDV and avian influenza (AI) in that chickens are highly susceptible, while ducks and geese can be infected without showing any clinical symptoms. The various strains of NDV are designated according to species serotype or the type of bird from which the virus was isolated, the geographical location of the isolation (state or country) and the reference number or name/year of the isolation. To date, there have been multiple strains isolated worldwide.

Another disease that has become more prevalent in recent years is avian influenza, commonly known as bird flu. About 39.2% of agents expressed familiarity with avian

influenza disease (Fig. 4). According to USDA-APHIS¹⁶, since the beginning of 2022, almost 59 million birds in 47 states have died or been euthanized due to exposure to avian influenza. Prior to this, the largest avian influenza outbreak was in 2014-2015, when 50.5 million birds in 21 states died or were euthanized. These viruses spread naturally among the wild aquatic bird population and can infect domestic birds and poultry. Birds such as waterfowl, storks and sandpipers are susceptible to these infections. According to the CDC¹⁷, dabbling ducks and other waterfowl are considered reservoirs or hosts for avian influenza type A viruses.

There are numerous subtypes of the influenza type A virus. There are two types of proteins that project from the surface of the virus. These are identified as Hemagglutinin (H) and Neuraminidase (N). There are 16 known types of H proteins and 9 known types of N proteins according to the CDC Influenza Type A Viruses¹⁸. Therefore, a wide variety of combinations of H and N proteins are available. The current outbreak in the U.S. is highly pathogenic H5N1.

The virus is also classified by two types of pathogenicity, its ability to cause disease in domestic poultry. Pathogenicity is classified as either low or high. Low pathogenic viruses rarely cause illnesses, whereas highly pathogenic viruses spread rapidly and cause high mortality in poultry in a short period. Influenza viruses in the H5 or H7 categories are of greatest concern for domestic poultry because they can mutate from low pathogenic to high pathogenic varieties.

This virus is very contagious among birds and can be localized in their intestines and respiratory tracts. The virus sheds through saliva, nasal secretions, feces and other contaminated surfaces, such as the environment they live in. To help slow down these viruses, one can wear personal protective equipment, avoid touching other surfaces after

touching or coming into contact with and handling birds, wash hands frequently and use dedicated or disposable clothing when working around poultry.

It is important that anyone involved with poultry production should review their premise biosecurity procedures and protocols regularly and stay vigilant to protect commercial poultry and hobby flock birds from this disease. The potential losses and costs associated with avian influenza outbreaks make it extremely important for the commercial producers and small poultry flock owners to protect their flocks against AI and other diseases by utilizing common biosecurity practices. An outbreak of avian influenza cannot be prevented by medicating or vaccinating. Therefore, our best tool for preventing disease entry into our flocks is biosecurity.

The knowledge of parasite infestation (~49% of respondents) and coccidiosis (~46% of respondents) has improved (Fig. 4). Due to its more common prevalence in other domestic animals, parasitic infestation (such as ear mites, lice, roundworms and other single-celled parasites) may be more familiar to humans.

Coccidiosis was the second most common disease and 46.09% of respondents were familiar with this disease. This disease lowers productivity and the overall welfare of the birds. Chicken coccidiosis is an enteric disease that impairs growth and suppresses the immune system resulting in high mortality which has been estimated to cost more than \$3 billion annually in the commercial poultry industry¹⁹. The genus *Eimeria* has seven known species to affect the intestinal tract of poultry. The species list is as follows: *E. tenella*, *E. maxima*, *E. mitis*, *E. acervulina*, *E. brunetti*, *E. praecox* and *E. necatrix*, with *E. tenella*, *E. necatrix* and *E. acervulina* causing most of the damage in domestic flocks²⁰. Transmission is through ingestion of the spore oocyst and can cause diarrhea, weight loss and a decrease in production. This disease can be rapid, with the birds showing signs in as little as 4-7 days. This disease can be controlled with anticoccidials, vaccinations, or a combination of both.

Figure 4 indicates that 14.92% of agents were unfamiliar with colibacillosis. A strain of *Escherichia coli* causes this infection. It is considered one of the most common bacterial poultry diseases worldwide¹⁵. Many cases of colibacillosis appear to be due to *E. coli* that have acquired several virulence genes clustered together in plasmid-borne pathogenicity islands (PAIs). Unfortunately, most bacterial isolates, such as *E. coli*, are resistant to multiple antibiotics and the good management practices are the best prevention.

Mycoplasmosis showed that 25.13% of respondents were familiar with this disease condition. This respiratory disease can cause a reduction in egg production and hatchability in

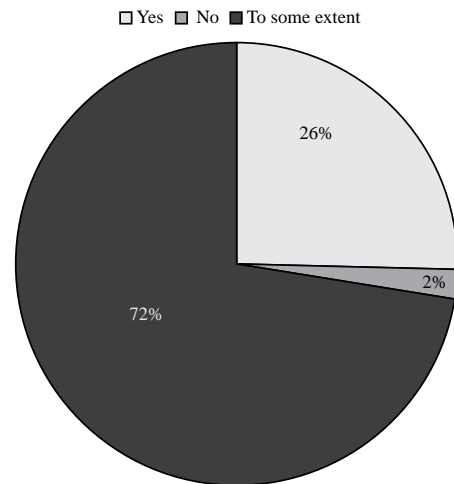


Fig. 5: Agents' familiarity with biosecurity measures at the farm

laying hens. This disease also affects turkeys, pigeons, ducks, geese and other avian species. In broiler chickens, one can see increased condemnation in the processing facility. However, it is not as noticeable in layers and breeder hens. The most common pathogenic strain is *M. gallisepticum* causing conjunctivitis in most bird species. Typically, the disease is transmitted through aerosol, contamination of feed and water, or vertically through contaminated eggs. We often see this disease more in turkeys than in chickens. Antibiotics may reduce some clinical signs but the best control measure is having a good biosecurity program and sourcing healthy chicks from the start.

Biosecurity: There are educational resources that provide information on biosecurity to optimize the flock. For example, the USDA has campaigns and programs to provide good biosecurity practices and resources to help prevent infectious diseases. These interventions ensure the flock's health, whether the operation is small or on a larger scale.

A total of 70% of respondents indicated that they have some form of knowledge on biosecurity measures that need to be practiced at the farm. For maintaining healthy flocks and keeping diseases completely out of the farm, one needs to be strictly practicing all the biosecurity measures. Therefore, it is essential that poultry producers become familiar with all biosecurity measures. The respondents indicated a lack of confidence in all biosecurity practices to be followed at the farm, with only 25% of respondents stating they are fully knowledgeable on this topic. According to the survey, farmers are aware of how to prevent the spread of disease-causing organisms in their flocks (Fig. 5). Biosecurity protocols should be familiar to contract poultry growers and they should

work closely with their company representatives to implement them²¹. In biosecurity, human transportation of microorganisms has been a major threat. Producers and growers should restrict human traffic throughout their farms to prevent infections and inspect flocks and housing daily to ensure flock health. Isolation, traffic flow and sanitation are key to keeping flocks safe.

To summarize, suitable nutrition and feeding are imperative for the flock health and optimal production. It is essential to understand the nutrient requirements (energy, proteins, lipids, vitamins and minerals) of birds specific to breed and bird age. While some backyard flock keepers could be comfortable mixing their own diets for their birds, this would require an in-depth understanding of feed ingredients and nutritional requirements that most flock keepers do not possess. For most flock keepers, it could be better to go to the feed store and purchase a complete balanced ration that has everything poultry requires in the correct amount in the feed. Even then, producers must know what type of feed they need based on their flock status and age (starter, grower, finisher, layer, etc.). A small flock poultry program requires attention to detail on management basics and a commitment to maintaining animal health and welfare.

The University of Tennessee, Knoxville and Tennessee State University have recently developed a collaboration between poultry specialists and county agents entitled the Master Backyard Poultry Producer Program to assist backyard flock keepers with critical knowledge areas. The program consists of a series of modules that may be taught in-person, online, or in combination and covers topics such as feeding management, biosecurity and disease recognition, flock environmental management and housing, predation control, National Poultry Improvement Plan (NPIP) certification, marketing, processing, *etc.* Local county agents are being trained by poultry specialists to ensure that clients sign up for the program through their local county extension offices and be trained by their local county agents in proper flock care and management.

CONCLUSION

Overall, the survey results indicated that Agriculture and Natural Resource (ANR) agents and 4-H agents require poultry training in various aspects of production to be able to efficiently address questions they get from the producers in their counties. Major identified need areas included balanced feeding and nutrition, bird health challenges, predation issues

and marketing of eggs and meat products. Outreach programs targeting backyard and small flock producers emphasizing topics of identified needs will help improve overall knowledge of agents' flock management skills for sustainable small flock poultry production practices. Extension agents are valuable resources that farmers and other clientele first go to with agricultural-related questions and serve as the first mentors to guide clientele on their production practices. If more agents can be equipped with knowledge on current research-based poultry production practices on the identified needs, then it is certain that more existing and novice farmers will greatly benefit from their local agents in the counties, making backyard poultry production a more sustainable practice.

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