



UNIVERSITY OF
MARYLAND
EXTENSION

Solutions in your community

MEP-300

Raising Your Home Chicken Flock

<http://www.healthybirds.umd.edu>



Table of Contents

| | |
|--|----|
| Why Have a Small Flock? | 3 |
| Before You Plan a Flock | 3 |
| What Kind of Chicken? | 3 |
| Housing Requirements | 4 |
| Rearing Poultry | 4 |
| Economics of Small Poultry Flock | 6 |
| Feeding the Flock | 8 |
| Biosecurity | 11 |
| Disease Management | 12 |
| Sanitation | 15 |
| Home Processing | 15 |
| Egg Laying and Handling | 15 |
| Maryland Regulations for Poultry Product Sales | 16 |
| Grading and Sizing Eggs | 17 |
| Exhibiting Poultry | 17 |
| Maryland Regulation for Registering Poultry | 17 |
| Conclusion | 18 |
| References | 18 |
| Suggested Reading | 19 |
| Publications on Other Species | 20 |

Raising Your Home Chicken Flock

A successful backyard flock requires sound animal care and management. Good animal care and management includes proper planning, careful management, a biosecurity (disease prevention) plan to control diseases, and a complete and balanced adequate feeding program. The United States Department of Agriculture reported that 7% of all U.S. households own a small flock, with an average size of approximately 49 birds. There are more than 138,000 small backyard flocks in the United States.

Why Have a Small Flock?

A small flock offers the convenience of having layers for fresh eggs or broilers for poultry meat right at home. Often, backyard flocks are a hobby or a learning experience for 4-H or FFA projects. Poultry can be exhibited at county and state fairs and poultry shows. There is also the pleasure of observing different shapes and colors in a backyard flock. Poultry may include chickens (large or small), bantams, geese, ducks, turkeys, game birds and guineas.

Before You Plan a Flock

Always begin with the end in mind. What is your goal? Have fresh eggs, pets, or meat? Teach your child the responsibility of caring for animals? Show birds? Or just enjoy watching and caring for poultry? Check with local, county, state and even federal zoning and environmental regulations as some may prohibit poultry flocks in the area. Zoning regulations are usually specific about animals and environmental considerations, such as flies, odor and noise. Check with your county Extension office or representatives of government agencies for information before planning a flock. Also consider the proximity of your neighbors and their opinions. Good neighbor relations are very important. Home flocks, no matter what the size, require water, food and daily care including weekends, vacations and holidays. The time and effort required for this care should be considered in weighing your desire for a home flock against other possible uses of your time and labor. Caring for a flock is a 24 hour, seven days a week commitment that begins with your first bird.

What Kind of Chicken?

There are three basic choices in the types of poultry to purchase; a breed primarily for egg production, a breed for showing or exhibiting, or one that is bred for meat production. Care and feed requirements will vary for each type of breed. Getting off to a good start is very important. You will want to purchase your chicks or chickens from a reputable hatchery or breeder. It is recommended to purchase chicks from hatcheries or breeders that participate in the National Poultry Improvement Plan (NPIP). A list of certified hatcheries and breeders can be found at www.healthybirds.umd.edu.

Egg production – White Leghorns are a very popular breed for laying white eggs. Rhode Island Reds and Buff Orpingtons are popular breeds that lay brown eggs. These breeds can lay approximately 200 eggs per year per hen. A rooster is not needed for the hen to produce eggs. Typically, chicken breeds with white ear lobes lay white eggs and chickens with red ear lobes lay brown eggs. These breeds of birds can be purchased as day old chicks or 18-22 week old pullets that are ready to lay eggs.

Meat production – Cornish Cross is a fast growing breed for meat. They can reach 4-5 pounds as a broiler in 6 weeks or 6-10 pounds in 8-12 weeks as a roaster size.

Exhibition/Showing – Chickens are judged depending on the characteristics of that particular breed. The American Poultry Association (APA) publishes *The American Standard of Perfection*. This book is the official breed standard for fancy (hobby) poultry in North America and it gives illustrations and descriptions of all accepted breeds of domestic poultry. Bantams are a small breed chicken, about ¼ the



size of large poultry, often exhibited by young 4-H members. This breed is easy to raise because it is small, and therefore eats less feed and requires minimal space.

Housing Requirements

Housing should provide protection from all kinds of weather, predators, injury, and theft. Consider the location of your poultry house on your property. Locate the building in a well drained area, with access to



water and electricity. Your job is to keep the birds comfortable at all times. The house should be tight, well ventilated and insulated. It is important to provide adjustable ventilation for adequate air movement in cold and hot weather. Permanent or temporary housing are two options to consider. A permanent house will remain in the same location on the property. Temporary or portable housing can be moved frequently throughout the property.

Temporary or portable housing is typically used when birds are raised on pasture. Pastured poultry includes raising chickens or other poultry on pasture rather than

raising them indoors. Typically, the birds are raised in bottomless pens directly on pasture and provided feed and water daily.

Depending on the breed of poultry, you may want to consider outside run areas. Outside run areas can be fenced with temporary or permanent fencing and overhead netting to protect the birds from predators. Bedding is material such as shavings or sawdust spread on the chicken house floor. The floor can be concrete, wooden, or dirt. Use a (½-inch) mesh hardware cloth over windows to keep out wild birds, rodents and varmints.

Birds need adequate space for movement, nesting and roost areas. Space requirements vary with type of bird (Table 1).

Table 1. Minimum Space Requirements of Various Bird Types (Clauer, 2009)

| <u>Type of bird</u> | <u>Sq ft/bird inside</u> | <u>Sq ft/bird outside runs</u> |
|---------------------|--------------------------|--------------------------------|
| Bantam Chickens | 1 | 4 |
| Laying Hens | 1.5 | 8 |
| Large Chickens | 2 | 10 |
| Quail | 1 | 4 |
| Pheasant | 5 | 25 |
| Ducks | 3 | 15 |
| Geese | 6 | 18 |

Rearing Poultry

Brooding

Newly hatched chicks need heat during the first few weeks of rearing. There are many types of chick brooders that can be adapted to a small flock. Standard hover brooders can be used for starting a flock of up to 1,000 chicks. The common infrared lamp is an inexpensive way to brood a small, 25-to-100 chick flock. The heat lamp should be at least 18 inches above the floor. In winter, make sure the room is insulated so heat lamps are effective in producing enough heat for the chicks. A two-lamp unit provides safety in case one burns out during cold weather. See Figure 1 for suggested arrangements.

Start brooding chicks at 90-95 degrees Fahrenheit (F) for the first week, reduce the temperature gradually by 5° F each week until the chicks are five weeks old and the house temperature is 70-75 degrees F. It is a good idea to hang a thermometer at chick level to monitor brood temperature. The behavior of the chicks is a better indicator of their comfort. If the chicks have loud, sharp chirps and they bunch near the heat source, they are cold. If they are panting and bunched in the corner away from the heat source, they are too warm.

A circular barrier called a brooder guard, usually 15 to 16 inches high and made of cardboard or other solid material, confines the chicks. This guard also reduces drafts of cold air, and keeps chicks near the heat source during the first seven to ten days.

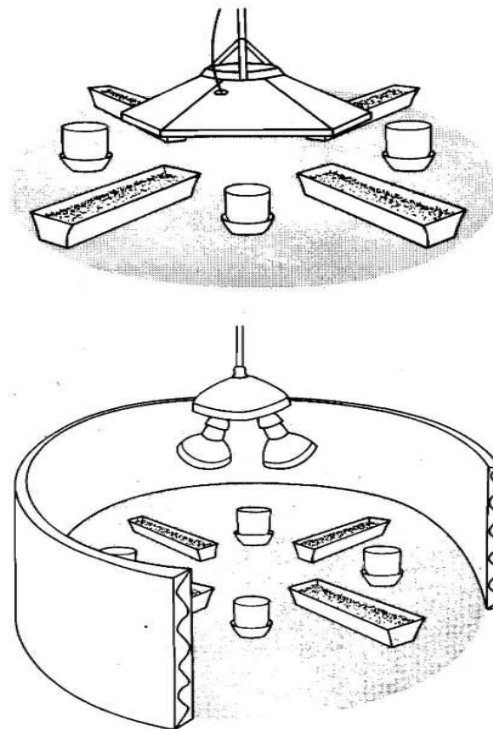


Figure 1. Suggested arrangements for brooders.

Feeders

Manufactured chick-feeder designs vary from the commercially used cardboard or plastic feeder lid to the metal trough type. Homemade boxes, egg flats and similar low, open designs are acceptable as long as the chicks have easy access to the feed, and feed waste is controlled. Provide enough space so that nearly all the chicks can eat at the same time. To avoid feed waste, gradually change chicks to regular tube or trough feeders so that open feeders can be removed when the chicks are 10 days old.

Hanging tube and trough feeders for all ages are available from farm supply dealers. Hanging tube feeders are adjustable and can be used for chickens from one week through adulthood. Trough feeders have a limited capacity for adjustment, which makes it necessary to use at least three different sizes of feeders during the growing cycle of the birds.

A feeder can be built from scrap lumber, but it is critical that it be designed to avoid feed waste. The feeder must have a grill or other device to keep chickens from roosting on it or scratching in it and a lip to keep the feed from being spilled out. It is also essential that the feeder be the correct height (the back height of the chickens). Allow 2-3 inches of feeder space per bird for a laying hen or a meat bird.

Waterers (Drinkers)

It is important that chicks have easy access to water at all times. Manufactured chick waterers (also called drinkers) are usually gallon or quart jars that screw onto special bases. Once filled, the waterers are inverted and the chicks drink out of the base. Another type of waterer is called a poultry fountain. The poultry fountain maintains a constant water level in the pan by a vacuum and the top is designed to

prevent roosting. A five gallon waterer can accommodate up to 75 hens. Height of waterers should be two inches shorter than the back height of the chickens. Allow 2-3 inches of drinker space per bird. Clean waterers and replenish with fresh water daily so chickens have access to clean water at all times.

Nests

Chickens kept for egg production should have access to nests at 19 to 20 weeks of age. Giving young pullets the opportunity to find nests one to two weeks before they start laying helps prevent them from developing the habit of laying on the floor. Nest boxes and roost areas should be placed 24 inches above the floor. One 10 inch x 10 inch nest box per four to five chickens will be adequate. Keep one to two inches of clean, dry nesting material (straw or pine shavings) in the nest. Make sure nesting areas are separate from the roosting area so birds don't roost in the nesting boxes. Nesting boxes will become very dirty if hens are roosting in the nesting boxes.

Roosts/Perches

The best way to understand a chicken is to remember that most birds roost in trees. Roosts or perches provide comfortable sleeping for hens. Roosts can be rods or tree branches at least two inches in diameter. Allow at least 6-7 inches of roost space per bird. Keep roosts higher than the nesting boxes. Hens will roost on the highest point in the house.

Waste/Litter Management

Dropping pits help with litter bedding and manure management; they catch a good portion of the bird's feces as well as water spillage. The dropping pit should be wire covered and at least 12 to 16 inches off the floor. Clean the dropping pit regularly, particularly if wet conditions develop and ensure a modest flow of air over bedding and manure to suppress the growth of bacteria such as *E. coli* and *Salmonella*.

Lighting

Artificial light benefits all types of poultry. Adequate lighting will maximize production of birds. One 25-watt incandescent bulb will light 40 square feet or one 40-watt incandescent bulb provides adequate light for 200 square feet of floor space. If the ceiling is painted white or a light reflector is used, the quality of light is enhanced. Proper artificial light during the fall and winter months will stimulate and maintain egg production in laying hens. A combination of natural and artificial light to give laying hens 14 hours of light is effective in maintaining egg production throughout the year. Usually broilers and roasters grow well with 24-hour light, but can be grown with only 8 to 10 hours, such as that provided by natural light. Installing an automatic timer is an inexpensive and easy to install tool to help adjust the amount of artificial light provided in the house.

Economics of Small Poultry Flocks

Whether you view your small poultry flock as a hobby or a significant contribution to the family diet, it is useful to estimate the costs of maintaining the flock. The following budgets for layer and broiler flocks (Tables 2 and 3, respectively) were developed by Dale Johnson, Farm Management Specialist for the University of Maryland Extension. They are based on his personal experience in raising layer and broiler flocks and in consultation with other producers. Small flock production is highly variable and good management is important for efficiency. Some producers will be much less efficient than what is reflected in these budgets while other producers will be more efficient. Following each of the budgets are a set of assumptions in which the budgets are based. These explanations will assist you in calculating your own numbers. You are encouraged to estimate your own budgets based on the number of laying hens or broilers that you are planning to raise. You should also consider your level of experience and your availability of inputs.

Table 2. Small Layer Flock Budget (2010) - 25 hens, 2 years production (1)

| | | | | |
|------------------------------------|-----------|--------|----------|-------------|
| Dozen eggs produced (2) | | | | 800 |
| Stewing hens | | | | 20 |
| | Unit | Amount | Price | Total |
| Cash expenses | | | | |
| Chicks (3) | per chick | 25 | \$ 2.00 | \$ 50.00 |
| Feed | | | | |
| Chick starter (4) | 50 lb bag | 3 | \$ 13.00 | \$ 39.00 |
| Early bird grower (4) | 50 lb bag | 5 | \$ 12.00 | \$ 60.00 |
| Layer feed (4) | 50 lb bag | 80 | \$ 11.00 | \$ 880.00 |
| Heat bulb (5) | bulb | 1 | \$ 7.00 | \$ 7.00 |
| Mileage to slaughter facility (6) | miles | 40 | \$ 0.50 | \$ 20.00 |
| Slaughter fee (7) | per bird | 20 | \$ 2.00 | \$ 40.00 |
| Total expenses | | | | \$ 1,096.00 |
| Total cash expense per dozen | | | | \$ 1.37 |
| Other required resources | | | | |
| Housing startup costs (8) | | | | \$ 750.00 |
| Feeder & waterer startup costs (9) | | | | \$ 75.00 |
| Labor hours (10) | Hr/day | 0.25 | 730 | 182.5 |
| Assumptions | | | | |

1. This budget is based on a two year lifespan. Some producers keep hens 3-4 years but egg production will diminish dramatically.
2. Production is calculated as 550 days x 25 hens x 70% egg yield. Out of two years, 180 days are required for raising chicks and molting. A 20% mortality over the life of the flock is factored into the egg yield. This egg yield also assumes supplementary lighting in the winter.
3. Chick prices are highly variable. Local hatcheries often have cheapest chicks. Make sure quality is good and chicks are vaccinated for Marek's disease.
4. Bagged feed from a reputable feed company. Also include crushed oyster shell to maintain calcium levels for layer hens. The feed conversion ratio in this budget is about five pounds of feed to one dozen eggs (50 lbs per week per 25 hens). Use good feeders to reduce waste.
5. Heat bulbs generally last one flock. Careful handling may extend life.
6. Many backyard producers prefer to have birds slaughtered by someone else. If this is your desire, then make sure there is a facility within reasonable distance.
7. Twenty stewing hens based on 20% mortality over life of flock.
8. Housing expenses are highly variable. This budget includes a chicken coop (\$500) and poly wire netting electric fence (\$250). Both will last several years.
9. Feeders and waterers, an estimated cost of \$75, will last several years.
10. Fifteen minutes a day to take care of flock. This includes feeding, and collecting and washing eggs. It is obvious that valuing labor would keep most small flock producers from raising layers if they were doing it for economic reasons.

Table 3. Small Cornish Cross Broiler Flock Budget (2010) - 50 birds, 10% mortality (1)

| Dressed lbs produced (2) | | 7 lbs /bird | 45 birds | 315 |
|-------------------------------------|-----------|-------------|----------|-----------|
| | Unit | Amount | Price | Total |
| Cash expenses | | | | |
| Chicks (3) | per chick | 50 | \$ 1.00 | \$ 50.00 |
| Feed | | | | |
| Chick starter (4) | 50 lb bag | 3 | \$ 13.00 | \$ 39.00 |
| Early bird grower (4) | 50 lb bag | 4 | \$ 12.00 | \$ 48.00 |
| Bird finisher (4) | 50 lb bag | 5 | \$ 11.00 | \$ 55.00 |
| Heat bulb (5) | bulb | 1 | \$ 7.00 | \$ 7.00 |
| Mileage to slaughter facility (6) | miles | 40 | \$ 0.50 | \$ 20.00 |
| Slaughter fee (7) | per bird | 45 | \$ 2.00 | \$ 90.00 |
| Total expenses | | | | \$ 309.00 |
| Total cash expense per pound | | | | \$ 0.98 |
| Other required resources | | | | |
| Housing startup costs (8) | | | | \$ 200.00 |
| Feeder & waterer start up costs (9) | | | | \$ 75.00 |
| Labor hours (10) | Hr/day | 0.3 | 70 | 21 |

Assumptions

1. Many backyard producers experience up to 10% mortality or higher; however, good management may reduce the mortality rate.
2. This budget assumes it takes 10 weeks to grow straight-run (male and female mixed) birds to an average weight of seven pounds dressed weight. Slaughtering at lighter weights will require less time and feed.
3. Chick prices are highly variable. Local hatcheries often have the cheapest chicks. Make sure quality is good and that chicks are vaccinated for Marek's disease.
4. Bagged feed from reputable feed company. The feed conversion ratio in this budget is about two pounds of feed to one pound dressed weight. This is assuming that birds are on pasture for about six weeks and receive 10%-20% of their diet requirements from pasture.
5. Heat bulbs generally last one flock. Careful handling may extend life.
6. Most backyard producers prefer to have birds slaughtered by someone else. If this is your desire, then make sure there is a facility within reasonable distance.
7. Whole birds bagged in loose plastic bags. Vacuum bags will cost \$0.50 - \$0.75 more per bird.
8. Housing expenses are highly variable. This budget includes a pasture coop which cost \$200 to build (not including labor) and will last several years.
9. Feeders and waterers, an estimated cost of \$75, will last several years.
10. Fifteen to twenty minutes a day to take care of flock. This includes moving pasture coop twice a day. It is obvious that valuing labor would keep most small flock producers from raising broilers if they were doing it for economic reasons.

Feeding the Flock

Feed represents about 70 percent of the cost of raising a chicken. Commercial poultry farms use bulk feed programs in which a single delivery of 12 to 30 tons of commercial poultry feed is common. Such high-volume handling results in a relatively low cost per pound of feed and explains why supermarket prices for poultry products are also relatively low. The small flock owner deals in smaller quantities of feed – typically 50 to 100 pounds– and thus pays a higher cost per unit for feed.

Chickens must be fed an adequate diet for maximum productivity. There are six categories of nutrients that are required in a diet to maintain and promote a healthy flock. These nutrients include water, carbohydrates, fat, protein, vitamins and minerals.

Birds of different ages and function have specific nutrient requirements, which are met by mixing together different feed ingredients. Formulating and mixing poultry feed is a complex process that ensures a diet contains all of the nutrients required by the bird. Specialized software programs are usually required to formulate a poultry ration. Therefore, it is recommended feeding a high quality commercial feed which can be purchased from most local farm stores. Veterinarians in poultry diagnostic laboratories note that nutritional deficiency diseases such as curly toe paralysis, nutritional coryza and rickets were ordinarily seen only with poultry being fed homemade (non-commercial) rations.

Commercial poultry feeds contain numerous similar feed ingredients and several types of rations are available (for example: starter, grower, finisher, and layer rations). Different types of rations are formulated to meet the specific requirement of different types of birds. It is important to choose the right ration for the type (pullet, layer, or broiler) and age of bird being fed. Do not feed layer rations to younger birds or starter/grower rations to birds producing eggs. If a young chicken is fed a layer diet, the calcium level is so high that the chick will experience improper bone formation, kidney failure, and possibly death. In contrast, feeding a broiler starter diet to a laying hen will result in poor egg shell quality. Problems associated with inadequate nutrition can occur quickly in the growing bird and often these problems are irreversible. What you think you may be saving in feed may cost you in bird performance. Table 4 outlines typical feeding programs for chickens of different ages and function. Use Table 4 only as a guide.

Feeding scratch grains to chickens is not necessary when they are receiving a complete diet. Scratch grains typically are cracked, rolled or whole grains such as corn, barley, oats or wheat which are low in protein and high in energy or fiber depending on which grains are used. When scratch grains are fed in conjunction with a complete diet they dilute the nutrient content of the prepared diet. Therefore, if you decide to feed scratch grains to your birds it should be provided sparingly. Generally scratch grain should be about 10% of the birds total daily food consumption. An insoluble grit should be provided when feeding scratch grain so the birds can grind and digest the grains properly. If the birds have access to the ground, they usually can find enough grit in the form of small rocks and stones.

Birds grazing on pasture can attain a portion of their nutrient requirement from grasses and insects. It is estimated that chickens can obtain 5 to 20% of their feed requirements by grazing. Nutrition obtained from pasture depends on the forage quality of the pasture and chicken breed.

Laying hens require large amounts of calcium for egg shell development. Diets formulated for layers should contain all of the calcium required by the hen. An extra source of calcium can be offered free choice in the form of ground oyster shell, calcite, or limestone.

Commercial poultry feed is available in mash, crumble and pellet form. Processing feed into pellet or crumble form increases the cost over the mash form. However, there are some advantages to feeding pellets or crumbles. Since feed is packaged in pellet form, the bird is able to consume and metabolize a greater amount of feed. Feed in pellet form is a complete unit of feed and birds cannot pick out individual feed ingredients. Pelleting feed can also improve handling quality and reduce feed wastage.

Regardless of what form of feed you decide to feed your birds, it is important to handle it properly to maintain its nutritive value. Nutrients in feed are broken down during extended holding times. Also store feed in a clean, dry, rodent free area. Do not store feed bags on a concrete floor because feed picks up moisture from the concrete. It is recommended to store feed bags in covered plastic trash cans or on wooden pallets so air can circulate under the bags.

Typically, feed is available as medicated and non-medicated. Medicated feed usually contains a coccidiosis preventive drug. Birds can become infected with an intestinal parasite called coccidia. A coccidiostat is typically added to diets of chickens raised on the ground. Many coccidiostats need to be withdrawn from the feed for several days before the birds can be marketed. Always read the feed label to ensure the proper withdrawal time.

In most cases, birds should have continued access to feed so that they are provided with the proper level of nutrients at all times. Vest and Dale (2002) reported estimates of feed consumption for layers and meat birds at different phases of production (Table 5).

Table 4. Typical feeding programs^a

| Layer | Layer Replacement^b | Broiler^b | Roaster^b |
|--|--|---|---|
| <p>20 weeks-production cycle, <i>Laying mash</i></p> <p>May be fed all mash or mash-grain method.</p> <p>Free choice: Calcium (oyster shell or limestone) may be fed for good egg shell quality. Soluble grit may be fed if whole grain is used.</p> | <p>0-6 weeks, <i>Starter</i> (mash form)</p> <p>6-13 weeks, <i>Grower or Pullet developer</i> (15% protein)</p> <p>13-20 weeks, <i>Developer</i></p> | <p>0-3 weeks, <i>Starter</i> (mash form)</p> <p>3-6 weeks, <i>Finisher</i> (mash or crumbles)</p> <p>6 weeks-market, <i>Withdrawal</i> (mash or crumbles)</p> | <p>Same as broiler to 7 weeks of age.</p> <p>Broiler Finisher and corn or whole grains until 2 weeks prior to market</p> <p>Insoluble grit may be fed if whole grain is used.</p> |

^aThis schedule should be used as a guide only.

^bA suitable coccidiostat must be included in feed for young chickens (see poultry disease section). Read the feed tag or make sure your feed store provides a Starter or Grower with a coccidiostat.

Table 5. Amount and type of feed required for one chicken by age and purpose (Vest and Dale, 2002)

| Layers (Brown egg type) | | |
|--|-----------------------------------|--------------------|
| Age | Total amount of feed (lbs) | Ration type |
| Day old to 6 weeks | 4 | Starter |
| 7 weeks to 18 weeks | 46 | Grower |
| 19 weeks to 70 weeks (onset of lay to termination) | 104 | Layer |
| Layers (White egg type) | | |
| Age | Total amount of feed (lbs) | Ration type |
| Day old to 6 weeks | 3 | Starter |
| 7 weeks to 18 weeks | 12 | Grower |
| 19 weeks to 70 weeks (onset of lay to termination) | 80 | Layer |
| Meat Birds | | |
| Age | Total amount of feed (lbs) | Ration type |
| Day old to 3 weeks | 2 | Starter |
| 4 weeks to 7 weeks | 7 | Finisher |

Biosecurity

Biosecurity includes management practices that prevent the entrance of disease-producing germs (pathogens) into the flock and into neighboring flocks. There are several biosecurity measures that must be taken: 1) purchase healthy stock; 2) keep your birds confined using pasture coops or fencing; 3) keep dirty equipment and materials from other flocks away from yours; 4) do not mix species of birds; 5) medicate properly and follow directions; 6) keep unfamiliar people and others who might be carriers of disease away from your birds; 7) control vermin, such as rats and mice; 8) practice an insect-control program; 9) keep pen areas weed and debris free and keep buildings in good repair; 10) keep new birds, sick birds, and birds returning from shows and swap meets isolated from the rest of the flock; 11) wear dedicated clothing and footwear only around your birds – do not wear dedicated clothing off your property; and 12) wash hands before and after handling birds. Rely on professionals such as veterinarians, Extension educators, animal health suppliers (those who sell vaccines and medicines) and universities, for educational materials and help.



Pathogens have many hiding places and numerous ways of spreading from flock to flock. Table 6 provides a few examples of their pervasiveness and persistency. Management strategies that block these pathogens include: isolation from other types of wild or domestic mammals or birds, confinement in secure houses, and rules you make and enforce to keep potentially contaminated items from other flocks away from your birds. Footwear and clothing, farm equipment, or anything that may have been in contact with someone else's birds can be considered "potentially contaminated." Remember, good biosecurity not only protects your own birds, it also helps to protect the birds---and in some cases the income---of others.

Disease Management

It is important to consider several factors that relate to the quality and health of the flock once the type or breed has been chosen. Purchase stock only from reputable breeders or hatcheries. Stock purchased from magazine advertisements, especially bargain offers, can mean serious problems later. Stock should be purchased from Pullorum-Typhoid clean flocks under the National Poultry Improvement Plan (NPIP). Pullorum and Typhoid are highly contagious diseases caused by *Salmonella*. NPIP breeders, hatcheries and facilities have been checked for proper management and sanitation, and the presence of seriously diseased birds. "Sources of Poultry and Supplies for Small Flocks", published by the University of Maryland Extension, provides a partial listing of poultry, eggs, and chicks for sale and can be obtained free from your county Extension office or online at <http://www.healthybirds.umd.edu/BasicMangement/index.cfm>.

Table 6: Examples of places pathogens hide and ways they spread to your flock

| <u>Hiding places/Ways of spread</u> | <u>Diseases produced</u> |
|--|---|
| Free-flying migratory birds and waterfowl | Avian influenza (bird flu) Chlamydiosis (ornithosis) |
| Wild or domestic mammals (e.g., raccoons, cattle, etc.) | Pasteurellosis (fowl cholera) |
| Soil and pasture land | Avian tuberculosis |
| Rodent droppings | Salmonellosis |
| Mosquitoes | Encephalitis in pheasants and other game birds |
| Puddles or pools of muddy water | Botulism, especially in waterfowl and game birds |
| Earthworms | Gapeworm, cecal worm infestations and histomoniasis |
| Crates and boxes previously holding poultry | Laryngotracheitis, Newcastle disease and most other avian respiratory infections |

Diseases



Because of the similarity of many diseases, diagnosis should be left to a professional veterinarian. With an accurate diagnosis, proper treatment can be given to the flock. Maryland Department of Agriculture Animal Health Diagnostic laboratories (see Table 7) offer free diagnostic services for poultry. When there is an outbreak in the flock, take one or two birds showing typical signs to the lab. When the diagnosis has been made, treat the disease under the direction of a veterinarian or with the advice of your county Extension educator.

Table 7. Maryland Department of Agriculture Animal Health Diagnostic Laboratories

| Laboratory | Address | Phone Number |
|------------------|---|----------------|
| Frederick County | 1840 Rosemont Avenue Frederick, MD 21702 AHFrederick@mda.state.md.us | (301) 600-1548 |
| Wicomico County | 27722 Nanticoke Road Salisbury, MD 21801 AHSalisbury@mda.state.md.us | (410) 543-6610 |

Respiratory diseases. Respiratory diseases affect the respiratory tract and are the most common diseases in chickens. Table 8 shows some of the common respiratory diseases; most can be prevented by good biosecurity backed up with vaccination.



Figure 2. A chicken infected with Mycoplasma

Table 8. Common respiratory diseases

| Disease | Symptoms |
|-----------------------|--|
| Infectious bronchitis | Rapid spread, gasping, wet eyes, coughing, swollen sinuses, drop in egg production, misshapen eggs, rough- or soft-shelled eggs, watery egg whites, death |
| Newcastle disease | Rapid spread, gasping, rattling, loss of appetite, coughing, huddling, paralysis of legs, twisted neck (stargazer), walking backward, drop in egg production, soft or misshapen eggs, death |
| Laryngotracheitis | Slow spread, conjunctivitis (eye inflammation), coughing, sneezing, sitting hunched on floor, emitting a cawing sound, coughing bloody mucus, nasal discharge, swollen head and wattles, drop in egg production, death |
| Fowl pox | Skin – white to yellow bumps on comb, face or wattles, turning to scabs Internal – cankers in membranes of mouth, throat and windpipe; difficult breathing; nasal or eye discharge |
| Coryza | Thick nasal discharge with odor, swollen sinuses, ruffled feathers, difficult breathing |
| Mycoplasma | Difficult breathing, ruffled feathers, nasal discharge, rattling, facial and nasal swelling, weakness, drop in egg production, swollen joints, yellowish feces (Figure 2) |
| Cholera | Droopiness; difficult breathing; loss of flesh; drop in egg production; purplish swollen head, comb and wattles; paralysis |

Highly pathogenic transmissible diseases, such as Exotic Newcastle and Avian Influenza, can be avoided with proper management and biosecurity measures.

Marek's disease. Marek's disease is one of the most common killers of chickens of all ages. Marek's disease is caused by a Herpes virus that often accumulates in the feather follicles and spreads by aerosol through infected dander (sloughed skin and feather cells).

Another tumor-causing disease of chickens, similar to Marek's disease, is Lymphoid Leukosis which is caused by a Retrovirus. Common poultry publications often use the terms Marek's and Leukosis to refer to the same disease but they are actually different diseases that cause similar signs and lesions. Birds with Marek's show various forms of the disease.

Visceral Marek's results in tumors on the liver and other organs; the bird becomes thin and eventually dies. The neural (nervous system) form of Marek's results in progressive paralysis of the wings, legs and neck. An enlarged sciatic nerve (a nerve found in the inner part of the thigh) is a common cause of paralysis, with the bird eventually lying on its side unable to move.

Gray eye is another form of Marek's, in which the iris shrinks, the eye turns gray and the bird goes blind. Fortunately, a vaccine for Marek's disease is available and most poultry suppliers sell chickens that are already vaccinated for the disease.

Coccidiosis. Coccidiosis is the single most common cause of death in young birds. It is caused by single-celled protozoan parasite that attacks different parts of the intestinal tract, causing an irritation of the lining that prevents the absorption of food. In minor outbreaks, the birds are droopy, have ruffled feathers and lose weight. Egg production in older birds declines. Severe cases result in hemorrhage and death. Practically all poultry house litter contains coccidia; it is important to keep litter dry and to purchase feed that contains a coccidiostat for young birds.

External parasites. External parasites cause losses if proper prevention and treatment procedures are not followed. Chickens should be checked once a week for signs, as shown in Table 9. Consult with your county Extension agent for procedures and chemicals for prevention and control. Follow directions on packages of chemicals for treatment and control.

Internal parasites. Internal parasites are worms found in the digestive and respiratory tracts. Often insects, such as beetles, act as the intermediate host. Insects carry the worm eggs, which are deposited in the chicken after the chicken eats the insect. Common internal parasites are listed in Table 10. Chemicals for the prevention and treatment of internal parasites should be administered under the direction of a competent authority.

Table 9. Common external parasites

| External parasite | Symptoms |
|-------------------|---|
| Chiggers | Red, pimple-like irritations |
| Lice | Large, yellowish, transparent insects on the skin; low weight; blackish discoloration (dirty) in the vent and tail area; drop in egg production |
| Mites | |
| Red (roost) | Loss of weight, red specks, death |
| Northern fowl | Red or black specks around vent, unthrifty, drop in egg production |
| Feather | Loss of feathers, web irregular with only shafts left in some cases |
| Scaly leg | Enlarged shanks and toes with raised, crusty scales |

Table 10. Common internal parasites

| Internal parasites | Symptoms |
|--------------------|---|
| Large roundworm | Long, yellow-white worms in intestine; droopiness; weight loss; diarrhea; death |
| Capillary worm | Hair-like worms in crop and upper intestine, droopiness, weight loss, death |
| Cecal worm | Short worms in the ceca, unthrifty, weak, loss of flesh |
| Tapeworm | Long, white, flat, segmented worms in intestine; unthrifty; slow growth; weakness |
| Gapeworm | Red, forked worms in trachea; gasping; coughing |

Other diseases. Other diseases are not as common and require a professional diagnosis. Moldy feed causes mycotoxins which may result in production losses and flock mortality. Chickens can also develop nutritional deficiencies if they are not given a well-balanced diet.

Sanitation

Lack of cleanliness is often a precursor to poultry disease. There are several sanitation measures that should be taken in a home chicken flock: 1) complete cleaning and disinfecting of house and equipment before starting chicks or housing layers; 2) daily cleaning of waterers; 3) screened manure pits under roosts, feeders and waterers; 4) managing litter to keep it dry and clean; 5) burying or composting all dead chickens; 6) raising young stock away from adult chickens; 7) isolating the flock from outside traffic (chickens raised off the farm, neighbors, birds, dogs, etc.); 8) practicing good housekeeping and rodent control; and 9) disposing of litter and manure by spreading and plowing or spading the manure under soil. Manure and litter should be spread and stored in areas not used by poultry.

Poultry manure can provide an excellent source of plant nutrients for your garden. Due to the danger of infection, poultry manure should always be well composted before adding to your garden. Never add any type of raw manure to your vegetable garden. Please refer to the on-farm composting publication listed in the References section of the bulletin for complete details.

Properly managing any mortality from your chicken flock will prevent the spread of disease. There are several options that are available for managing the disposal of dead chickens. Composting is one option to consider. Composting animal carcasses is identical to the process occurring in the composting of any other organic material. However, composting may not be a viable option when there is very little mortality. University of Maryland Extension Fact Sheet 717 by Brodie and Carr provides complete details about composting animal mortalities (<http://extension.umd.edu/publications/PDFs/FS717.pdf>). Burial may be another option of dead bird disposal; however, it may not be permitted in certain locations due to groundwater levels. It is recommended to check with your county before disposing of any dead birds by burial. There are also dead animal removal services available in Maryland that will dispose of dead birds for a fee.

Home Processing

The quality of ready-to-cook chicken is only as good as the live bird. When choosing chickens to be processed; look for healthy, well-finished chickens. Consider the weight and age that are desirable for your particular need. It is also recommended to withhold feed for 9-12 hours before processing to limit fecal contamination from the gut.

For good flavor, it is essential that the chicken be well bled. One of the best methods of killing and bleeding is to cut the jugular vein (on each side of the neck). During the process, the chicken should be hung by the feet so that it will not bump other objects and bruise the meat or be soiled.

Immersing the chicken in hot water so that the feathers are easily removed is called scalding. Scald water should be between 130 and 160 degrees F. Scald for approximately 1 ½ minutes for adequate feather removal. A large pot with a propane burner works well for scalding.

Remove the head, feet and viscera. Wash the chicken thoroughly in clean water and chill promptly to below 40 degrees F.

Egg Laying and Handling

Eggs are considered by many to be perfect nutrition in a perfect package. Traditional egg laying breeds like Leghorns and Rhode Island Reds typically start laying at around 4-5 months of age. Some breeds may not start laying until 8-12 months. Hens produce about one egg a day on average.

A hen will lay eggs regardless of whether or not you have a rooster. Fertilized or unfertilized eggs are both excellent for table use. Sometimes, a small blood spot may appear in the yolk; this spot is due to a rupture during ovulation and makes no difference in the taste of the egg. Occasionally, a hen may lay a double yolk egg. Although most eggs available in the grocery store are white, egg color is determined by breed and diet and may be brown or many other colors. The color of the egg has no effect on its taste or nutritional value.

Clean nesting boxes should be provided to encourage hens to lay. Nesting boxes should be approximately 10 x 10 x 10 inches square and are usually located up off the floor. Wood shavings and/or

straw make good nesting material. Hens that do not use the laying boxes can be trained to do so by gently placing them in a nesting box and promptly picking up any eggs that they lay elsewhere.

The egg shell is semi-permeable. Air enters the egg and moisture evaporates. Eggs should be cleaned gently with a damp cloth, and refrigerated. Since water can enter through the egg shell, do not immerse in water to clean. The risk of infection from eating eggs is low, but susceptible individuals should only eat hard cooked eggs.

Maryland Regulations for Poultry Product Sales

Poultry Meat

(Meat requirements provided are for less than 20,000 birds.)

State or federal inspection is not required if you are producing and processing less than 20,000 birds for meat annually and do not sell other than directly from the farm. You must register any poultry premises with the Maryland Department of Agriculture (MDA) as part of their avian influenza control efforts. There are no fees for registering your premises unless you have laying hens in excess of 3,000 birds.

MDA now has a Rabbit and Poultry On-Farm Slaughter/Processing Program. Producers who participate in this voluntary program will be certified to sell anywhere intrastate (restaurants, retailers, farmer's markets). Both parts and whole poultry and rabbits certified by this program are allowed to be sold; however, ground meat is not permitted to be sold. For complete details on this program go to http://www.mda.state.md.us/feed-food_safety-grading/food_qual_assur/poultry_rabbit/index.php or call the MDA at 410-841-5769.

You will need to process the birds in a clean environment and in a clean manner so that no feces or contaminants are visible on the final product. The presence of feces or other contaminants would constitute an adulterant and would, therefore, subject your farm to scrutiny by the United States Department of Agriculture (USDA), Food Safety Inspection Service, or the MDA. Packaging can be as simple as a clear plastic freezer bag. If you process less than 1,000 birds annually, the packaging must contain a label with the name and address of the seller, contents, and net weight. If you process more than 1,000 but less than 20,000 annually, you must also put the statement "Exempt-P.L.-492." Once processed, the carcasses must be held at a temperature of less than 40 degrees F until sold. In Maryland, you may sell your products from your property, but you **may not** sell at a farmer's market location or any other location off the farm unless you have been certified by MDA's Rabbit and Poultry On-Farm Slaughter/Processing Program. Be aware that carcasses must be kept at or below 40 degrees F until purchase by the consumer. Alternatively, be sure you have your clientele already committed to purchasing your poultry before beginning to raise birds (this is where a down payment and contract comes in handy).

Eggs

(Egg requirements provided are for less than 3,000 laying hens.)

In the state of Maryland, all eggs must be graded and sized if they are for sale. The sale of unclassified eggs is not permitted. If you package your eggs in used cartons collected from friends and neighbors, you must be sure to do the following:

1. Completely mark out the USDA grade shield.
2. Completely mark out logos such as PA certified, UEP certified, MEQAP, PEQAP, etc.
3. Completely mark out the packer or distributor's information.
4. Completely mark out sell by date.
5. Completely mark out any claims made by the original producer, unless you can substantiate your eggs meet the claims (ex. Omega Three).



You may accomplish all of this by marking with a large black marker found at most drug stores, grocery stores, or office supply stores. Be sure to label the egg carton with your name, address, and telephone number. You will also need to label your carton with the Lot number (#). The lot number (#) corresponds to your flock number. For most small flocks this is the same flock they have always had and therefore should be labeled as Lot #1. Additionally, you will need to write the egg registration number on the carton

(you will receive this number when you register with the MDA to sell eggs). Remember, it is free to get an egg registration number if you have less than 3,000 birds. Once you have 3,000 birds, you will pay a \$30.00 per year registration fee and \$.08 per 30 dozen sold assessment fee.

If you plan on transporting and storing your eggs, be sure to keep the eggs at or below 45 degrees F until sold to the customer. That means you should hold your eggs in a refrigerator or cooler with ice packs. Warning, in a cooler, ice will melt and cause regular cardboard egg cartons to become soggy. This water can also contaminate the eggs so the practice is prohibited by the MDA. This is undesirable and all efforts should be made to prevent this occurrence. Keep a small thermometer in the cooler with your eggs as evidence that the correct temperature is being maintained. You must register to sell eggs by contacting the MDA, and by registering a layer flock to sell eggs you are also automatically registered in MDA's mandatory poultry premise registration.

Grading and Sizing of Eggs

Be sure to mark your label on each carton of eggs with both the grade and size once you have determined each. Egg sizes are determined based upon the weight (ounces) of a dozen. It is recommended to weigh your dozen using a simple kitchen scale or egg scale before placing into the carton. This provides the true weight of the dozen without adding the weight of the carton. The grade of eggs (from best to worst), AA, A, and B is based on compliance with quality tolerances. Eggs labeled Grade A must be fresh, clean, no bloodspots, and unbroken. At retail sale, at least 82% of the eggs in a carton labeled Grade A must meet the A quality standard or better. The sale of restricted eggs (cracks and dirties), unclassified eggs, and eggs labeled Grade B to consumers in Maryland is prohibited. To determine the quality of an egg, the eggs must be examined for both external and internal defects.

External Defects

You will need to downgrade eggs that have slight stains, localized moderate stains less than 1/32 of the shell or scattered moderate stains that are less than 1/16 of the shell to a B quality. Localized moderate stains covering more than 1/32 of the shell, scattered moderate stains covering more than 1/16 of the shell, prominent stains, and any kind of adhering dirt (yolk, manure, etc.) are considered dirty. Thin spots in the shell or irregular texture, ridges, and shape all should be considered before deciding the quality of an egg. In general, if the shell defect weakens the egg or makes it not fit into the carton cell, it should be downgraded to a B quality. Eggs labeled Grade A cannot have more than 18% B quality shells (if they have other defects the amount of B quality shells allowed would be reduced because they still have to be a minimum of 82% A quality or better). Be sure to lightly wash your eggs before packaging to remove any adhering dirt, feathers, or shavings. Stains may be buffed out under running hot water that is at least as warm as the egg (perhaps with a little food grade soap in the sponge - see www.nsf.org/usda for soaps and sanitizers approved for use on food). Dirty eggs that have been cleaned should be sanitized by spraying with hot water containing 100 part per million of chlorine. The size and intensity of any remaining stains should be considered before packaging.

At the time of publication these regulations were current. It is recommended to visit MDAs website (<http://www.mda.state.md.us/>) for updated or revised regulations.

Exhibiting Poultry

Many small flock owners like to exhibit their birds at county fairs or in poultry shows. Purebred birds are shown by breed or class as identified in the American Poultry Association (APA) Standards of Perfection which lists the classes and descriptions for each breed and variety. Before your poultry can be exhibited you will need to obtain a Poultry Premises Registration number, an avian influenza test, and a pullorum-typhoid test. Contact MDA for more information on poultry testing. For complete details of Maryland poultry exhibition requirements go to MDA's website (http://www.mda.state.md.us/animal_health/fair_show/fair_show_info.php) or contact MDA directly at 410-841-5810.

Maryland Regulations for Registering Poultry

In conjunction with biosecurity, registering your birds with MDA's [Mandatory Poultry Registration](#) is an excellent way to protect your small flock. Not only are you notified of any disease concerns along with any poultry regulation updates within the state, you are issued a premises ID number that you can use as a

marketing tool with your customers. Your concern of the health of your birds will be conveyed to the buyer by registering with MDA. If you have any questions on the Poultry Registration Program please call 410-742-6023.

Conclusion

Raising a home chicken flock can be a good experience and a source of enjoyment. As a family project, it teaches about living beings and responsibility. The home chicken flock also can be an excellent source of low-cost, high-quality poultry products. This publication should provide the basic tools to start a successful flock.

References

- Brodie, H.L., and L.E. Carr. 1997. Composting Animal Mortalities on the Farm. Maryland Cooperative Extension Fact Sheet 717.
- Christian, A.H., G.K. Evanylo and J.W. Pearse, 2009. On-Farm Composting A Guide to Principles, Planning and Operations. Virginia Cooperative Extension Publication 452-232.
- Clauer, P, 2009 Small Scale Poultry Housing. Virginia Cooperative Extension. 2902-1092.
- LaCross, C. and R.E. Graves, 1992. On-Farm Composting. Pennsylvania State University Cooperative Extension, Fact Sheet C 3.
- Vest, L. and N. Dale. 2002. Nutrition for the backyard flock. The University of Georgia Cooperative Extension Service. Leaflet 396.

Suggested Reading

For copies of the following publications, contact their publishers. Those publications with no price listed are free.

A Guide to Better Hatching. 1975. Stromber Publishing Company; Pine River, MN 56474. \$9.95
Avoiding Residues in Small Poultry and Game Bird Flocks. PNE Publication 564. 2003. Washington State Cooperative Extension; Pullman, WA 99164.

Bantam Standard. 2006. American Bantam Association; P.O. Box 127, Augusta, NJ 07822. \$35.00

Bantams. North Central Extension Publication 209. Cooperative Extension Service, University of Wisconsin; Madison, WI 53706.

Biosecurity for Poultry. VME Factsheet. 2001. Teresa Y. Morishita. Ohio State University Extension. Columbus, OH 43210.

Biosecurity for Poultry at Community Farms. Publication 8280, McCrea, and F. Bradley. 2008. University of California Division of Agriculture and Natural Resources.

<http://ucanr.org/freepubs/docs/8280.pdf>.

Common Lice and Mites of Poultry: Identification and Treatment. Publication 8162, McCrea, J. Jeffrey, R. Ernst and A. Gerry. 2005. University of California Division of Agriculture and Natural Resources. <http://anrcatalog.ucdavis.edu/Items/8162.aspx>.

Considerations in Raising Small Backyard Flocks of Poultry in Population-Dense Communities. 02pr Publication. 2009. David Frame. Utah State University Cooperative Extension. Logan, UT 84322.

Capons. Fact sheet 54. 2000. University of Florida Extension. Gainesville, FL 32611.

Exhibiting Poultry for Pleasure and Profit. 1978. Stromber Publishing Company; Pine River, MN 56474. \$10.95

Home Processing of Poultry. ANSI-8400. 2004. Oklahoma State Cooperative Extension. Stillwater, OK 74078.

Homemade Comfort Cages for Small Poultry Flocks. Fact Sheet 429. University of Maryland Extension. College Park, MD 20742.

Incubating and Hatching Eggs. B-6092. 2000. Texas Agricultural Extension Service. College Station, TX 77863.

Poultry-A Guide to Anatomy and Selected Species. Wilson, D. University of Illinois.

<http://im.itcs.illinois.edu/ak17supp.pdf>

Poultry Showmanship. 4-H 2060. 1980. Ralph Ernst. University of California Davis, CA 95616.

Prevention – A Young Person’s Guide to Keeping Animals Safe and Healthy. Available at <http://www.vet.ohio-state.edu/1985.htm>. Colorful, 20-page booklet appropriate for all types of people keeping poultry. Can be reproduced locally.

Principles of Feeding Small Flocks of Chicken at Home. 2008. David Frame. Utah State University Cooperative Extension. Logan, UT 84322.

Salsbury Manual of Poultry Diseases. 7th ed. Salsbury Laboratories, Inc.; Charles City, IA 50616

Sexing All Fowl, Baby Chicks, Gamebirds, Cage Birds. 1977. Stromberg Publishing Company; Pine River, MN 56474. \$9.95

Small Meat Processors. <https://www.extension.org/small%20meat%20processors>

Sources of Poultry and Supplies for Small Flocks. Yearly. University of Maryland Extension, College Park, MD 20742.

The Standard of Perfection. 2001. American Poultry Association. Burggettstown, PA 15021. \$59.00.

1984 Yearbook of Agriculture, Animal Health, Livestock and Pets. Section II. Backyard Poultry and Pet Birds. Twelve chapters, pages 11 to 110. Available nationwide in many county libraries or Extension offices.

Publications on Other Species

Agriculture Alternative – Rhea Production. 1994. Penn State Cooperative Extension Service; State College, PA 16801.

Brooding and Rearing Ducklings and Goslings. G8920. 1993. University of Missouri Extension. St. Louis, MO 63180.

Emu Production. 1996. Joan Jeffery. Texas Cooperative Extension. College Station, TX 77843.

Hatching Ostrich Chicks. ANSI-9013. 2009. Oklahoma Cooperative Extension Service. Stillwater, OK 74078. \$0.20.

Ostrich Production. ANSI 3988. 2007. Oklahoma Cooperative Extension Service; Stillwater, OK 74078. \$0.20.

Raising Bobwhite Quail for Commercial Use. Circular 514. 1990. Cooperative Extension Service, Clemson University, Clemson, SC 29631.

Raising Ducks. WW01189. 2008. University of Minnesota Extension. Minneapolis, MN 55455.

Raising Ducks in Small Flocks. 2980. 2000. University of California Cooperative Extension. Davis, CA 95616.

Raising Geese. Farmers Bulletin 2251. 1983. United States Department of Agriculture. Washington, DC 20250. \$0.25 (Minimum order of \$1).

Raising Guinea Fowl. Leaflet 519. 1976. United States Department of Agriculture; Washington, DC 20250. \$0.25 (Minimum order of \$1).

Raising Waterfowl. A3311. 1985. Cooperative Extension Service, University of Wisconsin; Madison, WI 53706.

Small Turkey Flock Management. North Central Regional Extension Publication No. 60. 1981. Cooperative Extension Service, University of Wisconsin, Madison, WI 53706.

4-H Pigeon and Dove Project. 4-H 154. 2008. Oregon State University Extension Service. Portland, OR 97209. \$2.50.

Raising your Home Chicken Flock

Originally prepared by:

Charles J. Wabeck, Extension Poultry and Food Product Specialist
University of Maryland

Updated in 2010 by:

Jennifer R. Timmons, Regional Poultry Specialist
University of Maryland Extension
mdchick@umd.edu

Jennifer L. Rhodes, Educator, Agricultural and Natural Resources
University of Maryland Extension
jrhodes@umd.edu

J. Richard Nottingham, Educator, Agricultural and Natural Resources
University of Maryland Extension
jnotting@umd.edu

Dale Johnson, Farm Management Specialist
University of Maryland Extension
dmj@umd.edu

Reviewed by:

Nathaniel Tablante, Poultry Health Extension Specialist
University of Maryland
nlt@umd.edu

Edward T. Mallinson, Professor Emeritus
University of Maryland

Front cover photograph courtesy of
Edwin H. Remsberg, Photographer
University of Maryland
remsberg@umd.edu

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, University of Maryland, College Park, and local governments. Cheng-i Wei, Director of University of Maryland Extension.

The University of Maryland is equal opportunity. The University's policies, programs, and activities are in conformance with pertinent Federal and State laws and regulations on nondiscrimination regarding race, color, religion, age, national origin, gender, sexual orientation, marital or parental status, or disability. Inquiries regarding compliance with Title VI of the Civil Rights Act of 1964, as amended; Title IX of the Educational Amendments; Section 504 of the Rehabilitation Act of 1973; and the Americans With Disabilities Act of 1990; or related legal requirements should be directed to the Director of Human Resources Management, Office of the Dean, College of Agriculture and Natural Resources, Symons Hall, College Park, MD 20742.