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Pastured Poultry: Egg Production

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Many producers are looking for a cost-efficient way to integrate egg production into their existing farms. This publication examines many of the risk factors that beginning poultry farmers should consider before acquiring a pastured laying flock. It addresses animal-management issues including breed selection, housing, nutrition, predator control, and natural-resource management. It also discusses processing and marketing of the end product, table eggs.

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Photo: Kevin Ellis, NCAT

Introduction

A growing emphasis on higher-quality foods, paired with an interest in animal welfare, has increased consumer demand for eggs produced from alternative systems of rearing. One of these alternative systems that has gained considerable support and interest is pasture-based poultry production. Pastured poultry is a rearing system in which birds spend most of their life on pasture, free to forage and range during the day. Setting up and operating such a system can be quite an undertaking; however, a system designed to match a farm's resources can yield many benefits. These benefits include boosted fertility on farmland as part of a diversified farming enterprise, increased animal welfare, and an increase in nutritional value in the resulting eggs.

Some of the key elements of pastured-poultry egg production are nutrition, predator control, natural-resource management, marketing, and biosecurity. Management decisions on these topics are critical to the overall longevity and productivity of the enterprise. All of the inputs must be carefully considered, as no two farms are completely the same. For example, what may work for predator control in one area may not be effective where there is a different set, or wider variety, of predators. This publication's intent is to help producers identify the risks involved with pastured poultry. This publication will address animal management, as well as processing and marketing of the end product, table eggs.

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Breed Selection

For pastured laying hens, as for any animal-agriculture enterprise, a source of quality livestock is absolutely necessary. Different poultry breeds have different characteristics that a producer must take into account when choosing a breed for an operation. Egg-laying breeds used on pasture need to be able to keep laying a steady supply of eggs while being efficient foragers. The first step to starting a productive flock is to determine which breed will be the best fit for a farm and its climatic region. USDA's National Organic Program (NOP) organic regulations require "selection of species and types of livestock with regard to suitability for site-specific conditions and resistance to prevalent diseases and parasites."

Egg-laying breeds differ from meat-production breeds in a few main respects. The first is the way they grow. Layers grow at a much slower rate and will reach a lower final weight than meat-type birds. However, once laying age is reached, most energy derived from feed is used to produce eggs, so feed is utilized at a much more efficient rate. Layer rations have a lower protein content than meat bird rations. Not all layers can produce eggs at the same rate, though. Breeds differ in feed efficiency (a certain weight of feed needed in order to produce a certain weight of eggs), egg color, foraging ability, and overall behavior. Very good egg layers, meaning those breeds which can lay more than 250 eggs per year, include Leghorns; Bovans Browns; Rhode Island Reds; and Gold, Black, and Red Stars.

Egg Color

The shell color of the egg is linked to the breed of chicken. Differences in shell coloration do not denote a difference in nutrition or quality of the internal contents, meaning the yolk and albumen (the white of the egg) (Donoghue et al., 2010). Feed and general nutrition will help determine the contents of the egg itself. The most common eggshell colors are white and brown in a variety of shades, but a few breeds are known to lay blue or green eggs.

Sex Link

"Sex link" refers to poultry that have been cross-bred to produce traits that are linked to their sex chromosomes. This makes it easier for hatcheries to sort chicks by gender, based on the color of their feathers at hatch. Breeds in this category are usually very good layers and are preferred by many growers. However, sex-link birds are hybrids, meaning they are bred through the cross of two different breeds. As a result, they will not be able to be used in a breeding flock to produce another generation. An upside for producers looking to start out is that with sex links you can order a set of chicks that will have a much higher probability of being hens. Otherwise, "straight-run" is standard, meaning that there will be a mix of hens and cockerels that will only develop characteristics after they have been raised to maturity. Examples of sex links include Brown Stars, Red Stars, Red Comets, and Black Stars.

Weather Adaptability

Climate is a large deciding factor when choosing a breed to start a flock. All chickens originated from the Red Jungle Fowl, *Gallus gallus,* which was found in the forests of South-Pacific Asia. Ancestral members of the Gallus family (to which all chickens belong) survive best in warm climates. However, there are newer breeds more suited to a bit of cold. Heavier-bodied birds with more feathers usually survive better in areas that receive cold weather. On the other hand, smaller-bodied chickens tend to do better in climates where it can be hot for weeks at a time. Think of it as wearing a heavy coat: you would much rather wear a coat in snow than you would in a heat wave.

Another factor to consider relative to climate is comb shape and size. Breeds such as the leghorn have large combs, which are useful for heat dissipation in warm climates but make them more susceptible to frostbite in cold climates. If a flock will be on pasture during the winter in a colder climate, producers should look for a breed with a smaller comb (such as a "pea comb").

Foraging Ability

A distinguishing factor in raising pastured poultry is that the birds will be foraging through the day. This can relieve feed costs slightly, given the right combination of genetics and pasture quality. Although a producer can realistically expect a 5% to 20% contribution to total nutrition from pasture, genetics will play a role in exactly how much nutrition a bird can get from forages. Some breeds prefer to look for their own feed when they need it and will go to great lengths to find supplemental nutrition; others prefer to wait and be

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fed concentrated rations to satisfy the entirety of their nutritional needs. Examples of breeds that exhibit superior foraging abilities include Leghorn, American Gamefowl, New Hampshire, Barred Rocks, and Dominiques.

Dual Purpose

Breeds that can produce both meat and eggs are referred to as "dual-purpose" breeds. While this concept might seem attractive to a grower, these birds are usually not as efficient in either category of production as some of the top breeds. However, in some cases the flexibility of a dual-purpose breed can be of value to producers who don't have room for separate flocks. Notable dual-purpose breeds include Orpingtons, Australorps, and Plymouth Rocks.

A flock consisting of a variety of breeds on pasture. Photo: Kevin Ellis, NCAT

Choosing Day-Old Chicks vs. Started Pullets

In addition to traditional day-old chicks, many hatcheries are now selling started pullets. These are birds that have been raised at the hatchery up to 17 to 22 weeks of age, or the onset of lay. Since these birds spent more time at the hatchery, the price is higher to cover feed, housing, and shipping costs. A chick can cost anywhere from $1 to $3, but a pullet can cost $17 to $20. Buying day-old chicks and raising them until they start producing eggs provides several advantages: lower start-up costs, reduced financial risk, and greater adaptability. Although every farm situation is different, raising chicks up to lay will usually be more cost-effective than buying started pullets. Feed costs at the hatchery will usually exceed farm feed costs, depending on the source. Furthermore, the added expense of a started pullet causes higher economic risk for a producer trying to make eggs a viable agricultural enterprise. Predator attacks and disease can become even more costly when the starting cost of stock is so high. Furthermore, although some hatcheries start their pullets on pasture, most do not. The transition to a new, pastured environment is more difficult for an older bird whose habits have already formed. When birds are introduced to pasture at a young age, they can get comfortable with the conditions they will be living in for the long term.

USDA's NOP organic regulations require that "Poultry or edible poultry products must be from poultry that has been under continuous organic management beginning no later than the second day of life." If a farm is looking to become certified, it must maintain organic conditions for new chicks, or buy from a pullet producer who maintains organic certification.

Housing

Housing is one of the more important considerations when it comes to raising poultry. Since chickens are vulnerable to predators and weather, proper shelter is essential to ensure that the flock will survive, thrive, and lay eggs for as long as possible. For pastured poultry, the pasture may be the focal point of the rearing system, but proper shelter allows a flock to roost at night and provides a desirable area to lay eggs, free of stress. Proper shelters must be secure, protect poultry from the regional weather, and contain basic amenities for laying hens. USDA's NOP organic regulations require "[e]stablishment of appropriate housing, pasture conditions, and sanitation practices to minimize the occurrence and spread of diseases and parasites."

For more information on housing, refer to the ATTRA publications *Range Poultry Housing* and *Poultry House Management for Alternative Production.*

Hoop house-style poultry housing. Photo: Kevin Ellis, NCAT

There are two main systems of pastured poultry housing: fixed and mobile. Either can be used effectively in raising poultry, but the producer will want to consider overall space, cost, associated equipment on hand, and personal preference. To be successful, producers must plan ahead for different stages of a bird's life. In brief, in order to distribute nutrients appropriately, the producer will need to be diligent about moving both manure and birds; the amount of energy that will be used moving each one depends on the system design.

Fixed Housing

Fixed housing typically consists of a coop in the middle of a large area of pasture, with multiple doors that open into different sections to allow for pasture rotation. A producer must provide for the flock's basic needs: feed and water, nest boxes, and roost space. The building must be well ventilated to ensure proper temperatures and moisture levels, and must have exits that are easy to close and secure.

Pastured poultry have a tendency to destroy vegetation around a house and in high-traffic areas if quartered in an area too long. This can be a major challenge for fixed housing as, over time, overgrazing will have negative effects on the surrounding soil quality. The fixed-housing system requires strict management to regulate the amount of nutrient build-up (especially phosphorous, whose high levels can be a risk to water quality) in the soil in high-traffic areas around the coop.

To help combat overuse, many producers utilize a system of divided pasture around their fixed houses. Multiple exits lead to different paddocks and can be opened or closed to route poultry to the desired area. Typically, a producer will allow a flock to range in one paddock until it starts to get "hot" or worn down. The appropriate time to move poultry to a different paddock depends on the size of the area, stocking density, forage type and growth, and climate. To move poultry, the producer will close off the previous area and open the door to a new one. This allows the "hot" area to rest and regenerate. If a producer is aiming to produce a particular mix of plants or grasses, an optimal time to seed would be just after the birds have been moved, when the area is rich in nutrients.

The house itself should have enough room for the birds to roost at night. Anywhere from six to eight inches per bird allows adequate roosting space. Roosts should be about three feet off the ground to discourage cannibalistic behavior. Roosting should be encouraged in a flock because a higher incidence of eggs laid on the floor can be expected in a house without roosts. In the months before egg-laying, hens should be excluded from nest box areas, or the nest boxes should be covered. Hens that sleep in their nest boxes often provide dirty eggs. The number of nest boxes required for a house depends on the size of the flock. As a general rule of thumb, one nest box can serve four hens.

Use bedding with a high carbon content in the house to absorb waste. Wood shavings are a common bedding material. If ammonia or moisture build-up occurs, turn the shavings, or add fresh shavings on top. Ammonia buildup can also be attributed to excess waste in bedding. Shavings or other bedding material should be turned or replaced to keep housing sanitary and comfortable for the flock. Ammonia can lead to respiratory problems in a flock and should be avoided. If you can smell ammonia in the house, then the level is higher than is acceptable for optimal bird health. Good ventilation will help to remove both ammonia and moisture. Fans can be used to draw fresh air into the house or to help vent stagnant air. Some fans can be synchronized with a thermometer to turn on automatically when the temperature climbs above a pre-set level. Doors and

windows are necessary for ventilation. Secure wire or screen inserts are useful in deterring predators if the birds need the windows open for ventilation overnight.

Mobile Housing

The most popular housing system for pastured poultry is a mobile coop. A mobile house will allow a producer to move a flock around a property with ease. Frequent movement of a flock can extend the benefits of pastured poultry, including weed control, fertilization, and breakage of parasite cycles for other species, over a wider area. This type of system also allows for more flexibility in designing a grazing plan.

There are two main types of mobile housing structures: houses on wheels and houses on skids. Houses on wheels are built on a trailer that can be attached to and pulled by a tractor. The structure includes feeders, a watering system, roosts, and nest boxes. A flock is closed up at night (to protect the flock against predators) and moved to a different location in the morning or evening. Portable fencing is used to define the area around the coop to keep birds in and predators out. Move portable houses often—at least once a week (or at most two weeks)—to prevent erosion and buildup of excess nutrients around the house (which can cause deterioration of soil and water quality). Because chickens tend to congregate most closely around the house and its shade, food, and water sources, better distribution of nutrients may be achieved by moving the house more frequently. Equipment permitting, some feeders and waterers may be placed outside or even a short distance from the house itself. If the area enclosed by fencing is large enough, the house may be moved within that area.

Mobile housing unit constructed using a recycled cotton-trailer frame. Photo: Kevin Ellis, NCAT

Houses on skids can range from small hoop houses to larger, more traditional chicken houses. Smaller versions can be pulled by hand and larger ones can be moved with an all-terrain vehicle, car, pick-up, tractor, or other large machinery. Feeders and waterers can be hung from the frame of the structure to decrease the time it takes to pack up, move, and unpack a house. Skid houses, like any poultry housing, should be fully closed off at night to exclude predators.

Nest Boxes

When laying an egg, a hen will require a nest box. The nest box should allow the hen to sit comfortably and should give a sense of security. Nest boxes are often introduced to poultry around the time of maturity, so that they may develop good habits in laying eggs. If these habits are not established, a producer may receive a higher percentage of "floor eggs" or eggs laid outside of the house in general. However, nest boxes should be closed off at night, to encourage hens to roost on perches. This will help keep eggs clean and discourage any broody habits. "Broodiness" is when a hen sits on an egg or a clutch of eggs for an extended period of time, trying to hatch them. Replace bedding in nest boxes regularly to prevent a buildup of feces or broken eggs. This will also help keep eggs clean until they are collected.

Seasonal Management

All pastured poultry systems need to be developed to fit into the farm's climate and growing season. Some environments lack a forage-growing season or have cold and wet seasons that are hard on flocks. Producers should be aware of their climate and develop a system that allows the flock to fill a need on the farm, while being productive. For example, producers of vegetables will often feed culls to a flock as a supplement to their feed ration. This allows the producer an efficient way to dispose of produce that would not sell, while

helping to feed the flock that will produce eggs. Producers need to learn to work within the environmental parameters of their region and explain to their consumers the reasons for doing so.

Summer Considerations

Poultry production problems arise as a result of high heat, especially when temperatures rise abruptly. The average internal temperature of a chicken is 105°F to 107°F. Poultry are homeothermic, meaning they produce and dissipate heat in order to maintain a body temperature in this range (Kentucky Poultry Energy Efficiency Project, 2014). In warmer climates, it can be harder to dissipate heat and stay cool. Methods of cooling become essential for birds' survival. Keeping birds adequately watered is the easiest and most consistent way to help keep birds cooled. Birds will drink in order to replenish their fluids, which they use in evaporative cooling, or panting. Panting serves as the main form of temperature regulation in the warmer months, but in order for it to be effective, the bird must have a constant source of cool, clean water. Producers should have plenty of water sources both in the house and in the pasture. Check several times a day to ensure that the hens have a nearby source of fresh water, and that it is refilled as necessary. Some producers have created automated systems that are gravity-fed from water tanks to help reduce the amount of time spent filling bell waterers in the pasture. Check self-waterers frequently in hot (or freezing) weather to make sure that they are clean and in perfect working condition. Each type of water system has its problems. For example, gravity-fed systems can be susceptible to overflow, and individual nipples can clog.

Keeping birds adequately watered is the easiest and most consistent way to help keep birds cooled.

Shade can help reduce temperatures on hot days and improve poultry comfort and well-being. Building awnings that extend off of pastured poultry housing will provide shade. These typically consist of two arms that fold up, with a canvas sheet attached that can roll out onto the arms. This provides poultry with the comfort of a shelter to help protect them from the sun, and also protects them from some predators. Build and situate awnings for maximum protection from the sun through the day, based on the direction they are facing and on other trees or structures in the area. Small shelters built in the pasture can provide a place for poultry to rest and cool off. These can be set on wheels or skids. Place water or feed under these shelters to help draw hens to them initially.

Misters are another great way to help poultry cool off, by providing a light covering of water on their skin to allow for evaporative cooling. Misters can be bought or constructed using commercial misting supplies. These can be attached to a poultry house, preferably near shade or under an awning where the birds can safely rest. Misters should *only* be set up outside of a structure. If they are installed inside a house, the moisture can build up and lead to health issues with litter and ammonia. When installing misters, take wind direction into account to make sure the mist can reach the birds.

Ventilation is another critical way to cool poultry during warm temperatures, especially if a flock spends a significant part of its time in a house. If a flock is located in a warmer part of the country, the house needs to have lots of openings so that air can be pushed or pulled out of the house by natural wind or fans. Many producers prefer to have windows covered with chicken wire, with hinged doors or shades to cover the opening as needed. When placed correctly, the windows allow air to flow freely throughout the house to exhaust odors and moisture in addition to excess heat.

Winter Considerations

Colder weather brings certain obstacles for raising pastured poultry. In some areas, snow or ice on the ground can prohibit foraging. This coincides with diminished day length and reduced egg laying. If kept on pasture, a coop must be very well insulated. However, it should also have adequate and well-planned ventilation to prevent stagnant air.

"Winterize" a coop by adding insulation and sealing any cracks in the general structure to prevent drafts. Common types of insulation include fiberglass insulation and foam insulation board, among others. Insulation inside a coop needs to be covered in order to prevent pecking by birds. If an electrical source is nearby, heat lamps can be added near perches so birds can stay warm. Check heat lamps frequently to make sure that they are well secured. A fallen heat lamp can be the source of a fire that can quickly destroy a flock and even the coop. Ventilating a coop at least once a day can help move clean air into the house and remove unwanted odors, moisture, and ammonia.

Some producers use a "deep bedding" system over the winter. The flock is moved off pasture to a warmed house. During the winter, the producer will add more bedding as the original bedding

layers absorb droppings. The lower levels begin to decompose and provide heat within the house. At the end of the winter, the flock is moved back to pasture and the bedding may then be watered and turned actively to complete the composting process so that it can be used as a soil amendment. Deep bedding starts with a base layer of four to six inches of shavings and requires continuous turning or aeration throughout the season. Smell and sight are good indicators of when to add more bedding. When clean shavings are no longer visible, it is time to add a layer of fresh shavings. Ventilation is essential to remove excess moisture that can build up in this type of system.

Life Cycle

Brooding

Every successful flock starts in the brooding stage. After hatch, chicks need to be kept in a controlled environment to ensure that they start their developmental process off right. Brooding occurs for the first several weeks and allows the chicks to develop feathers and learn essential behaviors. Brooding requires attention to detail because the chicks are susceptible to many factors that might hinder their growth or threaten their lives.

Breeding farms ship out chicks at one day old. Before chicks arrive on site, a producer must have a brooder ready. A good brooder will adequately provide chicks with warmth, fresh water, feed, and enough space to move around. Generally, a 100-square-foot space will be comfortable for 100 chicks (Poole, no date). Larger flocks need to be divided in order to prevent overcrowding and to even out the feeder space in the pen.

Chicks start out in controlled environment commonly referred to as a brooder. Photo: Kevin Ellis, NCAT

Chicks start out with a coat of down feathers. During this period, chicks need to be kept warm until they develop adequate adult feathering. For the first week of brooding, temperatures need to be held in the range of 90°F to 95°F. Every week after this, the temperature should be decreased five degrees until outside temperatures are reached. Birds must have adequate feathering before they are placed in an environment outside of the brooder. The producer must monitor the weather and be prepared to alter planned dates of placing birds on pasture if adverse (rainy/damp/windy) weather presents a risk to the birds' health and survival rates. Different heating sources can be used, based on preference. Heat lamps with heat shields are the most common, but others, including electric or propane gas heaters and stoves, may be considered if they can be used safely to heat the brooding space.

The chicks themselves will communicate whether they are comfortable through their behaviors. If the birds are too hot, they will spread out from each other as much as possible and stay away from heat sources. If they are too cold, they will huddle together under the heat source, whereas if there is a draft they will huddle together away from certain areas in the brooder. Huddling can be very problematic for chicks; they can suffocate when they pile up, especially if the enclosure has corners. To help prevent this, a brooder should be made into a round shape, or at least have rounded inserts to put in the corners. Walls or inserts can be as simple as cardboard flaps, or as elaborate as prefabricated plastic pens. When the corners are rounded, the incidence of suffocation due to piling up is greatly reduced.

Good access to food and water is integral for the development of starting chicks. When the chicks arrive, they need to become familiar with their new surroundings, including the location of feed and water within the brooder. Different types of watering systems exist for poultry. Gravity-fed bell waterers are most commonly used in smaller poultry operations. These need to be refilled continuously with fresh, clean water, and wood shavings and droppings need to be cleaned out before fresh water is added. When introducing chicks to a waterer, gently dip their beaks into the water and then set them down in front of it. This will help young birds understand where the main source of water is inside the pen. Sugar can be added to the water to provide the chicks with more energy and an incentive to drink after a long shipment

from the breeding farm. Nipple waterers are efficient and easy to maintain. When introducing chicks to a nipple water system, make sure that the waterers are raised high enough to ensure that the chicks can reach and tap the nipple to receive water, but don't have to bend down or stoop.

In order to prevent coccidiosis and maintain consistently clean water for a healthy flock, all types of waterers should be situated high enough that they can be kept clean. Similarly, use feeders that are easily accessible for chicks to eat freely at a young age, but not designed such that they can stand on them and defecate into them. In order to foster foraging behaviors in the flock, some producers introduce small quantities of grass into the brooder while the chicks are still very young.

Light intensity and schedule can have major impacts on the amount of eggs laid over the lifespan of a hen.

The brooder serves as a safe, warm area where baby chicks can properly develop. Many different spaces can be used to satisfy these requirements and ensure proper growth. Barn stalls, tool sheds, horse troughs, and even bathtubs have been used to start chicks in being productive layers. An ideal area is free of drafts, yet provides adequate ventilation. Design must allow for easy clean-out. Wood shavings are a suitable bedding material, as long as they are large flakes. Avoid sawdust-style shavings, as any fine particulate matter can lead to digestion or respiratory problems. Leg problems can sometimes develop within the first week of brooding if shavings are too deep. To prevent deformities, some producers choose to put burlap or paper towels over the shavings for the first week. This allows the bird's legs to develop as they walk on a more stable surface.

After a flock is moved out of the brooder, the shavings may be reused or removed to be composted. If reusing the shavings, allow the brooder two to three weeks of rest in between flocks. An all-in, all-out approach effectively disrupts the cycle of any parasites in the brooder. A producer who is unable to wait this long should completely clean and disinfect the brooder before introducing a new flock. Under certified organic production, all materials used for either bedding or disinfection must be listed in the producer's Organic System Plan and approved for use by the certifier.

Grow Out and Laying Period

Birds should be ready to move to pasture within four to six weeks. Depending on the breed, they should have most of their adult feathers by four weeks and be able to withstand colder temperatures. It is easiest to move birds at night or very early in the morning during their resting period. This helps to minimize stress during the move and can prevent unnecessary injuries or mortality. Carry no more than four birds in each hand, so that you can place a finger between the legs of each one. Low lighting will help to maintain a low-stress environment during transportation. When moving birds to a new structure, be sure to have fresh feed and water available within the coop. This will help the birds to calm, since they are immediately able to perform behaviors that they are used to. Exits should remain closed until the pullets become comfortable with the shelter. When the birds have returned to their normal behavior, open the chicken-sized exits, or popholes, and let the birds range onto pasture. To help lure the pullets out of the house, place feed and water and a small sun shelter outside. This provides an incentive for the birds to leave the coop and get outdoors. Laying hens like to have a sense of safety and shelter, which small vegetation, trees or shrubs, or even pre-fabricated structures can provide.

Poultry on pasture prefer medium to short forages. If the pasture is taller than the birds, they likely will not venture into it for long. If the forage is tall, either ruminants should be grazed in the paddock before poultry or the area should be mowed. This will allow the flock to scratch and forage as they normally would.

Surrounding the foraging area with fencing can help provide protection, while keeping a flock within a certain part of the pasture. This is especially important in keeping species separate, if other animals are grazing in the area.

Light is a key element of egg production. Birds are very photosensitive because light influences the production of follicle stimulating hormone (FSH) and estrogen, which start the process of egg laying. Light intensity and schedule can have major impacts on the amount of eggs laid over the lifespan of a hen. It can be important to start a flock on a lighting program if the pullets were born in the "off-season." Off-season is the period beginning in August and extending until March. This season will have naturally increasing day lengths in the grow-out phase, which can negatively impact the number of eggs a hen will lay (Hawes, 2009). To prevent this, provide supplemental light, and decrease it steadily over time to help control when the first egg will be laid.

Light can be provided with a variety of different equipment, including solar-powered lights, LED lights, or incandescent lights. While lighting pastured houses is more difficult than lighting a regular windowed house, it can benefit the rate of lay and overall number of eggs you will receive and, in turn, help get more out of the high cost of feed. Once the flock has matured to 20 weeks, more light is required. At 20 weeks, lighting should increase 15 minutes per week until 16 hours a day are reached. Once this level is met, it should be held throughout the hen's lifetime. At maturity, 14 to 16 hours a day will ensure the maximum number of eggs are laid by a hen over her lifetime (Hawes, 2009). While a flock will still produce eggs without supplemental light, production can be expected to be slightly lower. With every aspect of poultry production, the producer will need to weigh the relative costs (investment in equipment, energy, and management/labor) and benefits (increased production) of each strategy. The decision will likely depend on the producer's marketing strategy: is a consistent year-round volume of eggs required to supply and retain customers, or do the customers accept that eggs may be a seasonal product?

End of Production

Depending on the breed, layers will show a decline in the weekly number of eggs they produce following their first molt, after a year of lay. Producers have the choice of keeping the flock through molting, when laying essentially stops and then resumes at a reduced rate of lay, or starting a new flock. After molting, a flock can still lay at a reasonable rate for another year, but the number of eggs will consistently decline over that time period. At some point in time, the cost of feed for the flock surpasses the revenue from selling the eggs. When this happens, the producer has a few options. Many opt to sell (for a price that recuperates their investment in raising the bird) or give away the birds to local backyard-flock owners. Through reaching out over the Internet, a producer can usually find a few willing homes that would like a pet laying hen who can provide a few eggs a week. Many in the community are excited to participate in their local food system and promote animal welfare, while being able to have a supply of fresh eggs in their very own backyard.

The other option is to sell live birds or process the flock for meat. Meat from birds at this age will not be comparable in texture to the meat found on young broilers. However, pastured poultry can yield excellent stewing hens. These will not sell for as much as regular pastured-poultry meat, but will produce meat and stock for soup. This will also give the producer some return on the costs that the hens represent in feed and labor. Some growers hold a workshop to teach consumers who come to "process their own" birds and include a stewing hen. Be sure to check with your local regulatory agencies about any applicable regulations. Offering such opportunities can be a good marketing tool and strengthen the bond between farmer and consumer.

Feed and Water

Although a pastured flock can obtain some of its feed from forages, this is only enough to satisfy 5% to 20% of the daily nutritional requirement. Feed rations are necessary to ensure optimum growth, a consistent lay rate, and sustained health of a laying flock.

After molting, a flock can still lay at a reasonable rate for another year, but the number of eggs will consistently decline over that time period.

Rations typically consist of a corn and soybean base with vitamins and mineral supplements mixed in. Feed is generally recognized as the greatest expense when it comes to raising poultry. Taking the time to find a reliable source of quality feed is a critical step when starting a pastured poultry operation. ATTRA provides a livestock feed database to help producers find an organic feed supplier that serves their surrounding region. Many local feed mills develop their own rations. In some cases, producers may provide input on the type of diet they want to provide to their flock. Currently, many feed types are marketed to meet a variety of different demands. For example, "soy-free eggs" are from hens that have been fed a ration completely free of soybeans. Other special diets have been developed to support particular labeling claims, but all developed rations satisfy fowl dietary requirements.

Laying hens have different nutritional requirements depending on their stage of growth. When a flock is starting out in the brooder, they need a high-protein diet to assist in overall growth. The feed given to a new, just-hatched flock is referred to as a "starter" diet. (Organic producers should take care not to feed rations that are "medicated" with substances that are prohibited in organic production. The level of protein in a starter diet should be somewhere in the range of 19% to 22%, and this should be continuously

Placing feeders away from the house can help draw hens onto pasture. Photo: Kevin Ellis, NCAT

available until the flock reaches six weeks of age (Ernst et al., 1983). For growth, the next stage of feeding, the protein content needs to be reduced to 14% to 16%. The "pullet grower" diet should continue up until week 20, when the birds start to reach maturity. Hens usually start to lay eggs at 21 weeks of age. At this time they should be put on a constant diet with 15% to18% protein. During the lay period, the flock will require extra calcium in their diet for eggshell development. The primary way to include supplemental calcium in a diet is by having extra feeders full of calcium supplement (crushed oyster shell is most commonly used) available for the hens to consume as they wish, a practice commonly known as "free-choice feeding."

A flock should have access to feed at all times. Producers can purchase or construct a variety of functional feeder designs. Feeders must be easy to fill, prevent spillage, and allow poultry to consume the feed easily. While these objectives may seem at odds with each other, a "bell"-type or "trough" feeder satisfies them easily. Bell-type feeders are especially helpful in that they are able to hold a greater volume of feed and distribute it via gravity to the tray below. The easiest way to prevent spillage from feeders is to make sure that they are at the proper height. Feeders need to be raised as the birds grow, so that the lip of the feeder is at the same height as the back of the bird (Sonaiya and Swan, 2004). The hens will be able to reach the feed over the lip of the feeder easily, without spilling feed that can mold or attract rodents. It's easy to adjust feeders that hang from the roof of a house by rope or chain. Alternatively, place feeders on top of a stand or mount them to a side wall. Place the majority of feeders within the main coop so that the birds feel safe during feeding. Outdoor feeders can offer an incentive for the flock to get away from the house and forage during the day. Ideally, the feed should be under a small structure to guard the birds from predators. However, feeders on pasture should be picked up at night to discourage nocturnal animals from consuming poultry feed. Store feed in plastic or metal containers until it is used. This further prevents rodents and insects from contaminating the feed source. Producers can usually purchase bulk feed by the ton at better prices, but purchasing this much requires larger bins for storage (to protect against moisture and rodents), as well as paying for the transportation to the farm. Locate storage close to the chicken house, or somewhere that the feed is easy to transport to the house if a mobile system is being used.

Poultry need cool, clean water. Depending on the type of system used to deliver water and the stocking density, waterers may need to be refilled multiple times each day, especially in the summer months. Since chickens do not have sweat glands, panting—and the subsequent evaporative cooling—is their main mechanism for temperature regulation. Panting contributes to dehydration, stress, and a loss of appetite, which can lead to a drop in productivity. It is critical to have enough cool water on hand for poultry in the summer months. (Like many other animals, poultry have a strong sense of belief. If a flock believes that it is out of water, birds will start to die.) In addition to plentiful clean, cool water, some producers provide their flock with plenty of shade and light water misters in the summer. These are helpful strategies in keeping a flock cool in warm climates.

Predator Management

Many problems can threaten poultry health. Consistently at the top of these concerns is predator control. Predators have the ability to wipe out a large portion of a flock quickly, literally overnight. Good management can help ensure the health and well-being of a flock.

Most areas that are suited for raising poultry are also very conducive to sheltering a range of predators

that will pursue chicken as a source of food. There are two types of predators: terrestrial and airborne. It is critical that you know what the probable predator risks are in your region, learn the predators' habits, and be prepared to prevent initial contact between them and your flock, so that you don't inadvertently train them that poultry can be a convenient food source. This is critical not only to the health of your flock and your business, but also to the predators themselves and the ecosystem of which they are a part. Wild animals are smart and learn fast. A predator that learns to eat poultry will not drop this habit and will, unfortunately, need to be destroyed. Predators are a very important part of an ecosystem, especially in controlling wild herbivore populations. As a producer, understanding regional predators will enable you to take appropriate preventative measures before a flock is ever placed into a field.

After any loss, a quick response is essential to identify the predator and take appropriate action to install physical barriers or implement management practices to prevent further damage to a flock. Losses will increase exponentially if the predators develop habits.

Terrestrial Predators

Land-dwelling predators are very common in the United States. Raccoons, opossums, coyotes, skunks, and foxes are among the most common. Others may include bobcats, bears, and even mountain lions. The frequency with which they attack poultry depends on the density and age of their populations in the surrounding areas—and previous experiences they may have had with prior or neighboring flocks. When looking for a location to raise poultry, a producer must also think about what kind of predator habitat the area offers. For example, predators do well with cover and a nearby water source. Pastures near woods or forests and water sources such as creeks, ponds, or lakes are likely to experience increased predator activity.

Shelter is obviously the first line of defense in preventing predator attacks. Close houses securely at night to prevent nocturnal predators from entering. Even if a predator is unsuccessful in reaching the birds through the coop, the stress birds experience from a predator attack will impact their production and may reduce their laying for up to a week.

Houses should have a closed floor or be secured to the ground in order to prevent predators from digging under the walls to reach the birds. Movable coops that sit on the ground can be staked down using U-shaped rebar in each corner. This also prevents high winds from moving or flipping the coop. Raccoons will try to reach through the structure and grab hens if they can. To prevent this, make sure the openings in the wire on the sides are too small to reach through. *Always* close shelters at night, when the majority of predator attacks take place. In the morning, open coops only after the sun has risen to prevent any early-morning attacks.

Housing that is well built will help to ensure the flock's safety. Installing automatic doors ensures reliable closing at night. Photo: Kevin Ellis, NCAT

For flocks of a sufficient size to justify the expense of maintaining an animal, producers may decide to rely on livestock guardian dogs for protection from predators. A number of canine breeds have been developed for the sole purpose of protecting livestock. Great Pyrenees and Old English Sheepdogs, among others, are known to be practical dogs when it comes to managing predators. Still, to be effective livestock guardians, these dogs must be well trained from a young age. Some producers have said that a dog is not completely trustworthy until it is three years old and has adequate training. In some cases, just having a guardian dog in the same vicinity as a flock will help deter predators because of the way the dog establishes its territory. Some producers, however, allow their dogs to roam with the flock. Before turning a dog in with your flock, make sure the breed of dog you plan to use has a reputation as a good guard for poultry (dogs are also known to be

problematic predators). Livestock guardian dogs need to be slowly introduced to a flock. They must never be allowed to chase birds. The dog must be carefully trained. It should be accompanied as it comes to investigate the coop, pasture, and flock while on a leash at first, to encourage best behavior. Livestock guardians will gradually become more and more comfortable with a flock to the point where they can be unsupervised throughout the day. Livestock guardian dogs are especially helpful in deterring larger predators such as coyotes and foxes.

There are many predator-deterrent devices on the market currently. Some scare away would-be pests with glowing red lights ("Predator Eyes" is one brand). Motion sensors flood areas in light or set off sprinklers to scare predators away. Good fencing with wire mesh is a good place to start in preventing predator damage. Electrically charged poultry netting can adequately keep smaller predators such as skunks, opossums, and raccoons away, but bobcats, coyotes, and dogs can easily jump this type of fencing. A good perimeter fence around a property can help to keep out larger predators.

Collect eggs several times over the course of a day to prevent breakage or other losses due to sitting in the nest for long periods.

Smaller terrestrial predators of poultry include rats, mice, and weasels, which can have serious impacts on a flock in the brooding stage. Rodents will nest under housing structures and consume large amounts of feed. Their feces left inside a brooder can also lead to contamination and health risks. Caution must be exercised when choosing a rodent-control method within a certified organic system, so that no prohibited substances are put into use. Poisons should never be used inside of or close to poultry housing, as they may unintentionally poison the birds.

Aerial Predators

Raptors can also pose a serious threat to laying flocks. At any time of the day, a flock can be vulnerable to an attack from a hawk, eagle, or owl. Aerial attacks are harder to prevent and control but can be just as detrimental as those from terrestrial predators. During the day, hawks can often be seen around flocks. Some sit in trees and wait to strike. High trees or other perches are attractive to predatory birds but, even without these nearby, passing avian predators are a danger. Some hawks swoop in, seemingly from nowhere, catch a bird, and fly off immediately, taking the prey somewhere safe to eat it. Note that there are often common "flight paths" for airborne predators in between tall trees. Producers should be mindful of this potential danger when setting up an area for pastured poultry.

Poultry can enjoy the comfort of a shelter when on pasture. For this reason, it is good to have small, mobile structures set up near the main coop, and these may also contribute to the birds' safety and survival. Hens can alert each other when a hawk is in the area and quickly run to safety. Other birds, such as domesticated guinea fowl or wild crows, can help to alert poultry to the approach of predators and allow hens to take shelter. Small shade structures can be as simple as a canvas tarp secured over a 3-foot-high square frame. Some structures can be put on wheels to move to different areas. In addition, small trees and shrubs are naturally occurring shelters for poultry. The more cover, the more comfortable poultry will be on pasture.

Eggs

Handling

Collect eggs several times over the course of a day to prevent breakage or other losses due to sitting in the nest for long periods. Every egg starts out at the highest internal quality (AA in the USDA's egg grading system), but that can drop drastically through the course of the day, especially during warmer months. Hens usually lay an egg in the morning, so check at higher frequency during the early hours to catch the majority of the eggs when they are fresh. However, on some days, hens will lay later in the day. While this is not as common, it still occurs regularly; because of this, check nests at least once in the afternoon or evening. Collecting eggs in wire baskets helps to keep the eggs from breaking and helps air circulate throughout the basket and cool them off, especially if they are fresh. Eggs should be stored in a cool, shaded location.

In pastured poultry systems, eggs may have a higher incidence of becoming dirty, depending on the laying nest design. In conventional egg operations, eggs roll down a slanted wire cage and onto a conveyor belt that takes them to be washed immediately. In many pastured operations, the egg will sit in the nestbox until collection. This allows the egg to become dirty from hens' feet, feathers, or feces as they sit in the nest. Some nest boxes available today do have a slanted floor to

Example of nest boxes with roll-out tray for easy egg collection. Photo: Kevin Ellis, NCAT

a collection area, and these help keep eggs consistently clean.

In some cases, producers may have to wash collected eggs. The first step is to brush off any fecal matter using a sponge or light sandpaper. An egg may only be surface-cleaned without water. If not properly handled, water may allow bacteria on the egg to spread. Once the egg is free of visible foreign matter, it can be washed by a warm-water bath. Water should be 20°F warmer than the internal temperature of the egg to prevent pulling bacteria into the egg through the semi-porous shell. A light sanitizing agent approved by USDA can be used to help clean the eggs further. Before using any material, certified organic producers must list that material planned for use in their OSP, and have it approved for their intended use by their certifier. Once eggs are clear of any stains or material, take them out of the bath immediately, dry them, and then put them into cartons.

For other strategies and more information on cleaning and handling eggs, refer to the ATTRA publication *Small-Scale Egg Handling.*

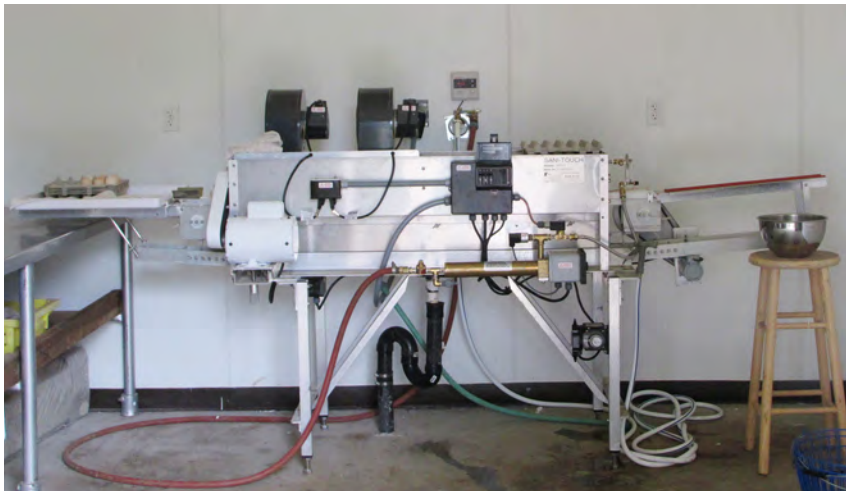
Defects

Eggs need to be inspected both internally and externally to determine that they are wholesome and suitable for consumers. Conduct an external inspection by looking at the shell. Discard eggs with cracks in the shell, or leaking albumen (commonly referred to as "leakers"), and do not sell them to consumers. These defects pose a health risk to consumers, as bacteria have an easier pathway into the internal contents of the egg. Remove any foreign material on the shell, including feces, feathers, or bedding, and clean the egg.

Other external defects include excess calcium deposits and "body checks." A body check is a defect that occurs where the egg was broken inside the hen but then repaired with extra calcium. The shell will appear thinner in these areas, also referred to as "water windows." Excess calcium can build up on the egg and show up as small bumps or ridges over the eggshell's surface. These are only structural deficiencies in the eggshell and these eggs are still fine for human consumption. Defined ridges on the eggshell or misshapen eggs can occur as well. While these eggs are also safe, their appearance may raise questions with consumers. However, these defects are usually very rare.

Internal defects present much more of a risk, as their appearance alone will turn consumers away. Internal inspection can be done by candling eggs. To candle, hold an egg up to, or over, a light source to see the internal contents. There are various candlers available on the market, but homemade ones can be made out of something as simple as a small, bright flashlight. To candle, hold an egg up to a light source, quickly turn it one-quarter revolution, and then stop. This spins the internal contents so that they can all be seen as they pass. There are two major defects to look for that will deem an egg to be inedible. The first is blood in the egg. While all eggs will have an orange glow under a candler, blood will show up as being bright red. Tissue or foreign objects can also appear in eggs. This defect occurs when a part of the hen's reproductive tract is caught within the internal development of the egg. These show up as small or large spots inside of an egg that are dark red or black in color and unmistakable. Although these eggs pose no health threat to consumers, selling them could seriously diminish consumer perception of the quality of eggs coming from a particular farm. Remove and discard eggs with internal defects.

Eggs can be given a grade based on their internal quality, as indicated by the air cell. The air cell is the area in the large end of an egg, where the two interior membranes do not lay flat on top of each other. It's possible to determine the quality of the egg by assessing the size of the air cell because it directly correlates to quality of the albumen and yolk. As an egg ages, water evaporates through the shell. This degrading of the egg is indicated by the air cell growing larger. For eggs free of



Example of an egg-washing machine. Photo: Kevin Ellis, NCAT

interior or exterior defects, the three main grades are AA, A, and B. Each internal-quality grade depends on the size of the air cell when the egg is candled. The following standards are from the USDA Agricultural Marketing Service (USDA/AMS, 2000):

- AA—1/8 inch or less
- A—3/16 inch maximum
- B—3/8 inch or larger

You can purchase cards with air-cell sizes and gauges to assist in grading eggs accurately.

Egg size is another factor in labeling. USDA regulations do not allow sale of ungraded eggs, so eggs of similar sizes should be grouped together for sale. These sizes are Peewee, Small, Medium, Large, Extra Large, and Jumbo. Use an egg scale to determine the size of each egg. Specific scales are meant to deal with the average weight of eggs and will denote the size immediately. For more information on egg sizes and handling, refer to the ATTRA publication *Small-Scale Egg Handling*.

Labeling

Label egg cartons before sale to ensure food safety and consumer confidence. Regulations vary by state, but at a minimum egg cartons should note the following:

- Address of the farm where eggs originated
- Farm contact information (phone number, website, etc.)
- "Sell by" date indicating 30 days after date of packaging

Prospective producers should be sure to check with their state or local regulatory agencies to learn how to label eggs legally for sale.

Marketing

Various marketing claims relate to how eggs are produced. Use of some terms is regulated, while others do not have much weight behind them. For example, eggs labeled "certified organic" must come from an operation that has been certified through an accredited certifier as meeting USDA Organic production standards for both the land on which the hens are raised and for the livestock production system. Labels must include the organic certifier's name, using proper placement as described in the regulations ("Certified Organic by [USDA-accredited certifier's name]" under the farm name and address). Use of the USDA Organic seal and the certifier's seal is optional but must meet original color and relative size requirements. Use of the organic label is regulated, and the National Organic Program can pursue legal action for its misuse. "Hormone Free" is another term whose use is regulated in labeling. When the term "Hormone Free" is used, there must be a note somewhere on the label stating this rule: "Hormones are never used in any poultry operation." On the other hand, terms such as "Free Range" and "Natural" are unregulated, and do not have legal meaning. Ordinarily, "Free Range" indicates that the birds have had outdoor access, but it doesn't specify to what extent. Some flocks are raised mostly indoors, with their only outdoor access being a small, enclosed sun room. Regardless, eggs from these flocks can still be labeled as "Free Range." "Natural" refers to a

Pricing

The pricing of eggs is dependent on several factors both on and off the farm. Eggs should be priced at a fair cost to the consumer and to the producer. The price also needs to allow for a return on initial housing, land, equipment, feed, and labor costs. Beginning producers should do some research to see what price a dozen eggs will sell for at local farmers markets, grocery stores, or farm stands. Egg prices should be competitive with the local rate, yet enough to cover all costs and eventually return a profit. For more information on pricing and marketing, refer to the ATTRA publication *Growing Your Range Poultry Business: An Entrepreneur's Toolbox*.

minimally processed product. Eggs fall under this category, as they are usually only washed. A popular label that is gaining momentum is "Pastured." This usually refers to hens raised in an outdoor system that is dependent upon pasture. While use of the term is unregulated, it gives the consumer a better idea of the system being employed on a farm, so they may make a decision based on their personal preferences. Choose a few key marketing terms that are both truthful and most meaningful to your consumer base.

Conclusion

Many consumers are starting to demand eggs from farms that use alternative systems of production, including pastured poultry. Raising hens on pasture provides benefits, as well as inherent complications. When implemented with planning and care, a pastured poultry system can offer benefits in animal welfare and environmental conditions, and it offers a quality product to consumers. Many farmers find raising chickens and producing eggs an enjoyable enterprise to manage, and eggs can provide a great "gateway product" to attract customers in direct marketing.

To be profitable, a pastured poultry enterprise must be well planned, and its success depends on a wide variety of conditions on a farm, including facilities, equipment, and labor. Further opportunities exist to incorporate hens into a larger system that may include grazing ruminants and vegetable and crop production. Pastured poultry, if implemented correctly, can increase the overall value of a farm, while providing a quality, nutritious product to consumers.

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Further Resources

American Pastured Poultry Producers Association
www.apppa.org
APPPA is an association of producers that helps members by keeping them up to date with new techniques, strategies, and other resources.

eXtension: Small and Backyard Flocks
www.extension.org/poultry
Extension services from around the United States have produced a webpage dealing with a variety of issues in alternative poultry production. Articles, webinars, and contact information are provided on a wide variety of questions.

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