

Feature article

The Impact of Environmental Management on Broiler Performance

In the simplest of terms, the modern-day broiler requires: (1) feed and water; (2) environmental protection; and (3) health protection. It is impossible to prioritize these three elements, because all are critical to the broiler chicken's survival and performance. But environmental protection is the area that probably has the most variables, and is the area where broiler producers have the greatest opportunity to manage the variable factors involved for improved livability and performance.

Just what do we mean by "environmental protection?" This term includes, or rather starts with, the broiler house itself, providing protection for the flock against an all-too-often unfriendly outside environment. The critical management factors that constitute environmental protection are temperature, air quality, and litter quality. These are of course interrelated, so that what a grower does to improve (or worsen) one usually will improve (or worsen) another factor. For example, providing fresh air (air quality) can also help improve temperature by exhausting heated in-house air and can improve litter quality by carrying excess moisture out of the house.

Environmental factors offer best opportunity to improve flock performance

Indeed, on a priority basis, providing "climatized air" is probably the most significant management factor by far. What we mean by climatized air is using ventilation and/or heating to deliver proper air temperature and air quality. By air temperature we mean the effective temperature a flock feels, which may result from still air (thermometer) temperatures, wind chill effect, or a combination of both. Air quality is judged on the basis of volume, ammonia, other gases, and particulate matter such as dust, virus particles, bacteria, and mold spores. How a grower manages house air drives or strongly influences almost all other factors affecting broiler house performance.

Key environmental factors are air temperature and air & litter quality

For example, temperature strongly influences how much feed and water birds will consume. Fresh-air ventilation promotes bird health by diluting the number of virus particles and reducing the number and viability of parasitic (coccidia) and bacterial populations (coliforms) in the house. Ammonia, respiratory viruses, opportunistic bacteria, and fungal spores in the air can all be harmful taken separately. When one or more (or all) occur together their combined effect is likely to severely impact the health and growth of the flock.

The maximum growth potential of the day-old chick is determined by the breed chosen and is part of the bird's genetic programming. This maximum potential is etched in stone upon arrival at the farm. However, whether or how far this growth potential is actually realized depends largely on the quality of the broiler house environmental management. When birds are unstressed by temperature variations, poor air quality, or disease, they are able to maximize their growth by taking in adequate feed and water. Environmental management is the key to achieving the grower's goal of achieving maximum flock live weight in the shortest time frame and at least cost.

When birds are unstressed, they are able to maximize weight gain, using more feed nutrients for growth and less for body maintenance

A key point to understand about the process of converting feed to broiler meat is that birds have a strict priority system dictating that feed nutrients always go first to satisfying body maintenance functions such as maintaining internal body temperature. That is, the feed nutrients that can be used for growth and gaining weight are only the amounts left over after the bird's survival needs are met. Under conditions such as severe heat or cold, feed/water deprivation, or disease a broiler flock may divert feed entirely to maintenance and gain little or no weight during a 24-hour period. In other words, for example, a forty-day old broiler must meet its

maintenance requirements before it can become a 41-day broiler by weight. This is why we must strive to maintain an optimum environment for birds, in which they have to use the least amount of feed for maintenance, and can use the most feed nutrients for weight gain.

The bird's internal heat balance is the most critical factor in maximizing growth. When the surrounding air temperature is too cold, the bird has to use feed energy just to keep itself warm. If the air temperature is too warm and the air is still (no wind), the bird has to expend feed energy in panting or lifting its wings to shed excess internal heat and keep its own temperature from going too high. Moving air over the bird helps carry heat away from the bird's body. If still air is too warm for bird comfort, getting the air moving provides a wind-chill effect that creates a lower experienced or effective temperature. On the other hand, if still air is too cool for bird comfort, any wind will make the bird experience an even lower effective temperature and have to use more feed energy to stay comfortable. Bird growth is maximized only when the effective temperature — the temperature experienced by the bird — is within a certain optimum range, not too hot and not too cold, as shown in Figure 1.

If the bird feels too warm or too cold, it has to expend energy to achieve a comfortable internal heat balance

Even in ideal conditions the proportion of feed energy birds must use for maintenance goes up as birds grow larger

Whenever two broiler flocks show a marked difference in overall performance, the bottom line is that the difference in performance will be the result of a difference in body maintenance requirements. The specific causes might be identified as temperature extremes, drafts or chills which drain heat away from the bird's body, better or poorer air quality, different feeding/drinking patterns, infectious causes, etc. But always the flock with the lowest maintenance requirements will shift the most nutrients into growth, which will be reflected in better overall performance.

Another key fact that must be recognized is that as a broiler chicken grows its body maintenance requirements increase steeply. This is because there is more body machinery to maintain as the broiler grows. Figure 2 shows the typical relative feed amounts that go to maintenance vs growth for each week of a growout. As the bird grows, it will take in more and more feed, but the amount of feed nutrients needed for maintenance, even in ideal conditions, keeps going up also. As a consequence, the feed conversion ratio (lbs feed/lbs meat) of the bird is best (lowest) in the early growth stages and increases as the bird grows larger, as shown in Figure 3. That is, although body size is rather small in the young chick, the growth obtained during this phase is the most efficient and economical. With each additional 24-hour period in a broiler's life, maintenance requirements increase and efficiency declines.

The importance of getting birds off to a good start cannot be over-emphasized

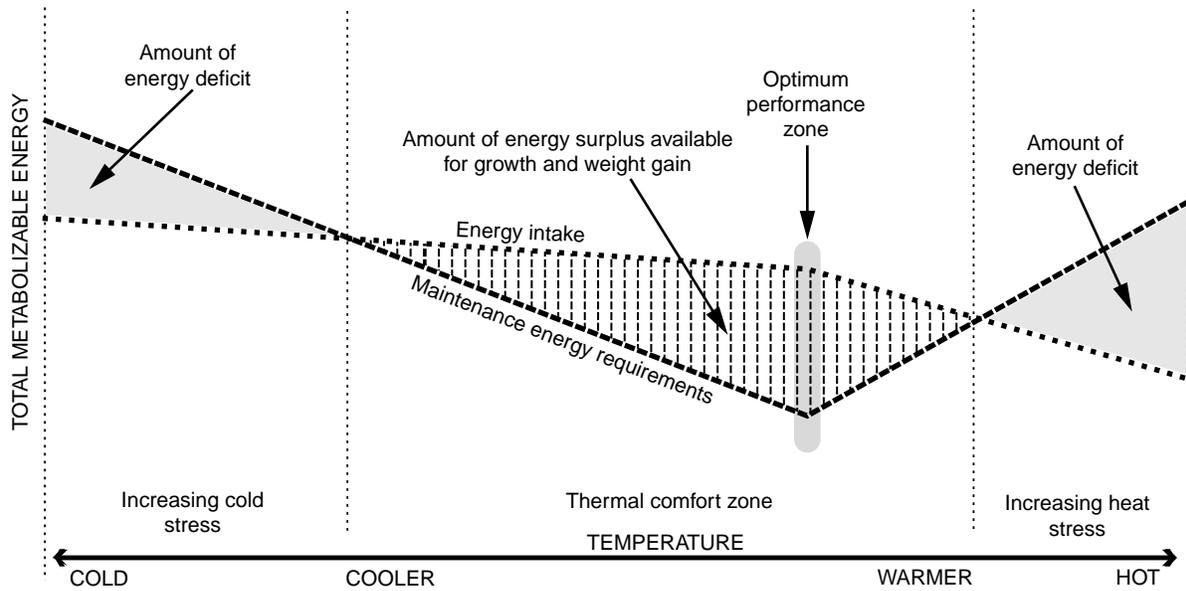
The management lesson to be learned from this is that the early growth stage is the time when environmental management is most critical, the time when there is most opportunity for rapid weight gain. Although the weight gain amounts are small, early growth establishes the maximum weight the bird is likely to be able to gain. It has been documented that feed and water consumption immediately upon arrival at the farm will positively impact broiler performance for the life of the flock. Certain systems in the young chick are programmed for later performance on the basis of the first weeks' nutritional status. In other words, slowed early growth cannot be made up later in the growout. The importance of getting birds off to a good start in the first two weeks cannot be overstated.

Early growth establishes the maximum weight a bird is likely to be able to gain

Although some environmental factors may seem insignificant, their impact is often subtle and may be cumulative over time. Minor variations in temperature and/or air quality may seem of limited importance with regard to performance of an individual chicken, but their impact must be considered on the basis of 20,000, 30,000 or more broilers in today's typical flock or farm situation. Management at the farm level targets the flock average, not individual birds within a flock. This approach offers all the advantages of rearing on a flock basis with large numbers of birds. Therefore good management at the farm level pays rewards on large numbers of broilers. However, the opposite (i.e., marginal management) approach exacts a price as similarly large numbers of birds are negatively affected.

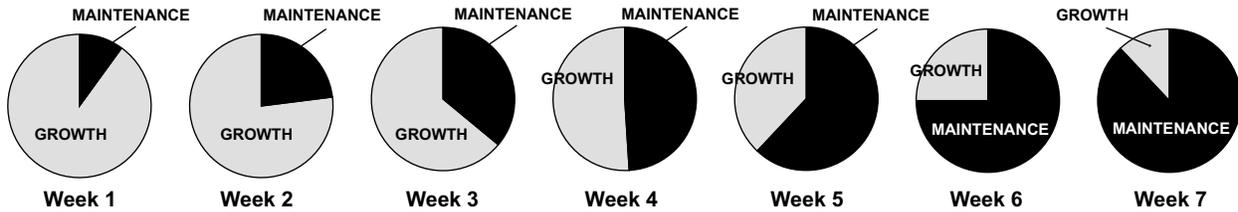
We in the broiler industry sometimes forget that we have not targeted individual chickens within a flock for over fifty years. It is therefore important to think in terms of consistent and maximum performance on large numbers of individuals. Minor variations in temperature, air quality, ventilation rate, litter moisture, etc, may

Figure 1. Optimum Performance Temperature Zone



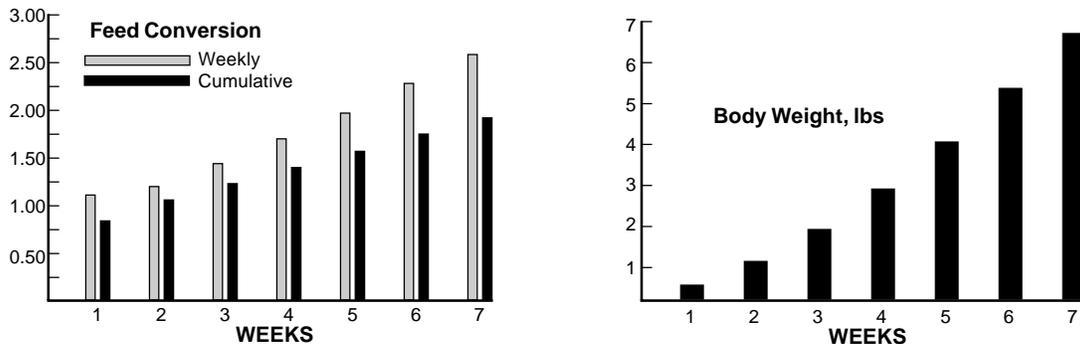
At each stage of a bird's development, there is one narrow temperature range where maintenance energy requirements are lowest and the bird can make maximum use of feed energy for growth.

Figure 2. Feed Energy Birds Can Use for Growth vs. Body Maintenance During Growout



Early in growout, almost all feed energy goes into weight gain. Body maintenance requirements go up as birds grow, however. Although birds will eat more and still gain weight toward end of growout, a much smaller percentage of feed energy can be used for growth. Proportions shown represent typical averages under normal conditions and are intended only to illustrate the principle that greatest opportunities for maximizing growth occur early in a growout when birds are able to use much more of their food nutrients to gain weight.

Figure 3. Feed Conversion and Body Weight, by Weeks



Charts show how feed conversion numbers rise steeply as body weight increases during growout. Gains in body weight are much greater toward the end of the growout, but it takes much more feed per pound of weight gained. When growing birds to larger sizes, producers should pay particular attention to maintaining optimum conditions, to avoid risk of birds consuming a great deal of feed with little or no weight gain. Charts represent typical averages under normal conditions and are intended only to illustrate the principles involved.

seem insignificant with regard to the impact on an individual bird; however, rarely are we dealing with less than 20,000 birds.

Let us do some simple arithmetic concerning management impact on an individual broiler versus a flock of 20,000 birds. One pound equals approximately 454 grams. Therefore, one tenth of a pound is about 45 grams, and one one-hundredth of a pound is about 4.5 grams. Now, 4.5 grams is about the amount of salt one uses to season a typical single serving meal of meat, potatoes, vegetables, etc. If that amount (4.5 grams) of growth in one broiler is diverted instead to body maintenance in a 24-hour period it would be hard to measure and considered of little significance. However multiply 4.5 grams times 20,000 broilers and we have 90,000 grams, which is slightly over 198 pounds in lost live weight gain. If this happens for another 24-hour period, the loss to body maintenance totals 396 pounds live weight for the 20,000-bird flock.

Very small per-bird performance gains will add up to substantial per-flock payoffs at catch time

The major environmental management lesson pointed out here is that seemingly minor variations in the environmental conditions provided for the modern-day broiler flock can have substantial impacts (positive or negative) when calculated on flocks or farms of 20,000, 40,000, 100,000 birds, or even more. It is also important to remember, as pointed out above, that most management factors that impact flock performance are cumulative, so it is especially critical to provide optimum conditions for the birds in early growth stages.

When flocks are compared, either on the same farm or from one farm to another, there is little doubt that environmental management has the greatest impact on bottom-line broiler flock performance. How much a grower could have made is determined by the number of chicks delivered on day one and by the genetic makeup of the breed. There is a certain maximum potential in the flock on day one in terms of growth rate, feed efficiency, livability, carcass quality, yield and pounds of salable meat. How much of that potential is realized, how much a grower actually makes, depends largely on how well he manages ventilation and heating to provide a comfortable environment for the birds, starting at day one.

Top ventilation and heating management is the key to realizing maximum flock income potential

The bottom line

“Growth potential” translates directly into income potential, how much a grower can possibly make on a broiler flock. Achieving that possible maximum income requires above all managing ventilation and heating to provide optimum conditions for the flock. In the example given above, where failure to maintain optimum conditions in one 24-hour period causes a loss of 198 pounds of meat in a 20,000-bird flock, that translates into a loss of about \$10, assuming a pay rate of \$0.05 per pound. Now, a loss of \$10 per flock is not huge, but we must realize this is the result of losing only about one-hundredth of a pound per bird on just one day. At \$10 per flock per day, how many days during a growout can a grower afford to lose just this tiny amount of per-bird growth potential? Looking at this from the other end, it is clear that for many growers, paying more attention to environmental management has great potential for increased income.

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