Monitoring Poultry House Environment

Correct placing of sensors and monitoring can guide you to achieve the right decisions about environmental control. ***— By Dr Dhia Alchalabi***

One of the major factors affecting poultry production is the feed cost, an essential factor in maximising profits. Lowering the feed conversion ratio (FCR) means cost savings and more flexibility in product pricing. All consumers look for low prices and good quality. So, the closer producers can control production parameters, the more control they have in the market. One FCR point can be worth thousands of dollars depending on the size of the farm.

Control of the birds' environment is one of these vital production parameters. It comes from data collection and monitoring of the farm. Good, reliable information is essential for decision-making. Inaccurate data collection leads to wrong decision-making.

Table The most important air contaminants and their effects

Ammonia (NH_3)	**Can be detected by smell at 20ppm and above** **>10ppm will damage the lung surface** **>20ppm will increase susceptibility to respiratory disease** **>50ppm will reduce growth rate** ***Recommended upper limit: 10ppm***
Carbon dioxide (CO_2)	**>0.35% (3500ppm) causes cartilaginous lung nodules associated with ascites** **Fatal at high levels** ***Recommended upper limit: 2500ppm***
Dust	**Damages lung surface** **Increases susceptibility to disease** ***Ventilate to reduce dust***
Humidity **more**	**Effects vary with temperature.** **At 29°C, 70% relative humidity limits growth because the bird cannot cool itself.** **Litter quality is poor at high humidity, leading to downgrading at processing.** ***Recommended range: 65 - 75%***

To make a start, we need to know the requirements of the birds and the limits of the farm. Birds reared today are different from those of even ten years ago. They require a better environment in order to perform well. The same applies to feeding and results with any feed will depend on environmental conditions. Feed does not change every day but environment does.

Birds that suffer health problems or lung damage in the first week of the growth period will not perform well later, however good the environment. It is important to provide a good, healthy environment for the birds from day one. This requires investment in data collection and monitoring systems, which is easily justified if you can lower FCR and improve health for the workers and birds alike. For larger companies, one FCR point is worth up to US$ 300 000 per year. Ten per cent of that amount is a very good investment toward production improvement.

The most serious problems facing birds at an early age are inadequate environment and management. Chicks suffer from high temperatures, low humidity and high concentration of carbon dioxide, combined with a lack of ventilation. This situation is created because many growers try to save fuel costs by cutting down ventilation rates and re-circulating the inside air by re-heating it. This scenario is even worse at night when harmful gases, temperature and humidity can be way outside the recommended range. If the weather is bad during the day as well, then this situation is repeated day and night. The birds' health and performance are adversely affected over the whole rearing cycle.

Scientific monitoring and control of the environmental parameters are vital. It can also help the managers to educate the growers by giving practical demonstrations of the importance of environment control. Growers must understand that a better environment for the birds means good returns for them or they will not follow the new procedures.

Measuring Parameters

Many environmental factors affect growth, performance, cost and the health of consumer, growers and birds. It is important to monitor, measure and control the parameters that affect production and to understand that these parameters are interlinked. The most important parameters can be grouped into environmental and managerial factors. Environment, bird breed and economic/political factors fall into the former group.

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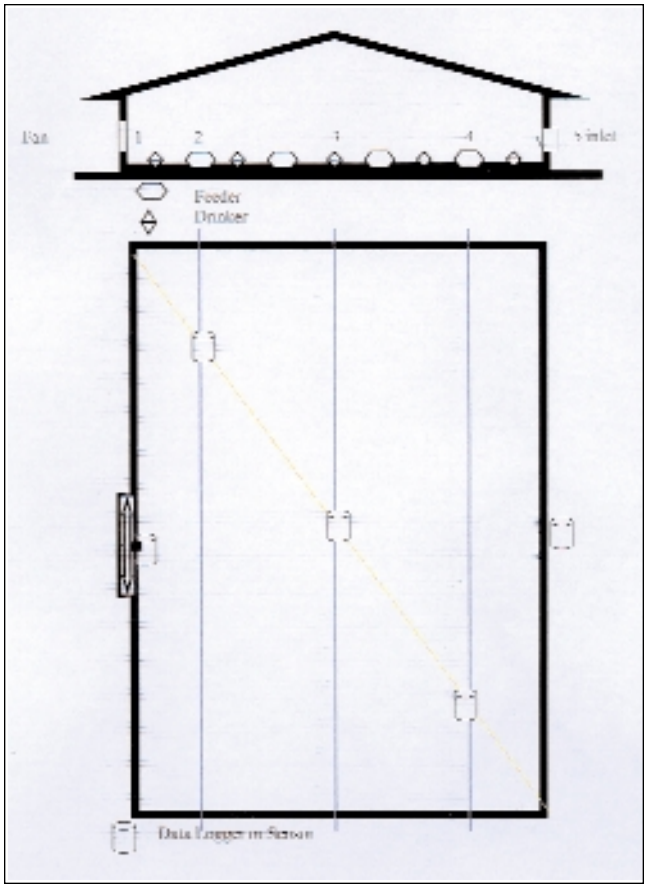

Figure 1 Placement of the sensors in a broiler house with extractor fans in the walls.

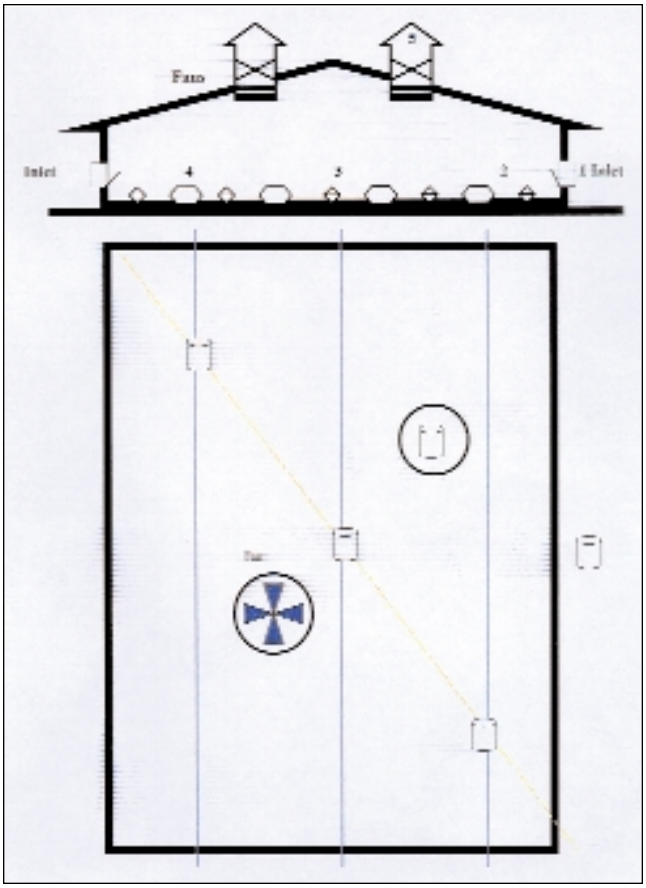

Figure 2 Placement of the sensors in a broiler house with extractor fans in the roof.

Environmental factors have a major impact on the production of meat and eggs from poultry. These include temperature, humidity, light (length of day and intensity), ammonia (NH_3) and carbon dioxide (CO_2) levels, oxygen (O_2), air velocity (air movement), solar energy, and air quality.

Placement of the Sensors

The location of temperature sensors is vital to get a clear picture about the temperature distribution inside the broiler house. Some important rules are these:

- Place probes in the effective environment of the birds (microenvironment).
- Always place a probe at the inlet to get outside temperature and relative humidity and on the exhaust fan to get the average inside temperature.
- Place a probe in the resting areas as well as near the drinker and feeder lines. You will also know if the ventilation system is working properly and affecting the places where it is needed.
- Divide the house into two or three blocks along the length of the building. Place the probes diagonally starting from the water line near the inlet and ending in the feeder line near the fans. Place some of the probes in the flow of air to get an idea about the temperature changes while the ventilation system is working. Place some also between the fans to have an idea about temperature rise when the ventilation system is in operation or not working.
- Check the probes frequently to ensure they have not moved, are dirty or become damaged. Clean them weekly. If the programming period does not cover the whole growing period, write a note (sticker) on the bottom of the probe to reprogram it before you lose any data. Read the data every week so you do not lose all the data if a sensor fails.
- The logger or probe must not touch any surface or wall.
- Protect the probes from the birds and outside interference (sunlight, rain). If placed outside, for example, use plastic disposable coffee cups. Make several holes in the cup to ensure proper ventilation around the probe.

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- Do not use red-coloured probes because the birds will tend to attack and destroy them.

Understand the probe data

This is the key to managing the environment in the house effectively.

The difference between outside, exhaust and inside temperatures will give useful information about what is going on inside the house.

If the difference between outside and the exhaust is more than 4°C, it means:

- The outside air is picking up the inside heat, but is not necessarily lowering the temperature to the wanted level.
- Air velocity is low.
- Inside temperature could rise with time.

If the difference between outside and exhaust temperature is less than 2°C, it means:

- The outside air is not picking up the inside heat and is not lowering the inside temperature. This situation could happen in winter or on cold nights. (The air is directed to the ceiling of the house).
- Air velocity is high.
- Inside temperature and relative humidity could rise.
- Looking at a graph with this information the sequence of the lines will be as follows:
  - Outside temperature (at the bottom)
  - Exhaust temperature (in the middle)
  - Inside temperature (at the top)

If the difference between the inside and exhaust temperatures is high (inside temperature line is above exhaust temperature), it means:

- This part of the house is not getting enough air.
- Probably there will be rises in CO_2, NH_3 and temperature.
- These places are close to the ventilation inlets and corners.

But if the inside line is below exhaust temperature line, it means that the air is directed to the floor (birds' level). This is bad in winter.

If the temperature of one of the inside probes changes suddenly, it means:

- A change in air direction (flap position).
- A higher stage of ventilation system is activated.
- Probe is touching a cooler or warmer surface.

Lists of environmental parameters

As broilers grow, they produce gaseous and waste products. These products accumulate over time and can cause substantial changes in quality of air in the broiler house. The main contaminants of the air are dust, NH_3, CO_2, CO and water vapour. These can have adverse effects. Direct effects of dust and NH_3 include physical damage to the lung surface, leading to lower disease resistance and reduced feed intake and in severe cases, poor growth.

The presence of noxious gases depresses oxygen uptake because of direct chemical competition. This is important because ascites tends to occur at low O_2 levels. High levels of CO_2 and CO also limit O_2 uptake. At higher levels, both gases can be fatal.

Relative Humidity

The moisture content of the environment affects directly the latent heat loss of the animals and is of major concern at high environmental temperatures when heat loss is limited.

The moisture content also indirectly affects the performance because of dust concentrations and pathogens although there is little documentation on this relationship.

Increasing humidity will adversely affect production at high temperatures. In general, humidity changes do not affect the response of growing/finishing animals at environmental temperatures below 24°C.

Humidity probes should be placed as for temperature probes. Some temperature sensors have humidity sensors as well, allowing for the monitoring of relative humidity.

Carbon dioxide

CO_2 is odourless, colourless and one-and-a-half times heavier than air. It is frequently ignored as a design parameter in general engineering practice. Experience has shown that ventilation to control temperature and moisture is usually sufficient to control CO_2 but this gas is an asphyxiant and should be of concern at high levels.

The maximum recommended level for poultry housing is 2500 ppm. CO_2 is a by-product of metabolism, along with heat and moisture. Additional quantities are produced during the decomposition of wastes.

Ammonia

NH_3 is colourless, lighter than air, water-soluble and has a pungent odour. The concentration in poultry houses is quite variable - 15 to 90ppm. It is a by-product of the biological process of the manure so problems tend to occur at the end of the run when manure accumulates on the litter. Monitoring this gas can be done along with CO_2. The two gases will give a good indicator of the air quality and the efficiency of the ventilation system (minimum ventilation rate). — *Dr. Dhia Alchalabi, poultry consultant, New Zealand.* PI