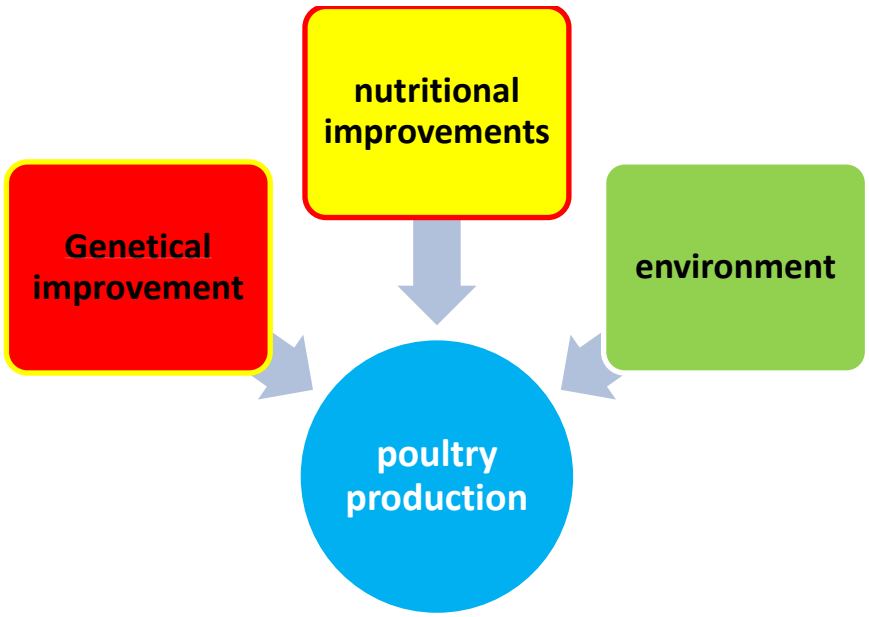
POULTRY HOUSE ENVIRONMENT

Factors associated with production:



Effectively Managing Environment:

- Reduces the total cost of production.
- Maximizes flock performance.
- Ensuring that bird health and welfare.
- To minimize dust (Better Environment).
- Increased Stocking Density.
- Optimum and uniform growth rate.

Environmentally Controlled House

- A Controlled house is one in which inside conditions are maintained as near as to the bird's optimum requirements.

- A Closed Building, Longitudinally Preferably East to West, with Big Exhaust Fans on West side while Evaporative Cooling Pads on East side along with Automatic Feeding and Drinking Systems Inside.

Evolution of the poultry house environment

Control and monitoring of the poultry house environment has evolved through two different phases involving poultry rearing:

1. The phase whereby mechanical and electrical devices come into use.

2. The phase where computers monitor and direct the use of mechanical devices.

3. Every poultry unit likely has components of all two phases for different environmental factors to be controlled.

Aims of Climate Control :

- To regulate the ventilation.
- Minimal temperature fluctuations.
- BETTER feed conversion ratio (F.C.R UNIFORM air movement).
- Lower medication costs.

- Lower mortality.

Microclimate is the local environment around an animal where the climate may differ from the surrounding areas of the farm building.

The microclimate, or surrounding air, contains oxygen for the animal's metabolism and is the medium for the transport of excess heat, water vapor, and gases emitted by the animals, and of gases from the decomposition of manure, and other particulate matter.

The important microclimate parameters that affect air quality in animal buildings include temperature, relative humidity, and air velocity as well as gases such as oxygen, carbon dioxide, methane, ammonia, hydrogen sulphide, and nitrous oxide. Others include dust and microorganisms found in air.

Macro environment

It's not possible to manipulate macro environment conditions but the ease of micro environment manipulation provides the better solution.

Local environment around an animal

-Temperature.

- Gases.

- Humidity.

-Dust and microorganisms.

- Particulate matter.

Microenvironment

- Air quality

- Relative humidity

- Temperature.

Environmental factors affecting poultry performance

.Temperature

.Humidity

.Ventilation

.Light

.Stocking density

.Flock size

.Feeding system

.Watering and Litter

Comfortable Environmental Conditions

Temp: -Broilers: 20 – 24 0C

breeders & Layers: 18 – 22 0C-

.Humidity: 50 – 70%

Ventilation: (Minimum: 6 m3/hr/kg (LBW)

(Maximum: 10 – 12 m3/hr/kg/LBW)

.Air change (open systems): 30 – 50 time/hr

.Air speed: At inlet & outlet: 2 m/sec

. At level of birds: 0.5 m/sec

.Ammonia: not exceed: 5 PPM

1.Temperature.

- Birds are homoeothermic

-The internal body temperature in the adult chicken the variability is between (40.6° and 41.7°C).

- The body temperature of a newly hatched chick is about 103.5°F (39.7°C), and increases daily until it reaches a stable level at about three weeks of age

- Birds have feathers that help them regulate their body temperature

- Their air sacs allow inhaled air (usually cooler than body temperature) to reach deep into the abdominal capacity so when the bird exhales heat is removed from the body.

- Birds do not have sweat glands. Broilers use a panting mechanism (referred to as gular flutter) during hot weather to evaporate water from its throat, thus reducing body temperature.

Thermo neutral zone

-Thermo neutral zone is a range of temperatures at which a bird does not have to actively regulate body temperature.

-The poultry thermal comfort zone, or thermo neutrality, depends on species and age, with younger birds responding better to warmer temperatures.

-Poultry feed conversion deteriorates when temperatures are outside the recommended comfort zone.

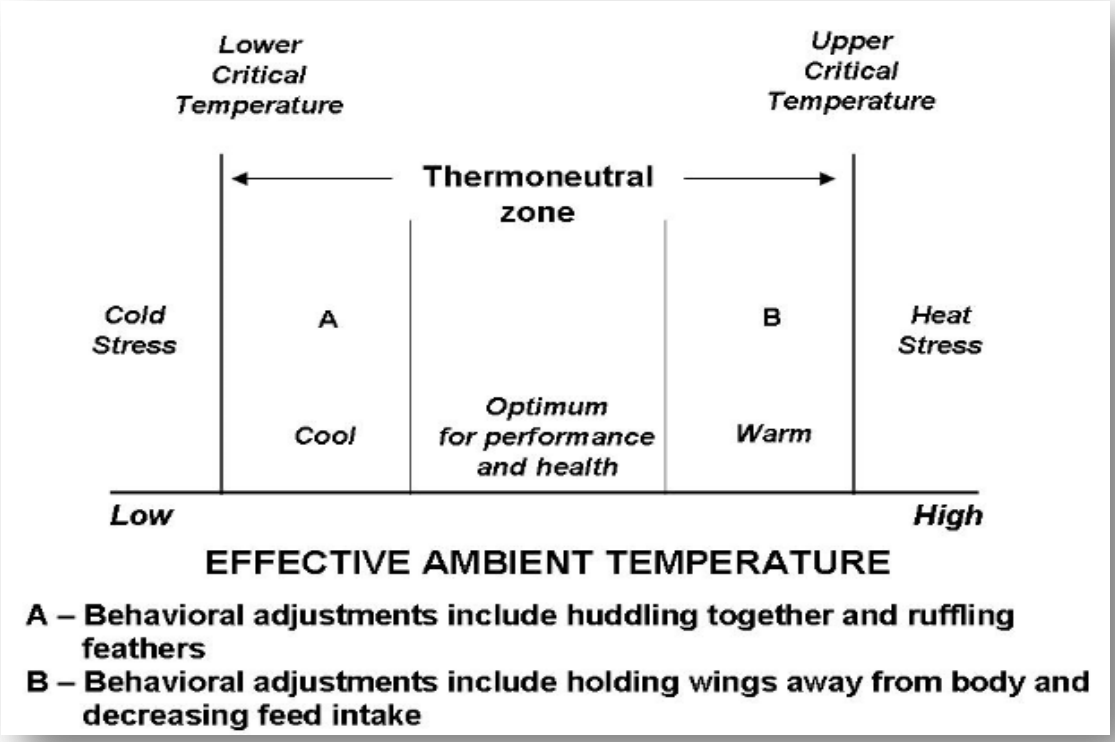
-Bird produces heat that must be lost to the environment to maintain constant body temperatures.

.Hatching temp: 37^0C - 39^0C

.Chicks have ill-developed thermo-regulatory system

.Gradual decrease in temp.

.Artificial heating of farm 12 hrs. before brooding of chicks (31 – 32 ^{0}C).



Relation between temperature & behavior of chicks

High temp:

.Birds are looking for cooler places

.Less active, spread-out wings and open beaks (rapid breathing).

.Increase water consumption (wet litter), while feed intake drops.

Low temperature :

.Come close together

.Close to heat source.

. Less active.

Artificial Heating:

1.Spot heating:

(For open farms)

2.Whole house heating

(for closed farms)

-Roof mounted heaters

- different capacities(75 – 200 Kcal) .

- Supplemental heat is usually needed in naturally ventilated grower houses to maintain desired indoor temperatures during cold weather.

- Different types of heaters are used for supplemental heating in poultry houses including radiant, space, and make-up air heaters.

Radiant Brooder

Pancake Brooder

Forced Air Furnace

Radiant Tube Heater

Step down heating program

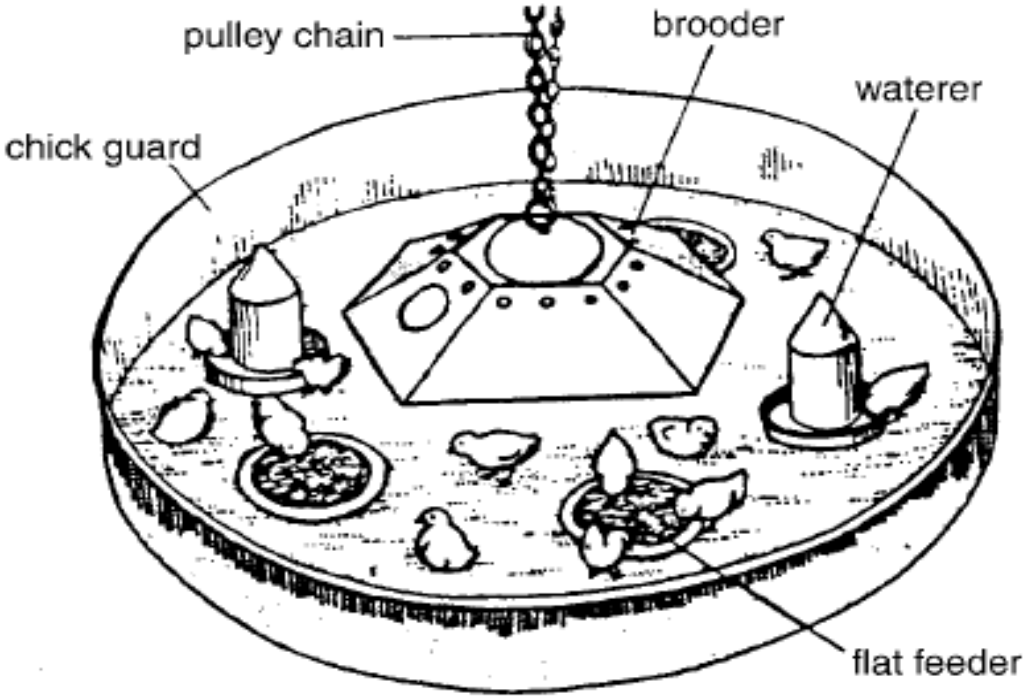
- Gradual reduction in temperature (0.4 C/ day) till comfortable zone.

-Each 1 m3 of air space needs 35 calorie/hr

- Don’t close the windows to rise temperature as this will affect the ventilation.

-Each bird needs heat of 6 Kcal/hr/kg LBW.

-Each bird emitted 6 Kcal/hr/kg LBW.



-Balance between heat gain and heat loss

-Heat gain normally = heat loss

Heat loss

- Radiation- conduction-convection (no evaporation as no sweating) and this begins at 29 ^{0}C of farm temp

-This to keep bird temp. at 40 – 41 ^{0}C

- If no heat loss, bird temperature will increase (2.3 ^{0}C/hr).

Effect of high house temperature

1.Alkalosis:

1- **Panting - reduction of CO2 conc. - Change of blood pH from neutral into alkaline - alkalosis**

2. Inactivate most enzymes

3.Disturbance in metabolism

4.Affect bird performance

2. Heat stroke

1.No heat loss so leading to heat stasis

2. At 40 0C lead to heat stasis and then heat stroke

3.Pulmonary and cerebral congestion

4.Off food and no activity

5 . **Death**

Effect of low temp:

.Bird will eat more feed just for warming

.Each 1 ^{0}C lower than 18 ^{0}C, the bird will eat additional ration (3.5 gram/hr.) without any increase in production.

Cooling the House

Pad and Fan System

Low pressure fogging system

Fog and Fan system

High pressure nozzle system

Artificial Cooling: Example

. Fog system (foggers)

.Evaporative pad cooling

.Desert cooler

.Ultra high pressure mister

Evaporation of 1 L. water reduces thermal energy in the farm by 560 – 600 calories

Fog system

.Pipe line (0.5 cm (thickness) hanged in ceiling

.The pipe has special nozzles (5 m. distance interval)

.Attached to high pressure pump

.Attach to timer (according to env. Temp.)

.Reduce temp. By 6 ^{0}C

Disadvantage

.Increase farm humidity

.Salts in water close the fine nozzles

Evaporative pad cooling

- Treated cellulose pad

- Resist water, bacteria and fungi

.5-15 cm. Thickness

- Apply extracting fans at the opposite side (tunnel ventilation)

- Decrease temp. to 10^{o} C (according to RH)

- Optimum cooling at 30% RH.

Sidewall and ridge openings

RainMaker with plastic pads

Double RainMaker for high cage houses

Curtains

Protection against wind, dust and no direct sunlight onto the Pad

Tunnel inlet with roller curtain

Automatic controls

- Automatic controls are needed to maintain the indoor temperature and provide air exchange as weather changes hourly and seasonally

- Controllers also regulate the supplemental heating rate. Sold state controllers and computer systems capable of controlling the inlet and outlet opening and supplemental heaters

Insulation

-A well-insulated building shell is needed to successfully naturally ventilate a poultry house. Insulation helps prevent condensation on the inside surfaces, reduce heat loss in cold weather, and reduce

solar heat gain in warm weather. Thermal buoyancy is enhanced by reducing building heat loss through the building shell.

2.Humidity

Sources:

- Normal humid air

- Expired air from birds

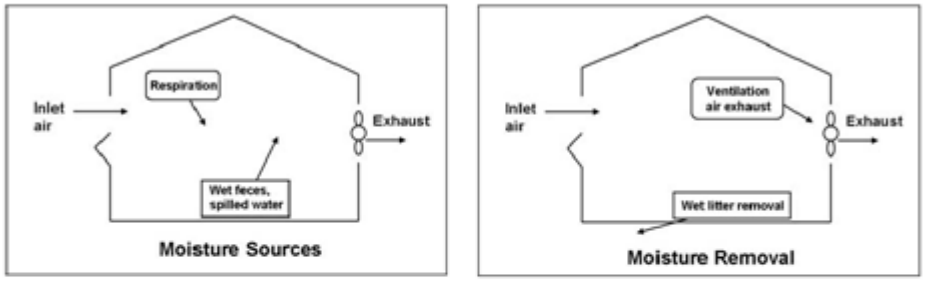
- Wet litter (each 1 kg LBW gives 100 cm water/day drinkers).

At brooding period, the RH should be 70%

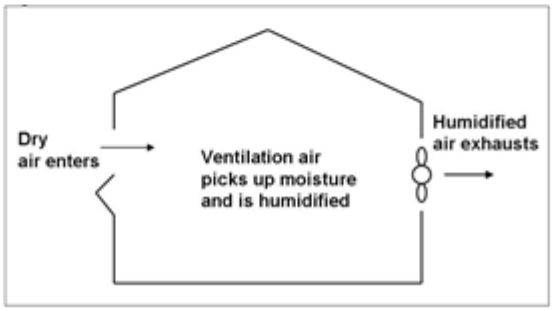
- If it decreased lead to dehydration of chicks

- Each 1 gram decrease in chick body weight due to dehydration results in 40 gram decrease in final body weight.

Moisture sources and removal in poultry houses.



Schematic of ventilation for moisture control.



Relation between Humidity & Temperature

Rise in humidity lead to increase bird sensation with temperature

3.Ventilation :

Natural in open house

Artificial in closed houses

Factors affecting natural ventilation:

- Geographical (north Egypt is differ than south)

- Farm aspect (north west)

- Farm width (not more than 10 m)

- Windows: a - not less than 20% of floor area

b -Equally distributed on two sides

- Trees or mountains will decrease ventilation.

Importance of ventilation:

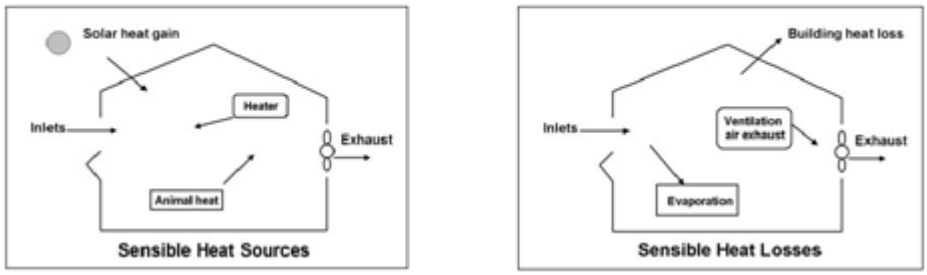
- Moving FRESH AIR INTO a house and moving STALE AIR OUT of the house.

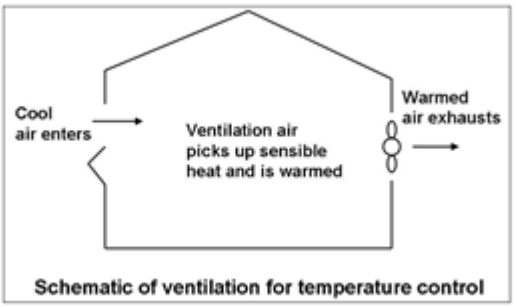
-Sending UNWANTED heat, EXCESS moisture, Ammonia OUT of the house.

- Limiting the buildup of HARMFUL GASES.

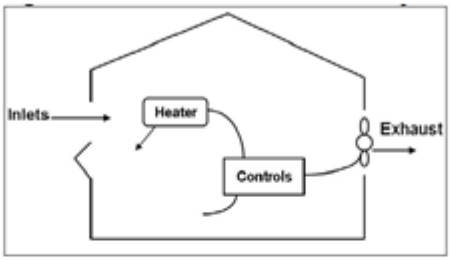
- Providing OXYGEN for respiration

Sensible heat sources and losses in a poultry house.

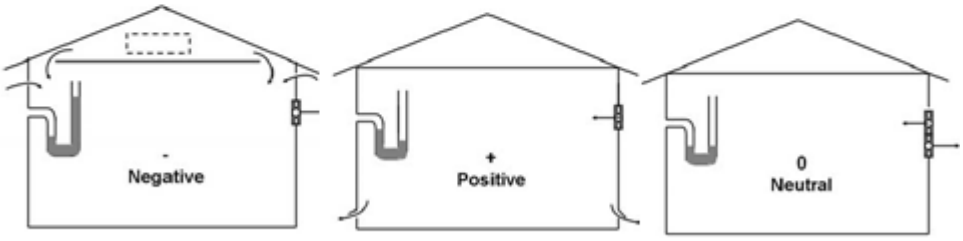




Schematic of a mechanically ventilated building and its components



Types of mechanical ventilation systems based on static pressure.



Improvement of natural ventilation

-Paddle fans (bad).

-Extraction fans under the windows (bad).

-Pushing fans in the side of air entrance (good).

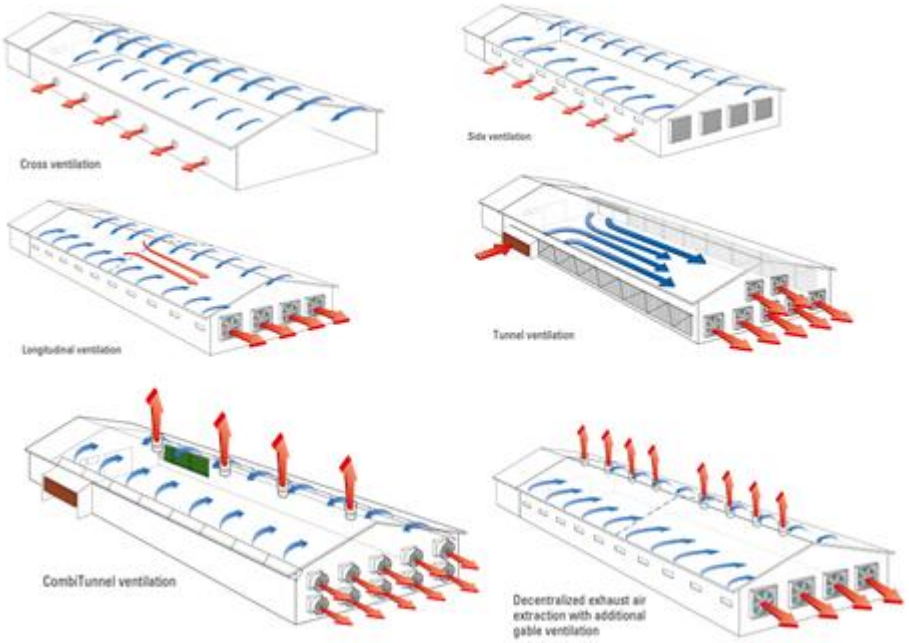
Ventilation in closed house

-Cross ventilation (suitable for caged layers)

-Roof extraction (suitable for one deck cages)

- Tunnel or longitudinal ventilation:

(Apply ext. Fans in face of cooling pad)


Cross ventilation
Side ventilation
Longitudinal ventilation
Tunnel ventilation
CombiTunnel ventilation
Decentralized exhaust air extraction with additional gable ventilation

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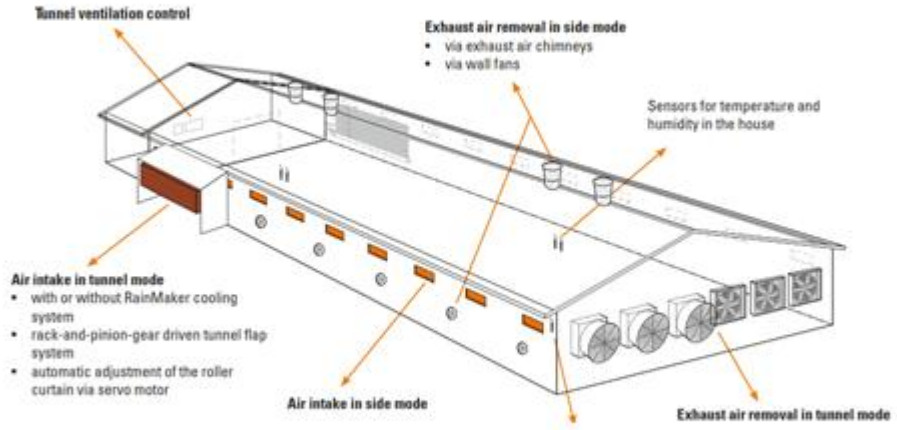
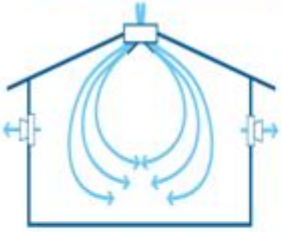

Tunnel ventilation control
Exhaust air removal in side mode
• via exhaust air chimneys
• via wall fans
Sensors for temperature and humidity in the house
Air intake in tunnel mode
• with or without RainMaker cooling system
• rack-and-pinion-gear driven tunnel flap system
• automatic adjustment of the roller curtain via servo motor
Air intake in side mode
Exhaust air removal in tunnel mode

- Different fan and air inlet setups are used in negative-pressure ventilation to achieve different purposes, according to prevailing conditions.

A. Exhaust fans on sidewalls and air inlets around the perimeter (high on sidewalls or in ceiling). This setup works well in cool weather and for use in tunnel ventilated houses operating in transitional mode.

B. Exhaust fans on one side of building and air inlets on the other. Commonly called "cross ventilation", this setup is most popular in areas where tunnel ventilation is not needed.

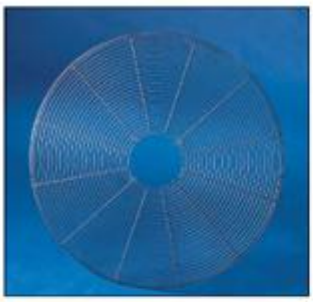
C. Exhaust fans in the roof and air inlets in the sidewalls. Often called "ridge extraction", this type of setup is also most used in cooler climates.



D. Exhaust fans in sidewalls and air inlets in the apex of the roof. Often called "reverse flow" ventilation, this setup is similar to setup **A** above except for the location of the air inlets.

Fans

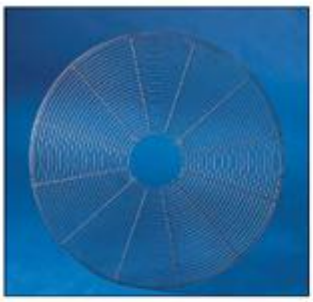
Fans are used in mechanical ventilating systems to supply the energy needed to exchange the desired amount of air in a poultry house each minute.



Wire mesh guard
A wire mesh guard is required if the fan is installed in an accessible location.

Shutters
This shutter is a self-actuated closing flap made of PVC. If the fan is at a standstill, the shutter is closed.

AirMaster with cone



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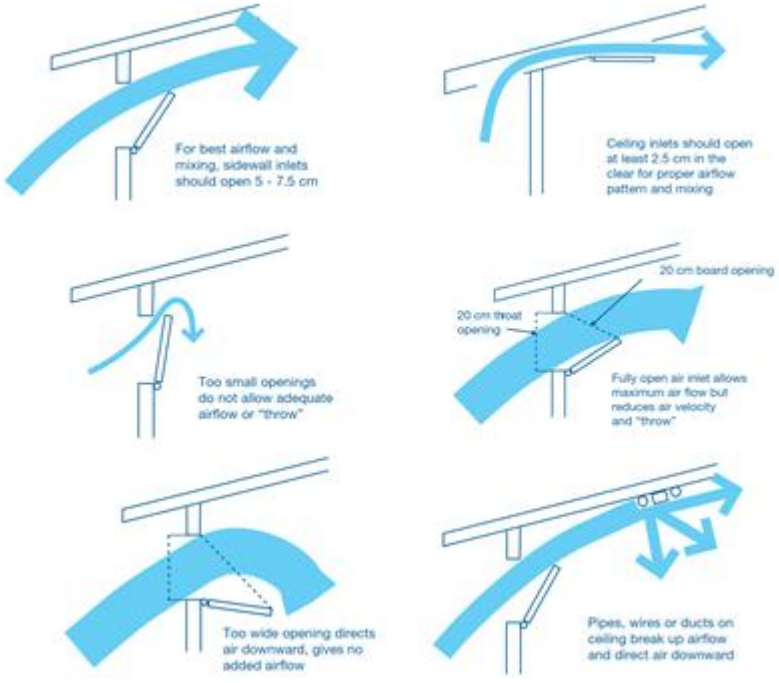


Fresh air chimney for negative pressure ventilation

Fresh air chimney for equal or positive pressure ventilation

Ascites:

- A multifactorial metabolic syndrome caused by exogenous and/or endogenous factors (interaction between environmental and genetic factors which occur among faster growing lines):

-Imbalance between O2 supply & O2 required.

- High altitude

-Decrease thyroid hormone

-Decrease development of pulmonary blood vessels

-Continuous photoperiod (24 hr. lighting)

-Env. Stress such as heat stress.

Relation between bad ventilation & ascites

Bad ventilation will lead to shortage in O2 supply - hypoxia - decrease O2 tension in blood - body try to compensate that by pass more O2 to lungs through right ventricle - overload on the right ventricle - flaccidity on its wall - rounded heart - right venous congestion as the contraction is decreased due to heart weakness - congestion in liver and

parenchymatous organs - effusion of plasma - ascites.

4.Light:

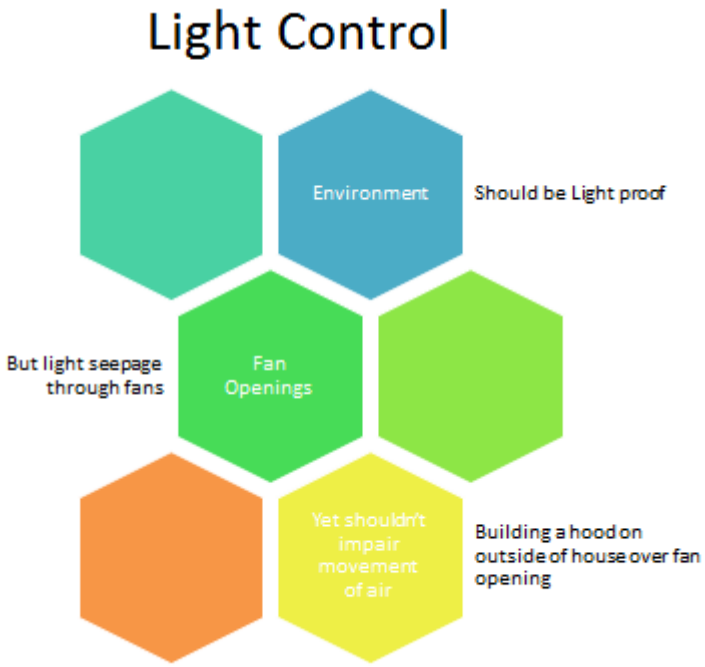
A) Light quality

White light: short wave length (good for human).

Red light: long wave length (comfortable for the retina of birds).

A monitoring and control system should provide scheduling of lights that is easy to use. It is especially important breeding facilities for precise lighting schedules to be followed

A system than can pre-program lighting schedules over the life of the flock is very useful for management. It is also important to provide the desired intensity of light.



B) Light intensity

Def: amount of light fallen on square area

Measuring units

- Feet candle

-Lux

Requirements

Broilers: 5 – 10 lux

Layers: 20 – 40 lux

Breeders: 80 – 100 lux

N.B: natural day light is 2500 lux

C) Lightening program

Broilers

Continuous photoperiod (24 hrs):

-exhausting of pituitary & optic nerve

- Cannibalism

- Consume more feed

Interrupted photoperiod (18 hr. light + 6 hr. dark)

-Dark hours are divided into 2-3 times

-Allow feed digestion

-Increase feed efficiency and assimilation

-Decrease weight loss

-Decrease cannibalism

Layers

- 24hrs. continuous photoperiod in ^{1st} 5 days

-Then gradual decrease till reach 9 hr. Light/day (extend to the 16th wks. of age).

-Then, according to manual of the commercial breed, increase lightening gradually to be 16.5 hr/day at 18-20th wks. to the end.

5.Stocking density

No, birds / m2

A) Broilers:

open system: (9 – 10 bird / m2)

closed system: (17 – 18 bird / m2)

B) Layers:

	Brown	White
Deep litter	7 / m^2	8 / m^2
cages	30 – 60 / m^2	

C) Breeders:

Open farms: 4.5 female / m2 + 10% males

Closed: 6 female / m2 + 10% males

6.Flock size:

-Number of birds housed in the house

-Relation with performance:

= Small flock → good performance

= good supervision and good follow-up-

= increase flock size will lead to over crowdness and bad ventilation.

7. Feeding :

Effects of nutrition

- Managers need to ensure that the diets provided to birds in commercial operations meet the nutrient requirements of each age group and strain of chickens (see Poultry Development Review on Poultry feed availability and nutrition in developing countries

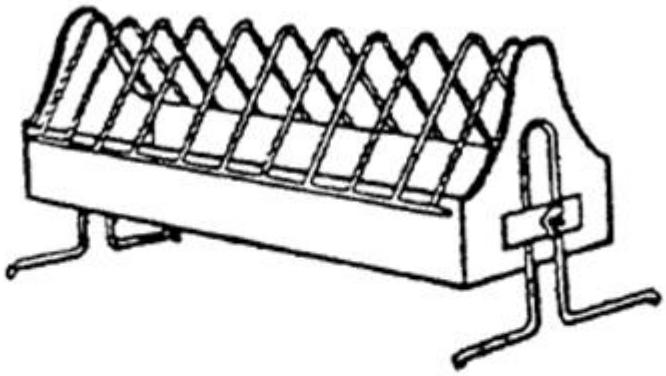
-Smallholder systems in developing countries typically place less emphasis on achieving maximum production and more on maximizing profitability by using diets comprised mainly of local feedstuff ingredients, rather than imported feeds. Key management practices by farmers who mix their own feed include ensuring that micro-ingredients are kept cool, mouldy ingredients are not used, and storage facilities are weather- and rodent-proof

Space allow for each bird to eat

Broilers	layers	Breeders
3 cm feeding space at 1st 3 wk.		
6 cm at 3 – 6 wk.		
	12 cm (after 6 wk.)	15 cm (after 6 wk.)

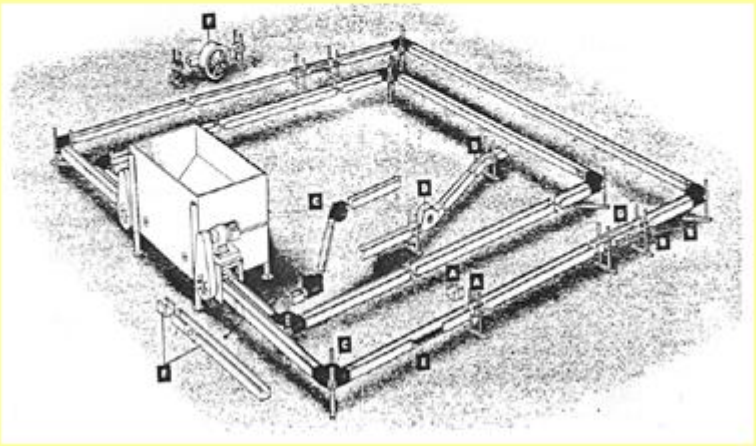
Feeding

- A feeding control system requires some way of knowing when to turn the feeders on and off. It is important for the same amount of feed to be available at all locations along the feeder.
- Feed monitoring systems are available to measure the amount of feed consumed by bird.



this feeder can be raised or lowered to fit different sizes of birds

Automatic chain feeder



8.Water:

-Water flow monitoring can be used to track how much water the broilers are consuming to quickly detect changes in flock behavior, or to spot problems with the water supply or distribution system

-There are 2400 nipples for 30,000 broilers which means as there are 12.5 birds/nipple



Importance of good hygiene

- **An essential management task is to maintain clean sheds, surroundings and equipment. A clean shed**

improves health and limits parasites, dust and microbial contamination, while clean shed surroundings reduce vermin and fly loads. This is important not only for litter and manure management but also for biosecurity.

- **Removal of residual feed from feeders is an important practice critical to the health of the flock. Another important management task is to sanitize sheds to minimize the risk of disease to incoming flocks of birds. Maintaining high flock health status is essential, and routine vaccination programmes for a number of diseases are typically in place, particularly in larger-scale operations.**
- **Some vaccinations are carried out at the hatchery, but it is essential that a proper vaccination schedule be established and that vaccination protocols be complied with.**

Conclusion

-The more environmental control a house has, the more it needs backups and fail-safes to prevent catastrophic losses from failure of the controls

-All backup or fail-safe systems should be as independent as possible; that is, not subject to failure because another system failed

-The best house orientation for optimum in-house conditions is with the roof ridge running at least approximately east-west

-Insulation to save heating fuel is essential; batt, board, and loose-fill insulation are superior

-Insulation under the roof or above the ceiling is essential in warm weather to keep solar heat from radiating down onto the flock

-Modern controls reduce management labour time but do not eliminate the need for a good manager

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