POULTRY FARMING

Introduction to Poultry Farming

Poultry farming can be defined as the process of raising various domestic birds like chicken, turkey, ducks, geese, etc. for their eggs or meat. This has been a common practice in Nigeria for such a long time that it has become an indispensable part of the farming and agriculture system.

Poultry farming can be considered one of the most lucrative agricultural business ideas in Nigeria today. It does not require huge capital to start as you can start from the comfort of your house if you have enough space to manage the number of birds that you desire.

Poultry Farming in Nigeria

The demand for livestock products, including poultry, is fast expanding in Nigeria and across Africa as a result of population growth and increased urbanization. Poultry farming is one of the fastest-growing segments in the Agricultural industry in Nigeria.

From a market size perspective, Nigeria's egg production is the largest in Africa followed by South Africa. The Nigerian poultry sector is extremely fragmented with most of the chicken raised in 'backyards' or on poultry farms with less than 1,000 birds.

Amongst all kinds of poultry farming - chickens, turkeys, geese, and ducks, chicken is the most common. The high consumption of the end product; chicken and egg are in constant demand in the marketplace making poultry farming very lucrative as it is a great source of animal protein outside fish, pork and beef.

About this Course

Are you planning to start your own poultry farm? If so, then you should enter the business well prepared by considering all of its aspects. Right from setting up some basic equipment to raising the birds and marketing your business, you have to take every step wisely.

This course on poultry farming will not just provide you with the right information, but also gives you step-by-step teaching on how to set up a profitable poultry farming enterprise.

Module 1: Poultry Species and Breeds

All species of poultry are used poultry farmers throughout the world. The most important species are chickens, guinea fowl, ducks, pigeons, turkeys and geese. The guinea fowl (*Numididae)* originated in West Africa; the Muscovy duck (*Cairina moschata*) in South America; pigeons *(Columba livea*) in Europe; turkeys *(Meleagrididae)* in Latin America; pheasants (*Phasianidae*) in Asia; the common duck *(Anas)* in Europe; and geese (*Anser*) in Asia.

A hen to cock ratio of about 5:1 is common. Both sexes are retained for 150 to 300 days, for culling, selling, home consumption and gifts, most of which require adult birds.

In the last 50 years, there has been a great advance in the development of hybrid breeds for intensive commercial poultry production. This trend is most noticeable in chickens, turkeys and ducks. The new hybrids (those of chickens in particular) are widely distributed and are present in every country, even in the most remote villages.

For the smallholder, keeping hybrids means considerable changes are required in management. These changes are expensive for the following reasons:

- All replacement day-old chicks must be purchased.
- Hatchery chicks require artificial brooding and special starting feed.
- Hybrids require higher quality balanced feed for optimum meat and egg production.
- Hybrids require more careful veterinary hygiene and disease management.
- Egg-laying hybrid hens require supplementary artificial light (a steadily increasing day length up to 17 hours of total light per day) for optimum (profitable) egg production.
- The meat and eggs from intensively raised hybrid stock are considered by many traditional consumers to have less flavour, and the meat to have too soft a texture. Consumers will thus often pay a higher price for village-produced poultry meat and eggs.

Guinea fowls

Guinea fowls are native to West Africa but are now found in many parts of the tropics, and are kept in large numbers under intensive systems in France, Italy, the former Soviet Union and Hungary.

They are very timid, roosting in trees at night, and although great walkers, they fly very little. Guinea fowls thrive in both cool and hot conditions, and their potential to increase meat and particularly egg production in developing countries deserves better recognition. The first egg is normally laid at about 18 weeks of age, and unlike many indigenous birds (which produce a single clutch a year), guinea hens lay continuously until adverse weather sets in.

In West Africa, laying is largely confined to the rainy season. Guinea hens under free-range conditions can lay up to 60 eggs per season, while well-managed birds under intensive management can lay up to 200 eggs per year. The guinea hen "goes broody" (sits on eggs in the nest) after laying, but this can be overcome by removing most of the eggs. A clutch of 15 to 20 eggs is common, and the incubation period for guinea fowl is 27 days. Domesticated guinea fowl under extensive or semi-intensive management in Nigeria was reported to lay 60 to 100 eggs with a fertility rate of 40 to 60 percent.

Ducks

Ducks have several advantages over other poultry species, in particular their disease tolerance. They are hardy, excellent foragers and easy to herd, particularly in wetlands where they tend to flock together. In Asia, most duck production is closely associated with wetland rice farming, particularly in the humid and subtropics. An added advantage is that ducks normally lay most of their eggs within the three hours after sunrise (compared with five hours for chickens).

Pigeons

Pigeons are scavengers (not fed any supplementary feed) in most countries, living on the roofs of houses and treated as "pets" that do not need to be fed. They appear to prefer homestead compounds to fields. In some countries, they are eaten only for ritual purposes. They normally lay two eggs in a clutch, and the young birds (squabs) hatch after 16 to 17 days. The growing squabs are fed by their mothers on *crop milk*, produced in the mother's crop (first stomach). This enables young squabs to grow very rapidly. They reach maturity in three to five months at a bodyweight of 200 to 300 g for males, and 150 g for females. Adult pigeons are monogamous for life.

Local pigeons are specific to different regions in the tropics. Africa has five breeds, within which Chad has three local breeds. Asia and the Pacific have five breeds, with local breeds found specific even to the Cook Islands.

Turkeys

These birds are native to Latin America. The breeds kept by rural producers in the tropics usually have black feathers, as distinct from the white-feathered breeds that are raised intensively. Where there are no geese and ostriches, they are the largest birds in the farming system. Bodyweight ranges from 7 to 8 kg in males and from 4 to 5 kg in hens. They have good meat conformation, produce about 90 eggs per year and have medium to good hatchability. They are more susceptible to disease than either chicken or ducks.

Chickens

Chickens originated in Southeast Asia and were introduced to the rest of the world by sailors and traders. Nowadays, indigenous village chickens are the result of centuries of cross-breeding with exotic breeds and random breeding within the flock. As a result, it is not possible to standardize the characteristics and productive performance of indigenous chickens.

In Nigeria today, aside from locally grown chickens, two major breeds are common among poultry farmers.

Broilers: Young males and Females raised for meat. They grow from a hatch weight of 40 g to a weight of approximately 1.5 to 2 kg within 6 weeks only.

Layers: Hens used for commercial egg production and then killed for meat. Layer chickens are raised from one day old. They start laying eggs at the age of 18-19 weeks and continue until they are 72-78 weeks of age.

Cockerels: Just like the broilers, cockerels are also for meat production and have a special market demand but then, its growth is very slow, unlike the broilers that grow very fast. Cockerels, however, can survive in many environments.

Module 2: Feed Resources

A regular supply of low-cost feed, over and above maintenance requirements, is essential for improved productivity in poultry farming systems. When feed resources are inadequate, a few birds in production are better than more birds just maintained, but without enough food for production.

Extensive Feeding Systems

Under the free-range and backyard systems, feed supplies during the dry season are usually inadequate for any production above flock-maintenance level. When vegetation is dry and fibrous, the scavenging resources should be supplemented with sources of minerals, vitamins, protein and energy. Under most traditional village systems, a grain supplement of about 35 g per hen per day is given.

Semi-Intensive System

Under the semi-intensive system, all the nutrients required by the birds must be provided in the feed, usually in the form of a balanced feed purchased from a feed mill. As these are often expensive and difficult to obtain, smallholders use either unconventional feedstuffs or "dilute" the commercial feed by supplementing it with grain by-products (which supply energy and some protein).

A well-balanced feed, however, is difficult to achieve, as grains and plant protein sources (the by-products of a few oil seeds) are becoming increasingly

unavailable for livestock, and premixed trace minerals and vitamins are usually too expensive for smallholders.

Phosphorus and calcium can be obtained from burnt and crushed bones; and calcium from snail shells, fresh or seawater shellfish shells, or limestone deposits. Salt to supply sodium can come from evaporated seawater or land-based rock salt deposits.

These mineral sources are rarely used. Feed provided for birds kept under this system is therefore of a much poorer quality (unbalanced by dilution with crop by-products) than under either the extensive or fully intensive system.

Available Feed Resources

The size and productivity of the flock ultimately depend on the human population and its household waste and crop residues, and the availability of other scavengable feed resources. Note, however, that there is a clear relationship between egg production and nutrient intake.

Feed Ingredients

The following descriptions may supplement the above source.

Cereals and cereal by-products

Examples of grains for supplementing scavenging poultry include millet, sorghum, maize, and rice in the form of whole and broken grains. Amounts supplied are inadequate when using the surveyed estimate of 35 g supplement grain/bird/day. This and the tannin content of sorghum have led to a search for alternative grains and the evaluation of agro-industrial by-products.

Dehulled rice grain

This can be used with vegetable and animal protein supplements for all types of poultry. Rough or paddy rice, off-coloured rice and broken rice have been used up to 20 to 30 percent in poultry rations. Rice bran has a moderate quality protein of 10 to 14 percent, approximately 10.4 MJ of ME/kg (2 500 kcal of ME/kg), and about 11 percent Crude Fibre (CF). It is rich in phosphorus and B vitamins. Because of its high oil content (14 to 18 percent), it easily goes rancid. For this reason, it should make up no more than 25 percent of the ration.

Maize starch residue (MSR)

This is a by-product of the extraction of starch from fermented, wet-milled maize, which is used as a breakfast cereal in West Africa. It usually has more than 16 percent Crude Protein, although the amount varies according to the maize variety and processing method.

By-products from local breweries and other local industries

Brewer's grain and yeast have become common ingredients for poultry rations, but the process of drying the wet by-product can be very expensive.

Legumes and legume by-products

Non-traditional legumes, such as boiled jack bean (*Canavalia ensiformis*) and sword bean (*Canavalia gladiata*), are acceptable to laying hens, although they should not form more than ten percent of the ration because the sword bean is of low nutritive value. Winged bean (*Phosphocarpus tetragonolobus*) contains approximately 40 percent Crude Protein and 14 percent oil, and its overall nutritive value is very similar to that of soybean and groundnut cake for broiler meat chicken (Smith *et al.,* 1984).

Winged bean leaf foliage is also acceptable to laying hens. Unless the plant is grown with stake supports, the yield is very low, which makes its cultivation on a

large scale less economical. However, it is suitable as a feed and fodder crop for smallholder poultry.

Soybean (Glycine max)

This crop is being grown increasingly for human consumption. If the cotyledons (fleshy beans) are used for human food, the testa (bean-seed coat) is given to poultry. Raw soybeans heat-treated by boiling for 30 minutes and then fed to scavenging birds in amounts of up to 35 percent of the ration resulted in satisfactory performance in broilers and laying hens.

Oilseeds

Oilseeds in full or partly oil-extracted form are a source of both energy and protein for extensive and intensive poultry systems.

Cotton (Gossypium spp.)

Glanded cotton seed cake (CSC) is a high-demand supplement fed to ruminants, but if available it can be fed in amounts up to 25 percent in the diets of layers and broilers without adversely affecting egg production and growth.

Birds are tolerant of the gossypol found in CSC, but it can cause an olive discolouration of egg yolks, which consumers do not like. Addition of 0.25 percent ferrous sulphate should be added routinely to laying hen rations containing up to ten percent CSC.

Sesame (Sesamum indicum)

The feed consumption and conversion rates for birds fed various forms of raw unhulled sesame seeds were better than those for birds fed dehulled but whole sesame seeds, confirming the practice of smallholders who use whole sesame

seeds as a supplement for scavenging poultry. Sesame seeds should be used in amounts between 20 and 35 percent of the ration.

Groundnuts (Arachis hypogaea)

Groundnuts may be used in the oil-extracted cake form to make up 8 to 24 percent of the ration. Mouldy groundnuts may contain toxic substances, the most dangerous of which is aflatoxin.

Animal protein

Blood meal

This is recognized as a high crude protein source with an imbalanced, relatively poor amino acid profile. Handling and processing of blood are difficult in low-technology situations. For processing small amounts, one method is to absorb the blood on a vegetable carrier such as citrus meal, brewers' grain, palm kernel, ground maize, cob rice or wheat bran, after which the material is spread out for drying on trays heated from below or placed in the sun. At the farm level, the blood may be supplied from the slaughter of livestock. Abattoirs and slaughterhouses provide large volumes of blood for making up feeds at the commercial level.

Earthworms

In an area of 25 m2, one kg of fresh earthworm biomass was produced daily. This is sufficient to supplement at least 50 chickens with high-quality protein. It must be noted, however, that earthworms (and snails as well) may be important vectors for tapeworms such as *Davainea* and *Raillietina* and also contain a growth inhibitor.

Module 3: General Poultry Management

Housing and Runs

The basic requirements for poultry housing are:

- Space
- Ventilation
- Light
- Protection (from weather and predators)

Space - This is the most important basic principle in housing, as the space available determines the number and type of poultry that can be kept. For example, a deep litter house measuring 6m by 11m can hold 200 laying hens at a stock density of 3 birds/m2 (3.6 ft2/bird).

Linear space or length of perch per bird is measured in centimetres. Hen groups are comfortable at a stock density of three to four birds per square metre. If more space is allowed, a greater variety of behaviour can be expressed. Less space creates stressed social behaviour, allowing disease vulnerability and cannibalism and leaving weaker birds deprived of feed or perch space.

Individual birds need more room for normal behaviour and adequate exercise than the 22 birds/m2 (0.5 ft2/bird) density currently used in commercial laying cages. Over recent decades, animal welfare concerns have encouraged research on laying cage structures to make designs better suited to the needs of hens, while retaining cost-effectiveness for production.

Ventilation - Ventilation is an important factor in housing. A building with open sides is ideal, otherwise, cross-ventilation at bird-level should be allowed for in the form of floor level inlets, open in a direction to allow the prevailing wind to blow across the width of the building.

An air mass between the sidewalls of a poultry house resists being moved, even across an open-sided building. The wider the building, the more the resistant it is to air movement. Buildings over 8m (26ft) wide have a significantly greater problem because of this inherent property of air to resist movement. It is recommended that buildings relying on natural airflow for ventilation should not exceed 8 m in width.

Heat stress is a significant constraint to successful production and can lead to death. Although birds can withstand several degrees below freezing, they do not tolerate temperatures over 40°C. This depends on the relative humidity prevailing at the time. Poultry do not possess sweat glands and must cool themselves by panting out water in their breath, which is evaporative cooling.

When the humidity is too high, this cooling mechanism does not work very well. Lethal temperatures for most chickens are 46°C upwards, and severe stress sets in above 40°C. In temperate regions, the chicken house may be constructed to face the rising morning sun to gain heat. In the tropics, however, an east-west orientation of the length of the building helps to minimize exposure to direct sunlight.

Building materials such as tin or other metal should be avoided for this reason, although white paint will reflect up to 70 percent of incident solar heat radiation. Ventilation concerns in building alignment may prevail over solar heat control in this aspect, as cross-flow ventilation requires the side of the building to face the prevailing wind.

Ground cover can also reduce reflected heat. Shade should be provided, especially if there is little air movement or if humidity is high. With no shade, or when confined in higher temperatures, poultry become heat stressed and

irritable and may begin to peck at one another. When new pinfeathers are growing (especially on young stock), blood is easily drawn, which can lead to cannibalism.

The effects of heat stress are:

- Progressive reduction in feed intake as ambient temperature rises
- Increase in water consumption in an attempt to lower temperature
- Progressive reduction in growth rate
- Disturbances in reproduction (lower egg weight, smaller chicks, reduced sperm concentration and an increased level of abnormal sperm in cocks).

Light - A well-lit house is essential. A dark house leads to lethargic, inactive, unproductive birds. Light is important for feeding, as poultry identify food by sight. This is especially important for intensively managed day-old chicks, which need very bright 24-hour lighting for their first week of life.

Light is also an important factor in sexual maturity. An increasing light proportion in the day, as naturally occurs from mid-winter to mid-summer, will accelerate sexual maturity in growing pullets, bringing them to lay sooner. If hens are already laying, the increasing light proportion will increase egg production.

The opposite effect is also true: as the light proportion of the day decreases (as naturally occurs from mid-summer to mid-winter), then sexual maturity is slowed in growing stock, and egg production is reduced in laying hens. These effects are somewhat reduced towards the equator, as the difference in the daylight proportion of a day changes less and less.

This physiological effect on poultry is important in terms of maintaining egg production in commercial flocks and requires supplementary lighting

programmes. Regular and reliable electricity supply is required for such programmes, otherwise, the effect can be made worse by breaks in the light supplementation system. A slow but steady increase maximises the rate of production.

However, lighting programmes producing an effective daylight proportion over 17 hours per day can have a worsening effect on egg production. A 24-hour security lighting system can have such an effect on egg production.

Birds do best in situations where there is plenty of natural light that does not raise the temperature of the house. Natural light is preferable unless regular, reliable and well-distributed artificial light can be provided. It is recommended that the interior of the house be whitewashed to reflect light. The intensity or brightness of the light is also important. Egg production will decrease at light intensities lower than five lux (the "lux" is the metric unit of light intensity and can be measured by a meter similar to that measuring light intake into a camera lens), although meat chicken will keep growing optimally at light intensities as low as two lux (not bright enough to read a newspaper).

These intensities are measured at the eye-level of the bird, not near the light source. Unless supplementary lighting is spaced uniformly, there may be areas in the building insufficiently lit to allow optimum growth or egg production. Designs for layout assume that the light bulbs or tubes will be kept clean, as dusty surfaces will reduce light output.

Protection - Many factors influence the type and choice of housing to protect poultry from the effects of weather and predators. These include the local climate, the available space, the size of the flock and the management system.

In extensive systems, birds must be protected from disease and predators but also be able to forage. Traditional large animal fencing using live plants is not enough protection against predators such as snakes, kites, rats and other vermin.

A simple and effective system to deter predator birds is to tie parallel lines of string across the main scavenging area, the intervals between which measure less than the predator's wingspan; alternatively, a fishing net supported on poles can be spread across the side of the run where predator birds could swoop on the scavenging chicks.

Leg traps can be set for large predators. It is not necessary to set traps around all the pens, as predators tend to attack the same pen on the second night. Steel traps can be boiled in walnut hulls or cocoa pods, both to camouflage them and to prevent rust. The traps will be more effective if not touched with bare hands, as most predators have a keen sense of smell. Instead, they should be handled with a stick, rubber gloves or tongs.

Rats, mongooses and snakes are only a problem when the birds are small. Rats often come up through the earth floors, and the first signs of a rat attack may be unusually quiet chicks huddled under the brooder heater or in a corner, or dead chicks with small bloody neck scratches. Snakes will kill chicks if they can get into the brooder house. A treble fishhook in a dead bird can be left as bait: the snake will swallow the hooks as it gulps down the bird and eventually dies. Holes around doors and windows through which rats and snakes may enter should be plugged.

Coops or baskets may be used to house mother hens and chicks to reduce chick mortality due to predators, thieves and rain. They also allow for separate

feed and water supplementation, although the inadequate feed usually provided in coops means that some scavenging remains necessary.

Construction - The floor is extremely important. An ideal floor for a deep litter house is well-drained and made of concrete, with a layer of heavy gravel or wire mesh embedded in it to keep out rats. This type of floor is usually costly.

Wood, bamboo, bricks or large flat stones (according to what is locally available) can be used, but are harder to clean. Clay floors are cheaper, but require the application of a fresh layer of clay either between flock batches or at least annually. In areas where construction materials are cheaper than deep litter, and particularly in humid regions where litter material is not available, raised floors are sometimes used. These are made of wire mesh, expanded metal, wooden slats or split bamboo, to allow the droppings to collect under the house, and should be about one metre above the ground to allow for cleaning and ventilation.

Higher floors may result in an unstable building. They are supported by pillars, which are either rot-resistant or have stone or concrete footings, and which are made of such materials as wood, bamboo, oil drums and concrete blocks. Houses with raised floors on posts can be protected against rats with baffles. The baffles can be made of a metal collar, a tin can turned upside-down or a metal band wound around the post, but must fit tightly to deter even the smallest rodent.

The roof and walls of the house can be made of any inexpensive local material, including bamboo slats, sorghum stalks, mud, wooden slats and palm fronds, as long as the structure is made relatively rat-proof. In colder regions, the walls should be thicker or insulated, but in warmer climates thatch can be used,

although it should be replaced frequently to minimize parasite and disease problems. The inside of the walls should be as smooth as possible, to prevent tick and mite infestation and to make cleaning easier. Interior length-ways building partitions are not advisable, as they reduce cross-flow ventilation.

The roof should be watertight and should overhang the walls by one metre if the windows have no shutters. The roof can be made of thatch, sheet metal or tiles. Thatch is usually the cheapest option and provides good insulation. It will probably have to be replaced every three years, or immediately if ticks get into it. It should be interlaced with bamboo or wooden slats to keep predators out. Sheet metal is usually too expensive, and in hot climates must be painted with white or aluminium to reflect solar heat. However, it is easily cleaned which is an important advantage where ticks are a problem. A layer of plastic sheeting sandwiched between bamboo slats is a good seal against rain and vermin.

Chickens need more ventilation than humans but should be sheltered from wind, dust and rain. During storms, wood or bamboo hinged shutters or curtains made from feed sacks can cover window openings on the windward side of the house. In humid climates, window design should take as much advantage of the wind direction as possible to reduce the amount of moisture in the house.

The maximum width for an open-sided poultry building, under conditions of a slight breeze, which allows air movement across the shed at the height of the bird, is 8m (26ft). To maximize the volume and velocity of airflow across the shed width, the end walls of the shed should be closed. This forces the air to flow across the shed width, especially if the wind is not already coming from that side. Centre ridge ventilation is not recommended, as it discourages airflow across the full shed width. Air enters at the prevailing wind side and is drawn up at the centre to exit at the ridge, excluding the other half of the building.

Providing Feed

In both intensive and semi-intensive systems, laying hens need constant access to food and water, and feeders should be distributed evenly throughout the chicken house. In the semi-intensive system, birds scavenge during the day, mostly for protein (from such sources as insects, worms and larva), minerals (from stones, grits and shells), and vitamins (from leafy greens, oil palm and nuts), but energy supplements such as maize, sorghum and millet are important for higher productivity and should be given.

Feeders

A good feeder should be:

- Durable enough to withstand frequent cleaning
- Stable enough not to be knocked over
- The correct height and depth
- Bird-proof (such that birds cannot get into it or roost in it)
- Equipped with a lid to prevent birds from spooning feed out onto the floor with their beaks.

The height of the feed inside the feeder, which should never be more than one-third full, should be level with the back of the birds, to prevent them from scratching contaminated litter into the feeders and to limit feed wastage. This is achieved by adjusting the height of the feeder itself.

To reduce spoilage and mould problems, feed should be supplied at sunrise and at about 14.00 hours (or more frequently if the birds empty the feeder), with all feed finished by sundown.

Feeders can be made of wood, sheet metal or bamboo, and are best suspended from the roof to keep rats out. The height of the feeder should be adjustable. The supplementary vegetable matter should be fed at beak level, either hanging from the ceiling wrapped in a string or placed in a net or placed in a floor-standing hopper with wire or slatted sides. It should not be thrown on the floor.

Feeder space is measured as the linear distance of lip available to the birds. This is either the circumference of a round tube-feeder tray or twice the length of a trough if the birds feed on both sides. If troughs are used, at least 10cm of feeding space should be accessible to each bird. When circular feeders are used, there should be at least 4cm feeding space per bird.

Providing water

Providing clean water is a priority often neglected. The amount of water, the right type of equipment and where it is situated are important considerations.

Baby Chick Management

Baby chicks should be kept warm and dry. The nest, which they share at night with the mother hen, must be kept clean. In colder climates (below 20 °C at night), the nest site should be kept warm by lining it with straw and placing it near a stove or fireplace.

The chicks should remain with the mother hen for nine to ten weeks, learning from her example how to scavenge and evade predators and other dangers. Clean drinking water and fresh feed in a clean container should be provided to supplement scavenging. See Chapter 3 "Feed Resources" for more detail on feeding techniques.

A suitable strategy for rearing chicks, therefore, would be as follows:

- The chicks should be confined for the first weeks of life and provided with a balanced feed.
- A vaccination programme should be followed.
- Sufficient supplementary feed should be provided during the remaining rearing period to allow the chickens to develop following their genetic potential.
- Feed supplements and protection should be provided to naturally brooded chickens during the first four to eight weeks of life.

The mortality rate of naturally brooded chicks, whose only source of feed is from scavenging under free-range conditions, are very high and often exceed 50 percent at up to eight weeks of age.

An efficient way of decreasing the mortality rate, which is a costly loss, is to confine and vaccinate the chicks during the rearing period. This, however, is more expensive as the cost of feed increases production costs. They are fed approximately 2kg each of balanced feed and thereafter kept under semi-scavenging conditions. At eight weeks of age, they are less susceptible to attacks by predators and more resistant to diseases, due to their larger body weight and more effective vaccination immunization (due to their better nutrient intake).

HYGIENE

Manure management

Whatever the type of confinement, proper attention must be paid to manure management. Adult birds produce 500g of fresh manure (70 percent moisture content) per year per kg of body weight. To preserve its fertilizer value, manure should be dried to about 10 to 12 percent moisture content before storage. This

will retain the maximum nitrogen content for fertilizer value. Nitrogen in the form of urea is the most volatile component of manure and is lost as ammonia if the moisture content is too high in the stored material.

If the moisture content is too high, then the stored manure releases ammonia, carbon dioxide, hydrogen sulphide and methane, which can have serious physiological effects on humans. Some of these components are also greenhouse gases, which contribute to the global increase in ambient temperature.

Poultry manure is very useful as an organic fertilizer, as animal and fish feed and as a raw material for methane gas generation in biogas plants for cooking fuel.

Other hygiene management measures

Good ventilation discourages the spread of diseases and pests. In overnight houses, the provision of perches or loosely plaited bamboo mats (such as those used for sieving) placed on the floor can help to keep them dry.

The practise of keeping chickens and ducks together should be discouraged. This results in wet floors, giving rise to diseases such as Fowl Cholera. Ducks are also much more tolerant than chickens to Newcastle Disease and are thus often carriers of this viral disease. Adults and young stock of any poultry should be housed separately to minimize cross-infections and injuries from bullying.

Module 4: Incubation and Hatching

Natural Incubation

The broody hen chosen for natural incubation should be large (to cover and thus keep more eggs warm), healthy and preferably vaccinated, with a good brooding and mothering record. Signs of broodiness are that the hen stops

laying, remains sitting on her eggs, ruffles her feathers, spreads her wings and makes a distinctive clucking sound. Brooding may be induced with dummy eggs or even stones.

Eggs usually become fertile about four days after the rooster has been introduced to the hens. A maximum of 14 to 16 eggs may be brooded in one nest, but hatchability often declines with more than ten eggs, depending on the size of the hen. Feed and water provided close to the hen will keep her in better condition and reduce embryo damage due to the cooling of the eggs if she has to leave the nest to scavenge for food.

The hen keeps the eggs at the correct humidity by splashing water on them from her beak. This is a further reason for providing her with easy access to water. In very dry regions, slightly damp soil can be placed under the nesting material to assist the hen in maintaining the correct humidity (between 60 and 80 percent). Fertile eggs from other birds are best added under the brooding hen between one and four days after the start of brooding.

The incubation period for chicken eggs is 20 to 21 days and increases up to 30 days for other poultry. After sitting for some days, a broody hen can be given some newly hatched chicks and, if they are accepted, the original eggs can be removed and replaced with more chicks. Thus, hens with a better record of mothering can be better utilized for their abilities.

Eggs initially need a very controlled heat input to maintain the optimum temperature of 38°C, because the embryo is microscopic. As the embryo grows in size (especially after 18 days), it produces more heat than it requires and may even need cooling. Moisture levels of 60 to 80 percent Relative Humidity

(increasing during the incubation period) are important to stop excess moisture loss from the egg contents through the porous eggshell and membranes.

Factors to consider for successful natural incubation include the following:

- Feed and water should be close to the hen.
- The broody hen should be examined to ensure that she has no external parasites
- Any eggs stored for incubation should be kept at a temperature between 12°C and 14°C, at high humidity of between 75 to 85 percent, and stored for no longer than seven days.
- Extra fertile eggs introduced under the hen from elsewhere should be introduced at dusk.
- The eggs should be tested for fertility after one week by holding them up to a bright light (a candling box works best. If there is a dark shape inside the egg (the developing embryo), then it is fertile. A completely clear (translucent) egg is infertile.

A hatchability of 80 percent (of eggs set) from natural incubation is normal, but a range of 75 to 80 percent is considered satisfactory. The setting of hatchings is best timed so that the chicks to be hatched are two months of age at the onset of major weather changes, such as either the rainy or dry season.

A plentiful natural food supply over the growing period of the chicks will ensure a better chance for their survival. Successful poultry species instinctively lay and incubate their eggs at a time of the year when newly hatched chicks will have a better supply of high protein and energy food provided by the environment. For example, guinea fowl will only lay eggs in the rainy season.

Artificial Incubation

There are many commercial artificial incubators of varying capacities. Most depend on electricity, but some use gas or kerosene for heating. All use a thermostatic switching device to keep the temperature constant within one Celsius degree. The correct humidity is usually maintained by having a predetermined surface area of water appropriate for each incubator chamber.

Turning the egg several times each day is important to prevent the embryo from sticking to the shell membranes. With hand-turning systems, an odd number of times turned per day (5 - 7 times) will ensure that during successive overnight periods the egg is always oriented the opposite way from that of the previous night. The broody hen carries out all of these incubation tasks instinctively, and artificial incubation attempts to duplicate these tasks.

By candling the eggs between days 5 and 7, infertile eggs can be detected as "clears" (as the light is not obscured by the growing embryo). These eggs are still suitable for sale for human consumption, which improves the economic viability of this system. Placing the egg on the upper eyelid allows the egg temperature to be assessed.

Eggs in the advanced stages of incubation produce a lot of heat, so on days 18 to 19, the "old eggs" are transferred to hatcher, where they are placed in a single layer for final development and hatching.

Module 5: Poultry Health Management

The best fed and housed stock with the best genetic potential will not grow and produce efficiently if they become diseased or infested with parasites. Therefore, good **poultry health management** is an important component of poultry production. Infectious disease-causing agents will spread through a flock

very quickly because of the high stocking densities of commercially housed poultry.

For poultry health management to be effective, a primary aim must be to prevent the onset of disease or parasites, to recognize at an early stage the presence of disease or parasites, and to treat all flocks that are diseased or infested with parasites as soon as possible and before they develop into a serious condition or spread to other flocks.

To be able to do this it is necessary to know how to recognize that the birds are diseased, the action required for preventing or minimizing disease and how to monitor for signs that the prevention program is working.

Principles of health management

The key principles of poultry health management are:

1. Prevention of disease
2. Early recognition of disease
3. Early treatment of disease

As much as is possible disease should be prevented. It is easier and less damaging to prevent disease than it is to treat it.

However, it must not be assumed that all disease can be prevented. Inevitably, some will get past your defences, in which case it becomes imperative that the condition is recognized as early as possible to allow treatment or other appropriate action to be implemented as soon as possible to bring the situation under control to limit damage to the flock.

Poultry Disease Prevention and Management

Routine preventative measures form the next line of defence against disease, after providing a clean and hygienic environment through good poultry farming practices. Preventative measures include:

- Vaccination
- Parasite control
- Identifying and treating sick birds
- Separating multi-age flocks
- Practising routine biosecurity procedures between flocks and staff working with them.

Vaccination

Vaccination can prevent many poultry diseases. Follow a suitable vaccination program or only buy appropriately vaccinated stock. You can request vaccination certificates from your supplier when purchasing chicks or pullets.

Poultry vaccinations include:

- Avian encephalomyelitis
- Chicken anaemia
- Egg drop syndrome 76 (EDS 76)
- Fowl cholera
- Fowlpox
- Infectious bronchitis
- Infectious bursal disease
- Infectious coryza
- Infectious laryngotracheitis
- Marek's disease
- Newcastle disease

For breeders of poultry, when vaccinating, always follow the instructions on the label, including storage conditions. Ensure you use disposable syringes and needles.

All unused vaccines, syringes and needles should be discarded. Maintain proper hygiene, but never use detergents or disinfectants near vaccination equipment. Also, do not disinfect the skin before vaccinating with fowl pox or Marek's HVT vaccine, as this will kill the vaccine virus.

Parasite Control

Birds that are housed on the floor and have access to pastures and outdoor areas will have greater exposure to internal and external parasites. For birds housed in these conditions, it is important to have a prevention program in place and treat as required. This helps to minimise physical stress and keep birds in good condition so they can resist disease.

Parasites can be controlled using the following methods:

- Regularly inspecting birds for external parasites
- Spraying or dusting birds thoroughly with an approved insecticide
- Cleaning sheds and rotating ranges to prevent worms
- Regularly checking faecal material for any sign of worms
- Always checking the label on worming treatments for withholding periods as some are not suitable for production birds
- Consulting a veterinarian

Remove Sick Birds

Regularly observe your birds for any signs of ill health or problems within the flock such as feather pecking. Remove sick chickens and other poultry from the main

flock and obtain a diagnosis from a qualified person. Sick birds usually appear different from healthy birds. You can give the correct treatment once you identify the disease or problem. Keep ill birds quarantined from the flock until completely recovered. If medication is given, it is important to adhere to any withholding periods.

Multi-age Flocks

When introducing younger birds into a flock of older birds, there is an increased risk of disease transfer from the older birds to the younger birds. Older birds often build resilience to diseases and disorders that younger birds have not been exposed to.

There may also be an increased risk of feather pecking and social issues when introducing new birds to a flock. It is preferable from a disease perspective to run single-aged flocks. However, if this is not possible and you are running multi-age flocks, then you should keep age groups separate - have an all-in and all-out system for each age group to allow for complete clean and disinfection of facilities and equipment between batches. Always start work with younger poultry and finish with the oldest.

Module 6: Breed Improvement

Strategies to develop poultry breeds suitable for family poultry smallholders in tropical countries must differ from those used in intensive production and should focus on improving indigenous breeds while also making use of pure exotic and cross-bred chickens where appropriate.

Conservation of local breeds possessing genetic variations specific to the particular environment is essential for sustainable development. Although they exist as numerically small populations, local breeds are not only highly adapted

to the natural environment but are also an integral part of the lifestyle of the rural people. People, livestock and environment form a delicately balanced but sustainable ecosystem, and thus the potential impact of any intervention to improve production in the traditional system should be predetermined.

The situation is less sensitive in peri-urban, industrial and small-scale intensive poultry production, in which rapid improvements can be achieved through well-designed development programs. The intensive poultry production sector, however, is generally much smaller than the family poultry sector in virtually all developing countries.

Cockerel or Pullet Exchange

An example of this type of strategy is a flock of indigenous local hens laying 50 eggs a year and beginning to lay at 25 weeks of age, crossed with "improved breed" cockerels, which have a genetic breed potential of 250 eggs a year, with hens beginning to lay at 21 weeks. The results are cross-bred hybrid pullets beginning to lay at 24 weeks, with a genetic potential of laying 200 eggs per year.

The first-generation hybrid cross-breed has a higher theoretical genetic potential (genotype) than the average (150) of the two parent breeds, due to the effect of hybrid vigour.

However, unless management (especially in the area of nutrition) is improved, this genetic potential will not be realized by the hybrid cross-breed in actual practice in the environment.

Although many strategies deemed appropriate for smallholder poultry production systems have been implemented, most have not succeeded, due to a lack of management input to support the improved potential.

Module 7: Poultry Markets

Poultry production ranges from small family systems, supporting livelihoods and supplying local or niche markets, to large-scale industrialized enterprises. The latter generally feed into integrated value chains, while the former, often characterized by low output, sell their produce through informal trading networks.

Poultry market prices can vary significantly, influenced by seasonal patterns (e.g. higher prices during festivities), production costs and competition from other products. Production costs are very volatile and can vary significantly from one region to another. They are largely based on the characteristics of the final product (e.g. high-quality meat takes longer to produce, which means higher costs) as well as on feed prices (mainly grain), climatic conditions and the genetic lines used. Poultry tends to be cheaper than other meats because they are efficient feed converters.

In most countries, poultry production is mainly for domestic consumption, but international trade is increasing. Most of the poultry meat available on the global market comes from large-scale, specialized commercial producers. The main importers of poultry meat are developing countries, where cheap, low-quality cuts such as wings, lower legs, necks and giblets sold by the piece make chicken meat more accessible to the average consumer. In contrast, consumers in developed countries tend to buy chicken breasts and thigh meat and, to a lesser extent, drumsticks.

Poultry meat products are usually exported frozen. International trade in eggs is relatively small compared to poultry meat, mainly because it is impossible to freeze them for transport over long distances.

The three categories of egg exports are:

(i) in-shell table eggs;

(ii) in-shell eggs for hatching;

(iii) egg products (in liquid, frozen or dried form).

The evolution and dynamics of world poultry markets are mostly driven by animal disease outbreaks and trade policies. In recent decades, avian influenza and Newcastle disease have profoundly affected poultry meat trade, as has the implementation of trade agreements. Sanitary requirements ultimately determine international poultry trade.

Farm produce must be collected, packed and transported in good condition to the cities and distributed to retailers near consumers' homes. This also calls for grading and storage of the product. The more developed the country becomes; the greater is the variety of products that can be economically produced.

A study of existing marketing systems in a country will often reveal how they have evolved to their present state. Many developing countries do not have refrigeration as a factor in their storage, either during transport, retail or consumer household stages. For this reason, poultry meat is purchased live and slaughtered immediately before consumption. Also, eggs are often retailed with a means for the buyer to check their quality before buying, either by "candling" (to see the internal quality with a lantern or battery-torch) or a bucket of water (to test the egg's age by the floatation method). Both methods essentially test

for the size of the air-cell situated at the blunt end of the egg, which increases in size as moisture is lost from the egg. With a bigger aircell, there is more floatation.

In developing countries, transport of eggs and poultry from the village to the city usually begins with a purchase by a middleman dealer, direct from the household, or small locally held weekly markets. Baskets with layers of straw protect the eggs from breakage, and other types of baskets are used to carry live birds.

Supply Channels

The local channel begins with the producer selling poultry products to retailers who serve the needs of local consumers. In most areas, local consumers also buy directly from producers.

The other marketing channel involves wholesalers. They buy poultry products directly from producers and sell to retailers, and are based in urban centres where urban-based consumers are located.

Egg Quality Control & Maintenance

Maintenance of egg quality is a major problem for those involved in egg marketing. Eggs soiled by droppings or the contents of leaking or broken eggs spoil faster than clean eggs. Only good quality eggs should be sent to the market. The simplest way of sorting is to divide the eggs into three categories:

Cracked Eggs - The cracked eggs should be eaten or sold locally for immediate consumption.

Dirty Eggs - The dirty ones should be cleaned and sold locally for consumption within a few days.

Clean Eggs - The clean eggs can be sent to the major marketing outlets. In some areas, eggs of certain colours or sizes are preferred, and the eggs should be sorted for these qualities.

Temperature Control

The most effective way to preserve egg quality is to store eggs between 10 °C and 15 °C during all handling, transport and marketing phases. Insulated containers and/or vehicles can maintain cool temperatures during long-distance transport. Even an outer layer of straw in a basket will help. In hot weather, and where there is no cool storage system, eggs should be transported to market at least every third day.

Eggs should never be left standing in the sun or a very hot room. Air conditioning or even an electric fan is advised whenever practicable. However, as air conditioning has the negative effect of drying out the egg contents as well as the advantageous effect of cooling, wet sacks should be placed as curtains in the cool store to alleviate this dehydrating effect. If fans or air conditioning are not available, then shaded well-ventilated rooms or underground cellars should be used.

Egg Transport

The four concerns regarding egg transport are:

- Protection against **mechanical damage,** which can be achieved by avoiding excessive shaking, especially where roads are bad, and by using spring suspensions on bicycle carriers.
- Protection against **poor egg handling**, which can be achieved by providing convenient loading levels to make lifting easier.
- Protection against **tainting odours.**

- Protection against exposure to **high temperatures** in transport.

Egg Storage

All egg storage systems must meet the following requirements:

- Water loss by evaporation to be minimized.
- Mould and bacteria growth to be minimized.
- Interior quality to be maintained (indicated by a good proportion of a thick white, a firm, rounded yolk and good flavour in both).

The first two requirements can be met (for storage periods of three to five months) by coating eggs with oil or water glass (sodium silicate); immersing eggs in limewater (calcium hydroxide solution); or putting eggs in dry storage (using such materials as bran, peat dust, soda lime, salt and wood ash). However, all three of the above requirements can only be met by refrigeration, which is the best storage method, if available.