

PART 2

Housing, nutrition and management

Newcastle disease is endemic in village chicken flocks in many countries. Since it regularly devastates family flocks, farmers have little incentive to improve productivity by investing in additional husbandry or management interventions such as improved housing or supplementary feeding. Now, however, the advent of effective thermotolerant vaccines has significantly improved the control of ND in villages. In areas where there are regular vaccination campaigns, it is worthwhile considering basic husbandry techniques that could increase the amount of chicken meat and eggs available for household consumption and for sale.

Villagers value their chickens but they are most often just left to fend for themselves under completely free-range conditions. The chickens find their own feed and water, breed at random, lay their eggs where they find it suitable to do so and raise their chicks on their own. Villagers slaughter or sell their chickens only when necessary and, in many regions, eggs are not collected for sale or consumption but rather left for the hen to hatch.

Farmers are often cautious of change and are naturally wary of taking on added risk or adopting practices different from those that have worked in the past. This is especially so for poorer farmers, as they are putting at risk the lives and health of themselves and their families. Management changes should therefore be introduced gradually. In addition, extension staff should undertake participatory exercises with the community to find out what are the most serious problems and which practices would have the greatest chance of being adopted. Start with those practices and then introduce other improvements once farmers have seen the benefits of the innovations.

The three main chapters in this part of the manual describe simple management practices that will help to turn village farmers from passive observers of their chickens into active producers, while still using minimal labour and other inputs. Chickens can become a more productive and important part of the farming system with little financial risk and impediment to the other activities of farmers.

Flocks from different households in a village intermingle, interbreed and share the same feed resources. Hence, families should be encouraged to work together with their neighbours and learn from each other.

4 Chicken housing and shelter

4.1 Introduction

Housing village chickens at night will protect them from rain and the cold, from predators such as rats, snakes and other wild animals, and dogs, and from theft. Also, housed birds are easier to catch to inspect for signs of illness or injury, or to vaccinate them against diseases.

Since exploitation of the scavenging feed resource base is one of the major advantages of the low-input village chicken production system, housing for adult and older growing birds should be provided only at night and the chickens allowed to free range for feed during the day.

4.2 Types of housing

Adult birds and growers are often provided with elevated night housing (Figures 2 and 3).



Figure 2. Houses built on poles to raise them well above the ground protect the chickens from predators such as rats, snakes and other wild animals, and dogs. They can also have inverted metal cones around the legs to prevent snakes and rats climbing them.

Chicken houses built close to the ground are suitable for hens with young chicks that cannot enter an elevated house. It may be necessary to dig a drain around such a house or to raise the floor, so that it will stay dry during the rainy season. The cage shown in Figure 4 does not have a floor and can be moved to a new place every day or two. Chickens can be housed in these cages overnight or confined in them for some time during the day. The chickens scratch the ground to find feed for themselves. A house like the one in the drawing is about 4 m long, 1 m wide and 1.5 m high. It can hold 8–10 adult birds if they are kept enclosed all day, or about 20 for overnight housing. The house can be completely covered with wooden slats or be partly open with netting or woven bamboo. This type of house may also be suitable for holding a hen with her young chicks for the first week or two after hatching.



Figure 3. Locally made cages can be moved easily and kept off the ground. They may be used to keep chickens inside the house overnight or to separate newly introduced or sick chickens from the flock for several days. This locally made house is easy to move and can be put on a metal or wooden sheet above the ground.

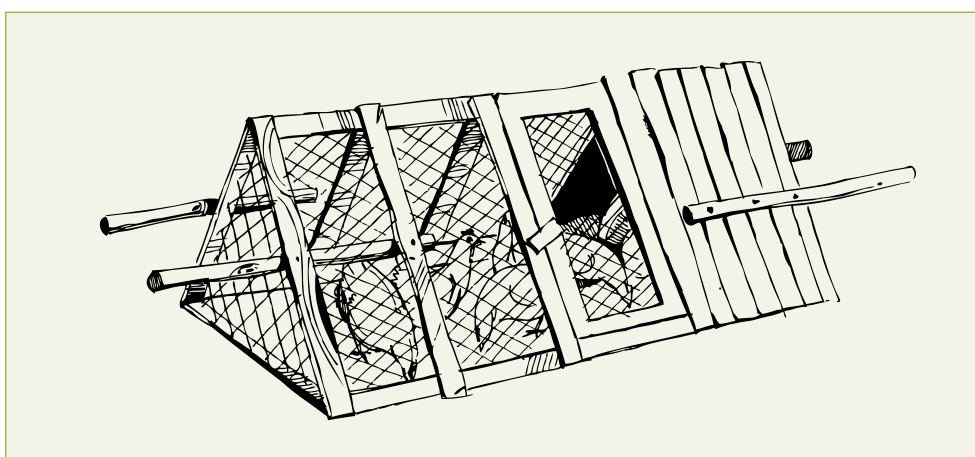


Figure 4. Another type of large cage that can be moved easily

4.3 Constructing a chicken house

The following are some simple rules for building a chicken house.

- Clear the grass and bush for about three paces (3 metres) on all sides of the house site to keep snakes and rats away from the chickens.
- A house can be built cheaply using local materials such as tree and bush branches or reeds and thatch grass.
- The size of the house will depend on how many birds the villager has (or plans to have) and if they are to be kept in the house overnight or for longer periods. For 10–15 adult birds, the size of the house should be about one large pace (1 metre) wide by one to two large paces long. If too many birds are kept together they may start to peck each other, leading to injury and diseases.
- Always remove the bark from timber used to construct the houses so that pests and parasites such as ticks and mites will have nowhere to hide.
- The house should protect the chickens from rain and wind but have enough ventilation to provide birds with fresh, clean air.
- The opening should be wide enough to allow the inside of the house to be cleaned easily and should be fitted with a door or other means of closure.
- Because many infectious diseases of chickens are transmitted via their droppings, the floor of the house should be slatted to allow the droppings to fall through (e.g. by using branches as a floor). The spaces between the slats will depend on the age and size of the chickens, ensuring they have adequate foot support and that droppings can pass through.
- If the chicken house is built on poles, it should be at least 60 cm above the ground but not so high that the inside of it cannot be reached by the villager.
- Putting inverted metal cones around the poles of a chicken house will make it harder for rats and snakes to get into it.

4.4 Roosts/perches

Perches are favoured by chickens, as they like to sleep above the floor.

Roosting on perches will minimise the contact between the birds and their droppings, and therefore help to prevent diseases. The roosts can be made from bamboo or straight tree branches (remember to debark the branches). They should be about 3 cm in diameter. Each adult chicken requires about 20 cm of perch space. If more than one perch is needed, the perches should be about 50 cm apart and at the same level. If they are at different levels, the birds will fight to reach the highest perch when they come in to roost in the evening, causing unnecessary stress.

4.5 Maintaining a chicken house

Cleaning the chicken house helps to prevent and control diseases, especially external parasites such as fleas and mites. The following procedures should be adopted.

- Remove droppings and litter from the inside of the house regularly (once a week) or, if the house is portable, move it to a fresh area.
- Fumigate the chicken house regularly with smoke (by lighting a fire under elevated chicken houses or placing cages above kitchen fires) to control external parasites (every 6 months).
- Clear the grass and bush around the chicken house to keep snakes and rats away.
- Do not overcrowd the chicken house.
- Empty a house where sick birds have been; clean it or even burn it and build a new one.
- Regularly remove the droppings from underneath the chicken house; compost them for at least 3 weeks, then place the manure on gardens, mixing it into the soil to reduce the chance of diseases and parasites accumulating and to prevent flies from reproducing in it. Flies will not be a problem if the manure is kept dry.
- Place wood ash or lime on the floor and walls to repel external parasites and aid the removal of manure when cleaning.

Safe use of chicken manure

Break up chicken manure so that it dries quickly—this will help to kill infectious agents and the eggs of parasitic worms within the manure. Digging composted manure into vegetable gardens will fertilise the soil, leading to better plant growth.

4.6 Provision of nests

Provision of clean nests in safe places assists in controlling and improving productivity. The quality of eggs is better if they are clean. Moreover, it is easier to find eggs if nests are provided rather than allowing birds to lay eggs in hidden locations.

Locally available items such as baskets, boxes, buckets or similar containers can be used for nests. Pad the containers with clean, dry nesting material (e.g. leaves, straw, old cloth or even sand) to help to keep the eggs warm and minimise the risk of breakage or contamination.

Some tips on the provision of nests follow:

- A sufficient number of nests should be provided: 1 per hen or, if there are more than 5 hens in a flock, 1–2 nests fewer than the number of hens.
- Eggs intended for brooding should not be removed from where the hen laid them, otherwise they might be abandoned.
- Nests should be located in safe places, protected from rain and wind, and out of reach of dogs, other predators and ants.
- Nests should be constructed in a way that protects the eggs from cooling from below or from falling out of the nest (Figure 5).
- Nests should be cleaned regularly.
- Nests that have been used for a long time should be fumigated with smoke (e.g. every 6 months).
- If there has been a serious outbreak of disease or a heavy infestation of external parasites (e.g. lice), the nests should be burnt and replaced using new materials.

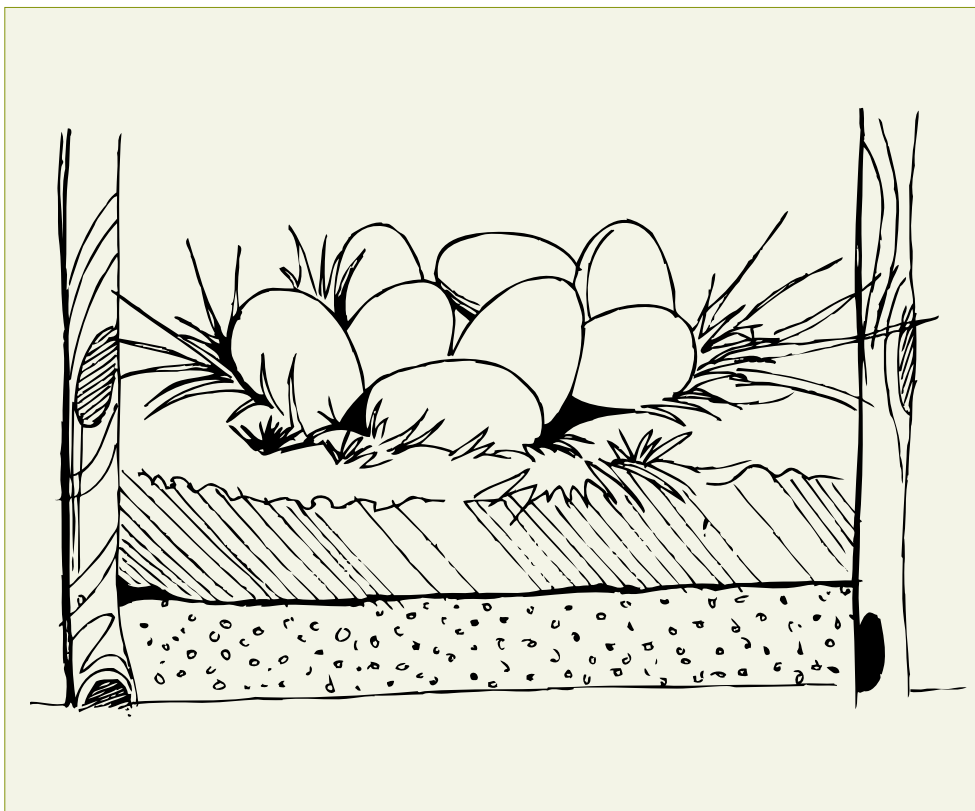


Figure 5. A hen will hatch more chicks if her nest is clean, dry and safe. She will favour a nest that sits above the ground and is provided with clean straw or grass.

4.7 Protection from predators and theft

4.7.1 Predators

Predators are a major problem in village chicken production, causing almost unavoidable losses in free-range systems.

Predators of chickens include other birds, mammals and reptiles, and even ants. Protective measures should be designed around which predators are common in the region and how these predators hunt. Birds of prey often circle high in the air and suddenly dive to catch a victim seen on open ground. Other predators, including some birds, hide in trees in search of their prey. Wild cats, foxes and other four-legged hunters usually prefer to use the cover of bushes to approach their prey unnoticed. Rats and snakes are more likely to catch chicks that are confined or housed. Losses due to ants have been reported only for caged chicks, and where the chick shelter has been built across the ants' nest or path. Farm animals such as dogs also enjoy an occasional chicken dinner and should be kept under control.

Implementation of the following general measures will help reduce losses due to predators:

- Construct shelters to offer protection from predators. Build a chicken house on poles and put inverted metal cones around the legs to make it harder for predators to enter.
- Clear the grass and bush around the chicken house, so as to limit hiding places for predators.
- Do not provide feed or water in extensive open areas where chickens can be attacked easily by birds of prey.
- Do not provide feed or water next to dense bushes where cats, rats or snakes can wait for their prey.
- Hang small pieces of tin in a tree or on a long pole close to the area to be protected. The noise produced and sunlight reflected when the tin moves with the wind might deter predators.
- Chickens with coloured feathers are better camouflaged than unicoloured (e.g. bright white) birds, which are an easier target for a predator.

4.7.2 Theft

In areas where chicken theft is a serious problem, many farmers keep their birds inside the family house during the night, rather than in a separate chicken house. In their opinion, a separate chicken house makes it easier for thieves to steal the birds. However, keeping birds in the house might be unhygienic (especially when the birds suffer from parasites or disease such as HPAI) and, if the flock is big, is impractical.

Keeping the birds in a separate but safe place is therefore strongly recommended. Measures that might be adopted to minimise theft from a separate chicken house include the following:

- The chicken house could be fitted with a very noisy opening that will alert the owner in case of attempted theft.
- Roosts could be placed at more than an arm's length from the opening so that birds are out of reach of thieves. This design is used in northern Malawi. Disadvantages of this type of chicken house are that it is more difficult to clean and for the owners to catch the birds for vaccination.
- The chicken house could be built next to one of the outside walls of the family house.

Nevertheless, when theft is a big problem, farmers may see guarding their chickens inside the house as the only solution. In such cases, to avoid the chickens roaming around the room or even the house as a whole, it would be best to construct one or more portable cages (according to the flock size) that can be placed in any corner. Portable cages should have short legs, and slatted floors to allow the droppings to fall through. Put large leaves, old paper or sacks under the cages to catch the droppings or feathers for easy removal from the house. To avoid fighting inside cages, it is best to provide at least 1 m² of floor area for every 10 birds. Another possibility is to construct perches in one corner of the family house (see Section 4.4). This will encourage the birds to roost in one place inside the house. The roost can be placed over leaves, sand, ash or sacks to make cleaning easier.

Daily removal of the droppings and feathers, or cleaning of the place where the birds were kept overnight, is necessary to avoid negative consequences for human health. No inside housing of birds should be practised in areas where zoonotic diseases such as HPAI are present.

5 Nutrition

5.1 Water

Chickens need water for survival, growth, activity and egg production. **Five chickens will drink about 1 litre of water every day** and they will need more than this when it is very hot. Water should be available at all times.

Although chicks can survive for several days without feed, they will quickly die without access to water. Complete water deprivation may result in death in less than a day during hot weather. During hot weather, if a chicken has not had access to water for some time, it may drink too much when it does obtain water and this could result in diarrhoea. To avoid this, chickens should always have access to fresh, preferably cool water. If water is accidentally forgotten and provided only at the end of a hot day, at first only small quantities should be given.

Scavenging chickens usually manage to find enough water to survive. However, chickens, especially young chicks and laying hens, will perform much better when provided with water.

While clean, fresh water is best, when water is scarce, chickens can be offered used water as long as it contains no detergents or other harmful substances.

Waterers should be:

- not too high, so that all age groups can drink without risk of drowning (Figure 6)
- not too large, so as to avoid contamination with droppings (and ducks bathing in it)
- cleaned daily
- kept constantly in the same place that the chickens get used to (helpful in case of the need to add medication via the water)
- placed where the chickens will be at least risk of attack by predators.

Clay bowls make simple but effective waterers. They should have a flat bottom and vertical sides so that they are not easily tipped over. They should not be so deep that the chicks can drown in them. Waterers need to be cleaned and refilled daily (or more frequently if they become dirty during the day).

Waterers for young chicks should have a lower lip of approximately the same height as the backs of the chick, so that the chicks can easily reach the water but not dirty it. Place stones on the floor of the waterer so that the chicks will not drown if they accidentally step into it.

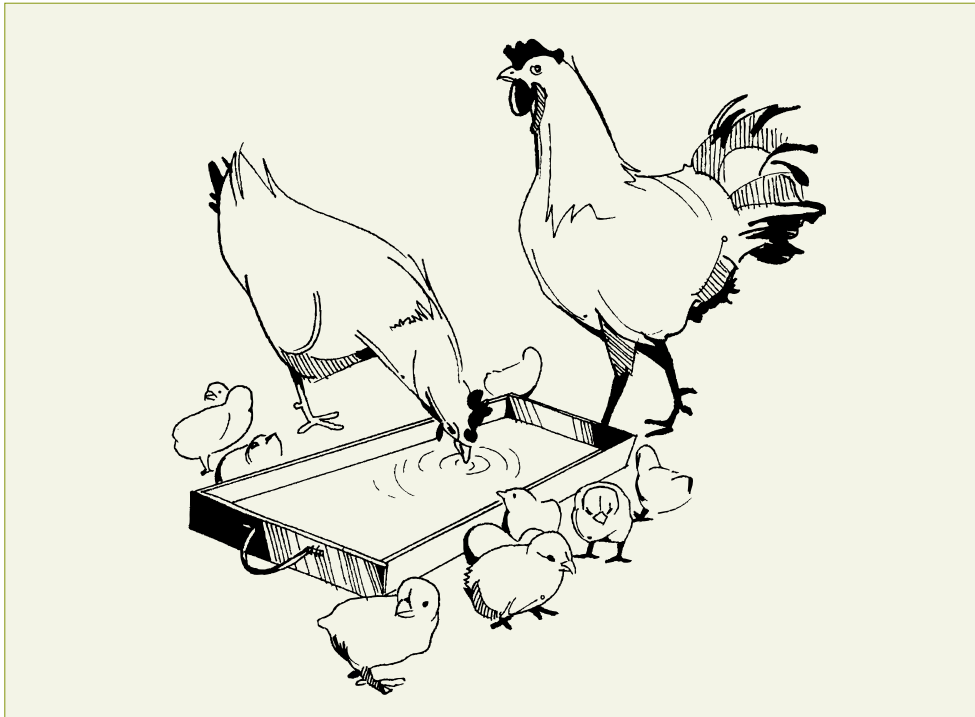


Figure 6. A chicken can live for several days without eating but if it does not have water it may die within a day during hot weather. It is very important that chickens always have access to water—preferably clean and fresh.

5.2 Scavenging

Making best use of the scavenging feed resource base (SFRB) is a major characteristic of extensive poultry-keeping systems. The SFRB includes various types of green feed, seeds and fruits, insects, worms, minerals in the soil, gleanings from cultivated fields, bran when cereals are processed and household food scraps and leftovers.

At some times, the SFRB is deficient in protein-rich feeds while at others, energy-rich feeds may be lacking. The quantity and quality of the feed base is usually the main factor limiting chicken production, and it is essential to take the particular SFRB into account when looking into possible management improvements.

It is essential that farmers keep an eye on their chickens

Farmers should be encouraged to monitor the general health of their flock and the availability of feed around the house. If the flock is generally losing weight or condition, or if there is little feed available around the house, then some supplementary feeding may be necessary if some birds cannot be sold or consumed. They should be advised to keep an eye on young chicks in particular, as these will be the first to suffer and can serve as an early warning sign.

If a farmer is unsure of which type of feed to provide to supplement the SFRB (e.g. more proteins or more carbohydrates), then 'cafeteria' feeding (see Section 5.6.1) may be worth while.

5.3 How a chicken digests food

Chickens pick up feed with their **beaks** (Figure 7). The beak in active birds might therefore be blunt, while a long beak might indicate that the bird is not feeding well. Food is mixed in the mouth and then swallowed whole (since chickens have no teeth). It goes into the **crop** where it is stored for up to 18 hours. The crop can be felt at the right side of the neck when it is full. The food passes from the crop into the **proventriculus** where it mixes with juices that will help with digestion. It then passes into the **gizzard**. The gizzard is a very muscular organ with hard ridges which, together with small stones that the bird has eaten, help to grind up the food for digestion. In the **small intestine**, the food is broken down with digestive enzymes into nutrients that are absorbed through the wall of the intestine into the blood. In the **large intestine**, excess water is absorbed from the food. After nutrients and water have been taken from the food, the residue passes into the **rectum**, the **cloaca** and exits via the **vent** as faeces (droppings).

Birds do not produce liquid urine. Waste from the kidneys forms a thick white material (mostly uric acid) which is mixed with the faeces. Both are then voided through the cloaca as droppings.

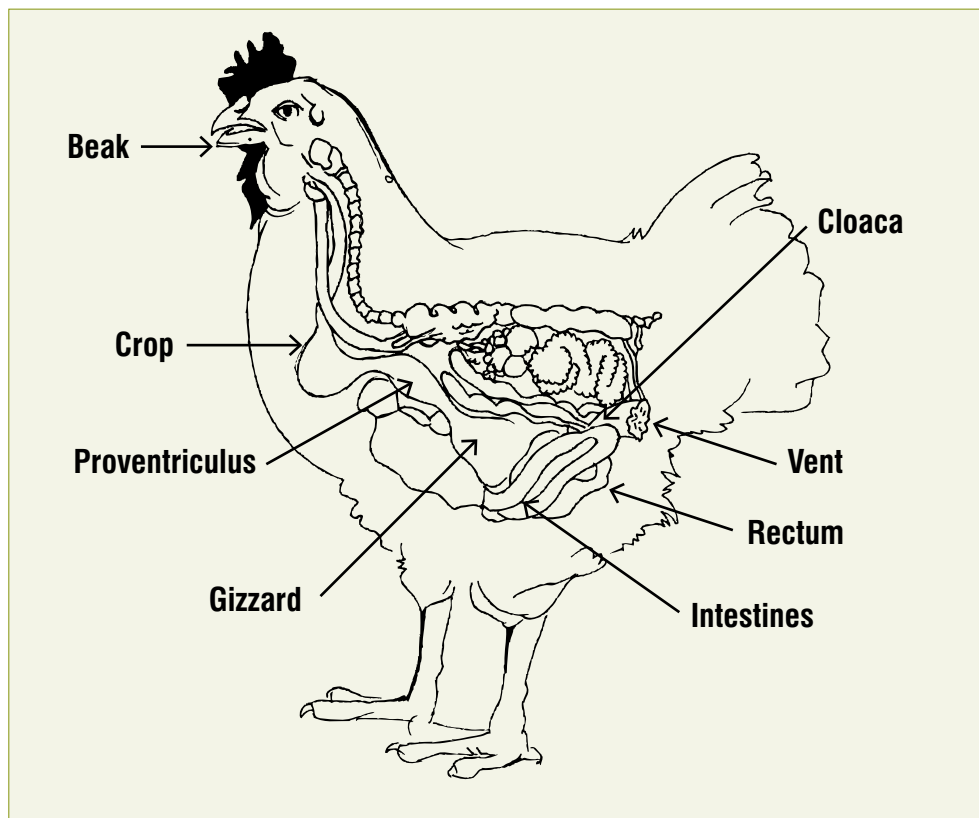


Figure 7. The internal organs of a chicken, highlighting the digestive tract

5.4 What chickens need in their feed

Chickens need adequate feed to maintain their condition (e.g. to move around, renew their feathers, fight diseases), to grow and to produce eggs. Their diet—like the diet of humans—consists of different nutrients: carbohydrates, proteins, fats, vitamins, minerals, crude fibre and water (Table 4).

Table 4. Functions of various nutrients in chicken feed

Nutrient	Function
Carbohydrates	To provide energy (e.g. for movement) To maintain body temperature [Any surplus is stored as fat reserves (in lipid deposits) in the body]
Fibre	To enhance digestion [Crude fibre is itself poorly digested]
Proteins	To replenish the body's muscles, organs and fluids To contribute to the growth of feathers, beak and claws To produce eggs
Fats	To provide energy—fats are very high in energy To maintain body temperature [Surplus is stored in lipid deposits in the body]
Minerals	To build bones To produce eggshells To assist in chemical reactions inside the body
Vitamins	To maintain the body's functions To fight diseases
Water	Essential for all body functions

All these nutrients are necessary to provide energy, grow muscles and produce eggs. Lack or shortage of a single nutrient may result in poor growth or egg production and increased disease problems. The daily feed ration of a chicken must therefore contain certain amounts of carbohydrates, proteins, fats, vitamins and minerals. To make a balanced diet, these nutrients need to be combined in the right ratio, according to the age and productivity of the bird. For example, to optimise egg production in commercial layers, the chicken's diet should be moderate in both energy and protein, while a ration for commercial broilers should contain higher levels of both energy and proteins to optimise the production of lean tissue. Because of their lower rate of production, diets for village birds tend to have lower nutrient specifications.

Sources of nutrients include:

- Carbohydrate-rich feeds—energy feeds—include maize, sorghum, rice, millets, cassava and cooked sweetpotato.
- Cereal brans contain moderate levels of energy and fibre. They are a very useful, and often cheap, feedstuff for chickens but, because of their fibre content, they should not be fed to chickens in large quantities.

- Protein feeds are primarily classified as being of either animal or vegetable origin.
 - Animal products usually have a higher protein content than vegetable products, as well as better-quality proteins. Examples of animal proteins include fish, meat of various origins, blood, earthworms, termites, and other larval and adult insects. Chickens will also eat the ticks off cattle lying in cattle corrals. Eggs are an excellent source of proteins. If available, a hard-boiled egg can be given to young chicks, with an egg a day being sufficient for 6–7 chicks.
 - Among the sources of vegetable proteins are various legumes (e.g. cowpea, pigeon pea, chickpea, mung bean, garden pea, groundnut, sunflower seeds, sesame seeds, pumpkin seeds [after removal of the outer shell] and coconut). Some legumes (including soybean) contain toxic chemicals that must be removed by some form of heat treatment before the feed can be consumed. The legumes mentioned above are known to have little or no toxicity when eaten raw. Certain fermentation processes may improve the protein quality of some beans. Since vegetable proteins are of inferior quality, as many as possible should be combined in any particular feed (e.g. beans and sunflower seeds together provide proteins that are nearly as good as animal proteins). Leaf proteins, including those of grasses, are of better quality than those in seeds—free-ranging chickens eat a lot of green feed, so when they are enclosed their feed should include the leaves they like (e.g. the leaves of bean plants, sweetpotato, pumpkin, cassava and certain wild herbs that people also use as salads and relishes).
- Chickens require, in very small amounts, a wide range of minerals including iron, zinc, copper, iodine and manganese. They must get these minerals from their feedstuffs and the soil. An important mineral required in greater amounts is calcium, which is present in sea and snail shells, limestone in the earth and bones (burnt and crushed). Eggshells also contain high levels of calcium but they should be roasted before feeding to chickens, which will otherwise acquire a taste for eggs and become egg eaters. Phosphorus, another essential mineral, is also present in bones and certain rocks. People often forget the importance of salt—this can be sprinkled in small quantities over any feed given, but too much of it can cause diarrhoea.
- Vitamins are also required in very small quantities. There are many different vitamins, and feeds such as liver, fruits, vegetables and leaves are rich sources of them. Other feeds, such as grains and insects, also contain vitamins in varying amounts.

All the above nutrients are necessary for optimal production but the proportions vary according to age, stage of production, local climate, season of the year and other factors. For example, growing chicks need more proteins than adult birds. Energy-rich feeds usually form the largest part of the diet of chickens (about 60–70%), then come protein-rich feeds, while the various

minerals and vitamins are needed only in very small amounts, except for calcium for laying hens—in layers, the formation of the eggshell requires higher levels of dietary calcium than those needed for non-laying birds.

5.5 Feed resources

Chickens need sufficient good-quality feed to grow, produce eggs and maintain their resistance to diseases. In village chicken systems based on scavenging, the feed resource is a critical constraint to the expansion of chicken flocks once ND is under control.

The SFRB in a village is generally fully utilised. Village populations of scavenging chickens can grow until the SFRB is over-utilised. When the SFRB is not sufficient to nourish all birds (as well as other scavenging animals), birds less able to compete and fend for themselves, like chicks and growers, are the first to starve. Furthermore, the SFRB varies with the different seasons, increasing competition for available feed in times of food shortage.

To avoid starvation of chickens, especially young and weaker birds, the flock size needs to match the locally available feed resources throughout the year. To ensure that this is so, villagers should:

- observe their chickens to see that they are not losing weight through lack of feed, keeping an eye on young chicks in particular, as they will be the first to suffer and can serve as an early warning sign
- be aware of their neighbours' chickens and other scavenging animals when calculating the available feed resources
- reduce the number of chickens they keep in times of feed shortage
- not allow hens to sit on too many eggs, otherwise the chicks that hatch will not find enough food
- provide supplementary feed when the SFRB is depleted and the number of chickens kept cannot be reduced.

In certain circumstances, supplementary feed (either local ingredients or commercial feed) can be supplied. The farmer must be aware that extra feed must be supplied constantly and permanently when the flock size is too big for the birds to receive adequate nutrition from the SFRB. **Malnourished birds are not productive and are more likely to contract diseases.**

Farmers must decide between providing supplementary feed and reducing the flock size. This decision will take into account current and projected levels of chick mortality, the cost of feed, the relative returns from sale of chickens and eggs in the market, and the value placed on home consumption of eggs.

When flock mortality is reduced and production increases, farmers must decide how to deal with a bigger flock. If the SFRB is not sufficient to support the flock, then farmers should ask themselves the following questions:

- Can I afford to keep this many birds at the moment? (factors to consider: the money needed to buy feed; the availability of other supplementary feed; the time involved in looking after the birds)
- Is it better to sell some birds now instead of later? (factors to consider: the current price of birds compared with the expected future price; an important festival or ceremony coming up, for which many birds will be needed)
- Is it necessary to keep this many birds or would it be preferable to consume more birds and eggs at home?
- Should we be selling and eating more eggs rather than hatching so many chicks?

Farmers could use the decision-making sequence shown in Figure 8 when the SFRB is not sufficient to meet the needs of the flock.

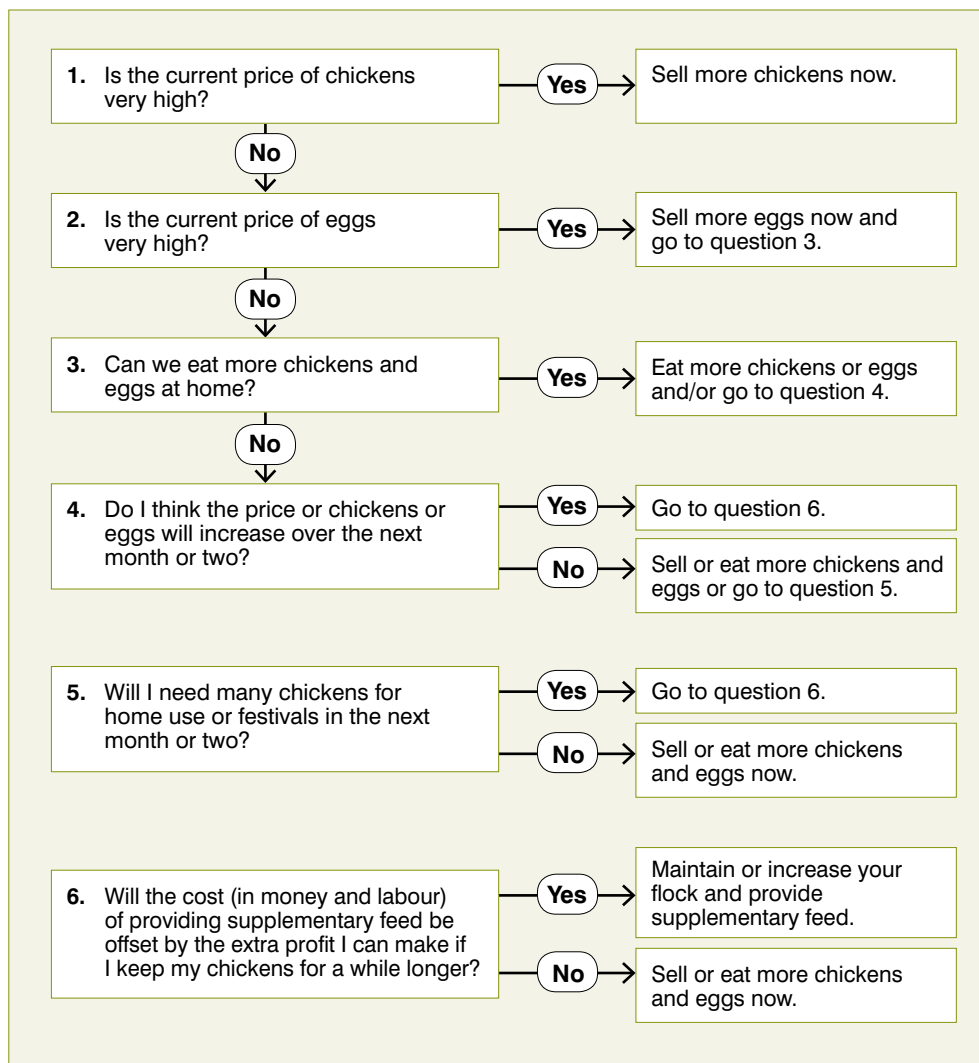


Figure 8. Decision-making scheme for farmers when the scavenging feed resource base is insufficient to meet the needs of their flock

Remember that relying on commercial feed will take away one of the biggest advantages of village chicken production: low input and, consequently, low risk.

5.6 Supplementary feeding

Supplementary feeding can be used to increase the productivity of scavenging village chickens and to assist the chickens when the SFRB is insufficient to allow the whole flock to thrive.

Supplementary feed is just that—a supplement not a replacement—and must therefore not distract the chickens from scavenging. In general, it is therefore best to offer supplementary feed in the late afternoon before the chickens are penned overnight.

Poorer farmers might find it difficult to regularly supplement their chickens' feed. In such cases, supplementary feed might be provided for only selected birds or age groups, such as young chicks or laying or brooding hens. If this is done, then a way must be devised to separate the selected chickens from the flock so that only they have access to the supplementary feed.

What can be used for supplementary feeding?

In general, everything edible can be used for supplementary feeding of chickens, but the benefit will be higher when the nutritional needs of the chickens are considered.

Chickens that get all their nutrients from scavenging may eat an excess of proteins and therefore benefit most from supplemental feeding of carbohydrates (e.g. a few handfuls of maize, sorghum or millet). Hens in lay can be provided with a diet rich in proteins and some extra crushed mollusc or eggshells. These contain calcium, an element necessary for the production of the eggshell.

Chickens can be provided with leftovers from household food, as well as green feed such as grass, weeds and leaves from garden plants. Bran (the seed coat but not the husk) from grains such as rice, maize and wheat after polishing is a useful feed ingredient for chickens, containing moderate proteins and energy. The outer husks or hulls have little nutritional value.

Some advice on the provision of supplementary feed:

- Feed should always be provided fresh daily rather than being provided in one big heap for the chickens to finish over a few days.
- Feed should be offered in troughs to avoid mixing with the soil, which spoils and contaminates valuable feed. There are various types of feeders (Figure 9), the best being those that prevent the chickens from stepping onto the feed.

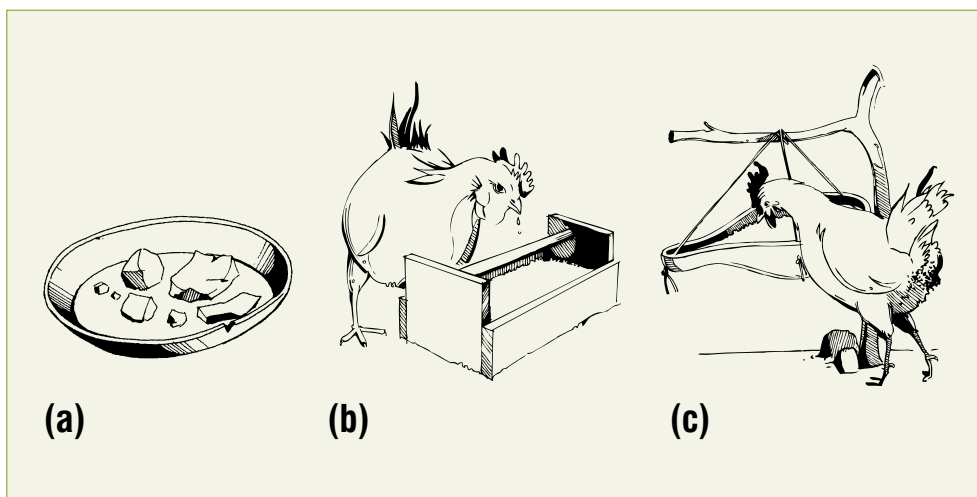


Figure 9. Three types of feed troughs

- Feed troughs should always be clean. Remove old feed daily and clean the trough before refilling. Feed should never be allowed to become mouldy or rotten. Mouldy feeds can cause illness and death of chickens.
- Contamination of feedstuff with faeces should be avoided because many diseases are spread via the droppings.
- Feed should be offered always at the same location so that the chickens get used to it. The feeding place should not be easily accessible to predators (see Section 4.7.1).
- If eggshells are provided, they should be roasted and crushed, so that the chickens do not recognise them as part of an egg. Otherwise, they might start eating eggs from nests.
- Since chicks have very small beaks, feeds such as cereals and beans, as well as some of the minerals provided, need to be ground into pieces small enough for them to be easily swallowed (but not so fine as to be powdery). Leaves and hard-boiled eggs should be finely chopped for chicks. Chicks have a very limited capacity to ingest and digest high-fibre feedstuffs.
- Some simple procedures may improve the nutritive value and/or digestibility of certain feeds. For example, bean or pea seeds should be kept moist in a covered container and allowed to germinate before feeding them to chicks. Cereal grains can be soaked in water overnight to improve their digestibility. Since such materials can become mouldy, it should be ensured that the chickens eat them as soon as they are offered.

The suggestions above assume the production of a variety of crops surplus to the family's needs. Farmers will generally increase crop production when there is a market for the crop plus products available that they want to buy (assuming there is suitable land and weather conditions to increase production). Similarly, village chicken farmers may also decide to produce more crops for feeding chickens once they see the value of having more meat and eggs to eat and sell.

The importance of making clean water always available for chickens cannot be overemphasised. Scavenging chickens find much of the water they need by themselves, but having extra water available will greatly improve their productivity and chances of survival, especially during dry weather. Young chicks, in particular, need easy access to clean water. Remember that an adult chicken drinks about a quarter of a litre a day, and more when the weather is hot. When it is hot, try to keep the water as cool as possible by locating it in the shade. Section 5.1 has further information on chickens' water requirements.

5.6.1 Suggestions for producing supplementary feed

Some supplementary feed for chickens can be produced from materials that are available from around the house. Although it would be difficult to produce enough locally made supplementary feed to support a whole flock of birds for any length of time, the suggestions below could provide some extra feed during dry times of the year, or for layers or young chicks that would benefit most from the extra feed. When preparing feed, remember that birds have no teeth and so their feed will be used more efficiently if it is presented in small pieces (Figure 10).



Figure 10. Birds have no teeth and so have difficulty eating large pieces of feed.

Sources of carbohydrates

The main sources carbohydrates will be cereals such as rice, maize, millet, sorghum and cassava. However, as far as possible, chickens should not compete with humans for food. If the family's own cereal needs have been met, a small area of rice, millet or sorghum could also be grown for animal feed.

Sources of proteins

Earthworms, and insects such as termites and cockroaches, are good sources of proteins. Their presence in chicken-scavenging areas can be encouraged in various ways:

- Maize bran mixed with enough water to make it gluggy will attract insects.
- Branches, grass and rubbish collected into heaps on the ground will be colonised by various types of insects. As required, a heap can be turned over and the chickens allowed to scavenge for the insects underneath. If a number of heaps are made, one heap of material can be made available for the chickens every few days.
- Branches and plants that attract termites can also be put into heaps and used in a similar way.
- If any cows are owned by the family, cow dung can be heaped to attract insects.
- Discarding dishwashing water and other waste water on an area of earth will moisten the soil and attract earthworms, especially in dry weather.

Plants such as leucaena can be grown as another source of proteins. Their leaves can be supplied to chickens fresh, or dried and crushed.

Sources of vitamins and minerals

Eggshells and bones can be roasted and crushed to provide a range of vitamins and minerals. It is important to roast and crush eggshells so that the chickens do not acquire a taste for fresh eggshell.

5.6.2 Cafeteria approach to supplementary feeding

In the 'cafeteria' approach, separate plates of feeds that provide concentrated sources of proteins, carbohydrates and minerals so that the chickens can choose the type of feed they most need (Figure 11). It is desirable to provide the feedstuffs in the approximate proportion that they are required. To optimise this approach, the approximate composition of the SFRB needs to be known (i.e. is it energy or protein deficient?) as do the composition and palatability of the feedstuffs provided. Where the protein supplement on offer is both reasonably palatable and well balanced in terms of amino acids, it should be sufficient to provide a grain (wheat or maize), the protein supplement and a source of calcium.

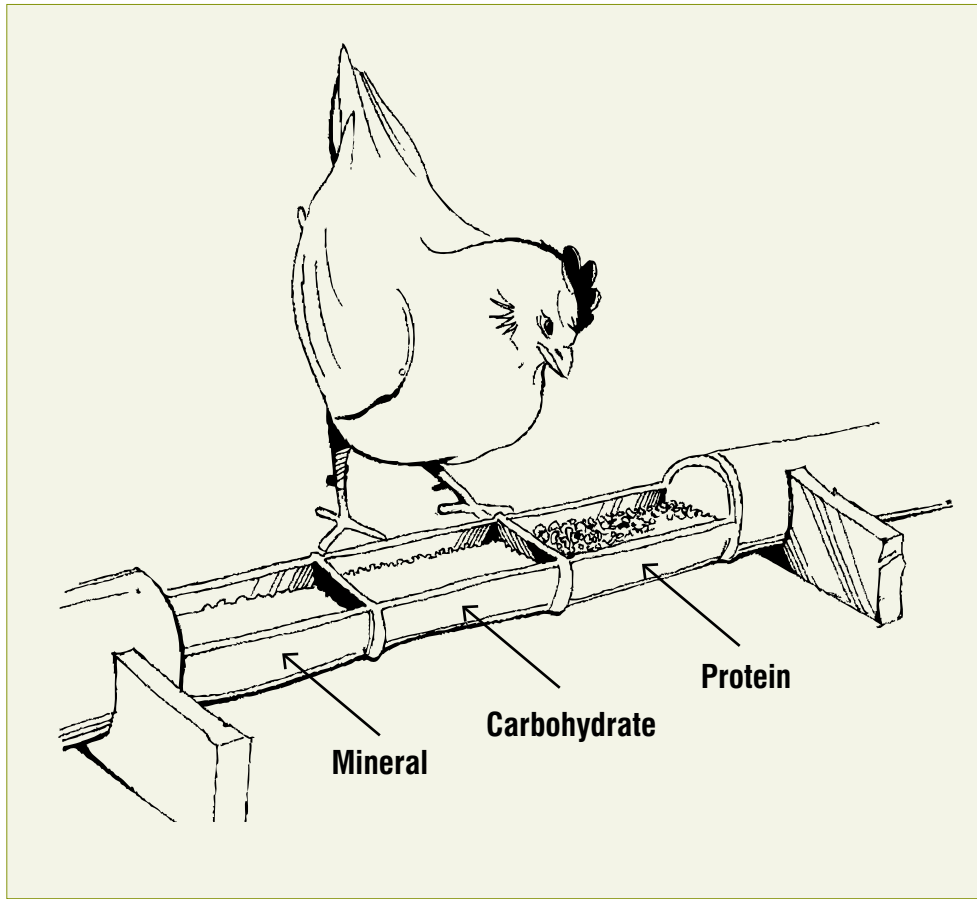


Figure 11. Bamboo can be used to make a feed trough to provide proteins, carbohydrates and minerals in a cafeteria style.

5.7 Feedstuffs that might be offered to chickens, and their nutrient content

Table 5 lists feedstuffs that can be used for supplementary feeding of chickens. Nutrient contents are given in relative terms only, since their absolute values might vary according to methods of preparation or processing employed. The list is not complete.

5.8 Feeding confined chickens

In general, confining chickens for long periods is not recommended under village conditions. Most villages do not have access to a regular supply of commercial chicken feed or, if they do, the cost of this feed exceeds the returns and increases the risks of raising village chickens.

Nevertheless, it may sometimes be necessary to confine some or all of the flock and, in such instances, providing a commercial chicken feed could be an option. Confined birds need to be fed a balanced diet since they are not able

Table 5. Feedstuffs that can be used to provide supplementary feed for chickens, and their relative nutrient contents

Feed	Carbohydrates	Proteins	Fats	Minerals	Vitamins
Barley	+++	+	+	+	+
Beans	+++	+++	+	+	++
Bones	–	–	–	+++	–
Clover	+	+	+	+	++
Eggshells	–	–	–	+++	–
Fats of animal origin	–	–	+++	–	–
Fish	+	+++	++	+++	+++
Fruit	+	+	+	+++	+++
Grass	+	+	+	+	++
Groundnuts	++	+++	+++	+	+
Insects	++	+++	++	+++	+++
Insect larvae	++	+++	++	+++	++
Lupins	+	+++	+	+	++
Maize	+++	+	+	+	+
Millet	+++	+	+	+	+
Oats	+++	+	+	+	+
Peas	+++	+++	+	+	++
Plant oil	–	–	+++	–	–
Potatoes	+++	+	–	+	+
Rapeseed	++	+++	+	++	++
Rice	+++	+	+	+	+
Rye	+++	+	–	+	+
Snail shells	–	–	–	+++	–
Sorghum grain	+++	+	+	+	+
Soybeans ^a	++	+++	+++	+	++
Sunflower seed	+	+++	+	++	+
Termites	++	+++	++	+++	+++
Tree and plant leaves	+	+	–	+++	+++
Wheat	+++	++	+	++	+
Worms	++	+++	++	+++	+++

a Soybean feeds for chickens are heat treated to inactivate inhibitors. Untreated soybean feeds can be poisonous to chickens.

+++ high content
 ++ medium content
 + low content
 – none

to satisfy their needs by scavenging. Any imbalance or mistake in the ration offered will lead to a drop in productivity and perhaps disease and death of the birds. Birds should be given the diet appropriate for their age and stage of production: layers should not be given chick or grower diets, and chicks and growers should not be given layer diets.

If a reliable source of commercial feed cannot be obtained, or if the cost of this feed is too high, then a feed ration can be made at home. Care needs to be taken to produce a balanced ration. Feed could also be offered cafeteria style, as described in Section 5.6.2.

Another point to consider is that chickens need a few days to become accustomed to any new diet. When changing from a scavenging diet to commercial or other supplied feed, or vice versa, the ration should be changed gradually by offering a mixture of the existing and the new feed for some days.

Some advice on providing feed to confined chickens

- If possible, offer commercial feed to confined chickens.
- The most important group of birds to offer supplementary feeding to is young chicks from hatch until about 2 weeks of age.
- A village-type hen needs about 75 g of commercial layer feed per day (1 kg per 13 hens per day). Commercial layers require approximately 100 g/day.
- Buy feed that is designed for the type of birds held (e.g. chick starter for young layer or indigenous breed chicks to 6 weeks of age, layer mash for laying hens and, depending on their age, starter or grower broiler mash for broilers).
- Do not abruptly change the type of feed provided.
- Provide fresh feed daily to avoid contamination and spoiling.
- The trough must be big (long) enough to allow all chickens to feed at the same time. If the trough is too small, weak birds that are low in the pecking order might be pushed away.
- Prevent birds from sitting in or scratching in the trough. The trough should have a lip as well as a wire mesh grid to prevent food spillage. The food is expensive and waste should be kept to a minimum.
- Full troughs lead to spilt feed.
- Clean the trough regularly.
- Offer fresh water to the chickens daily.
- Store chicken feed safely away from rodents and wild birds to avoid losses and contamination. (Rodents and wild birds might carry infectious diseases.)

6 Flock management

6.1 Keeping the flock healthy and productive

Every chicken farmer aims to keep their chickens healthy and productive, to benefit from the flock in terms of meat and egg production. One major step towards increased productivity is to vaccinate against ND, the most devastating disease of chickens in many regions. Other diseases can also be controlled or limited in their effects (see Part 3) and improved housing (Chapter 4) and nutrition (Chapter 5) will help keep the chickens in good condition. The benefits from these actions can be augmented by good flock management.

Flock management aims to maintain a healthy and productive chicken flock throughout the year by choosing an adequate flock size and taking off any surplus in a way that is most beneficial to the chicken owner. Flock management also includes control of breeding and egg production to increase the output of eggs and chicks per hen.

Village chicken production is characterised by low inputs and outputs, many farmers selling or eating their chickens only when the need arises. However, once ND vaccination is implemented and/or other killer diseases are controlled, more chickens will survive. Consequently, the following possibilities emerge: 1. the breeder flock size can be allowed to increase; 2. surplus chickens surviving can be marketed or consumed prior to maturity; 3. fewer eggs can be set under the hens, allowing more eggs to be consumed or sold; 4. various combinations of 1–3. The scavenging feed resource base (see sections 2.4 and 5.2) will probably not support a significant increase in flock size within a village (1. and 2. above), which means that farmers will need to plan and manage their flocks more carefully. Good planning and management will help to maximise the benefits of increased chicken production and minimise any other problems that may arise once ND is controlled.

Farmers need to **plan well in advance** to get as much benefit as possible from their vaccinated flocks.

Possible negative effects that may occur once ND and other killer diseases are controlled include that:

- an increasing number of chickens might not find enough feed in the local environment
- other diseases (e.g. fowl pox) might become more prominent and important
- the supply of chickens and eggs to local markets may increase, resulting in a drop in prices received.

Extension staff can assist farmers to plan and manage their chicken production so as to minimise the above effects.

Case study

In the Mtwara Region in southern Tanzania a successful ND vaccination program has resulted in the price of village chickens increasing in the markets. Whereas previously farmers would sell their chickens at any price before an expected outbreak of ND, they are now more confident that their birds will survive. Farmers have become reluctant to sell their birds and are asking and obtaining a higher price from traders. The traders can also be more confident that the birds they purchase will not die from ND before they get them to market.

6.2 Flock size

Encouraged by the benefits of successful ND vaccination, farmers may be tempted to expand flock size. Farmers must consider the available feed resources (and the cost of supplemental feed if required), the family work capacity and the stocking density before making a decision. They should ask themselves the following questions:

- Will all chickens find sufficient nourishment from the feed in the surrounding area? (Be aware that many other farmers may be increasing their flocks at the same time.)
- Does the person who is looking after the chickens have enough time to take care of a larger number of birds?
- Is the chicken house, or the place where the birds are kept at night, big enough for the whole flock?

6.2.1 Feed resources

'Feed resources' refers to the feed available for scavenging around the house and village. In scavenging systems the feed resource must therefore be considered as probably the most significant constraint to expansion of chicken flocks once ND is under control (see Section 5.5)

6.2.2 Family work capacity

This manual contains suggestions for a range of possible interventions to improve the productivity of chicken flocks. Most of these interventions require at least a little extra labour (e.g. cleaning the chicken house, providing nests, feeding young chicks, treating hens for external parasites etc.). When the flock size increases, the time consumed by these activities will also increase. When a family considers keeping more chickens, they should make sure that there is a family member who will be responsible for the chickens and who has enough time to look after them properly. **A small chicken flock that is carefully looked after will bring more benefits to its owners than a big flock that is neglected.**

6.2.3 Stocking density

A high stocking density is likely to cause problems in a chicken flock. Chickens will fight more often to establish their ranking within the flock and they will compete for all resources (such as feed, water, nests and sleeping places). Infectious diseases might also spread easier and faster within a crowded chicken flock. Conditions related to poor husbandry or nutrition are also likely to be aggravated with an increasing number of chickens. For example, the amount of droppings (i.e. manure) increases with chicken numbers. Increasing quantities of droppings in the chicken house can increase the risk of transmission of parasitic worms and coccidia. Excessive amounts of moist droppings can also cause 'bad air' in the chicken house, which promotes the development of respiratory diseases.

If the flock size is increased, a farmer should ensure that:

- there is enough space in the chicken house for all birds
- there are enough nests for all hens
- all chickens can feed at once if supplementary feed is provided
- someone can remove droppings regularly from inside and below the chicken house
- there are not too many roosters (to avoid fighting).

A farmer would be well advised to increase flock size only gradually as they gain experience in managing and feeding the birds. Given the limitations of the SFRB, especially in low-rainfall areas or during the dry seasons, farmers should be encouraged to maintain a nucleus flock of not more than 15–20 adult breeding birds (the actual number will depend on local conditions). Even if supplementary feed is available, they should, rather than build up large flocks, eat or sell the surplus eggs or chickens of inferior breeding quality. Neighbours should also be encouraged to keep smaller flocks so that the feed available in the village can be shared equitably.

6.3 General hygiene

The saying that 'Prevention is better than cure' is very appropriate. Although there are limited possibilities to improve chicken hygiene under rural village conditions, being aware of the need to maintain general cleanliness for chickens will certainly help. Here are a few procedures that farmers should find easy to carry out:

- Clean the chicken house regularly, both inside and outside. Remove droppings and rubbish and replace worn and dirty perches when necessary.
- Put ash on the floor and treat the wooden parts with old engine oil to help reduce the number of external parasites. For the same reason, fumigating the chicken house with smoke two or three times a year is a good practice. If lime-wash is available, the walls can be painted with it.

- Bury or burn birds that die, otherwise they remain a source of infection for healthy birds. If there is a good pit latrine, not yet too full, dead birds can be disposed of by throwing them into it.
- Kill and bury chickens that appear very sick, so that they do not infect others. If many birds in the flock have been sick and died, the old chicken house should be burnt and a new one built on a different site.
- Do not immediately return to the family flock chickens that have been sent away to market and have not sold. They may well have come into contact with disease-carrying birds. If they cannot be killed and eaten, they should be isolated for at least 14 days before they are returned to the flock.
- Be on the lookout for traditional, local treatments for chickens. As most rural people know, many plants have medicinal value. Some local remedies that are used to treat humans could also be effective for chickens. For example, medicines used to treat intestinal worms in children will probably have the same effect in chickens—at least they could be tried out on a small sample first.
- Use locally available plants that have been shown to assist in lowering infestations of external parasites (lice, fleas, mites, ticks).
- Work with other poultry farmers in the community to encourage hygienic practices throughout the village. As village poultry can roam throughout the village, the best way to have healthy birds is to make the village environment a healthy one.
- Do not introduce new birds into a flock when there is active disease in the village or surrounding area.
- Keep all new birds separated for 14 days before allowing them to mix with the existing flock.

6.4 Laying, brooding and hatching

Proper management of laying hens will improve their productivity through increases in egg production and the number of clutches per year, and in the hatching rate.

6.4.1 Laying hens

In villages, hens start to lay eggs when they are about 5–6 months of age. Malnutrition or poor health condition in growers will result in the birds coming into lay later and producing fewer eggs.

In uncontrolled conditions (i.e. no active management), a hen lays about 10–15 eggs, usually on consecutive days (called a clutch), before she becomes broody and sits on the eggs to incubate them. After about 21 days she will hatch out an average of 8–12 chicks. She then repeats this, on average, three or four times a year.

Not all eggs laid are necessary for producing future generations. Some hens may lay 20 or more eggs in a clutch, but a small village hen cannot adequately cover so many eggs, and can only properly look after a maximum of 8–10 chicks (especially in colder weather or when the SFRB is poor). A hen may also abandon her nest with all the eggs in it. This is a waste of a very valuable protein or income source for the family. In addition, eggs left in nests are repeatedly being heated and cooled as hens leave and return daily to lay more eggs. This can cause early embryo mortality.

One simple intervention is to collect eggs from the nests at least twice a day (preferably when no hen is on the nest). Always leave at least one egg in the nest to encourage the hen to continue using that nest. By taking eggs from a hen that is not yet brooding, you will stimulate the hen to produce more eggs, as the hen will always try to complete the clutch before starting to brood. If a hen is eating well, she may lay as many as 25 eggs before becoming broody.

Good-quality eggs for brooding

Some farmers may wish to have more control over the quality of eggs. If so, the following procedure could be adopted. All eggs laid on a particular day could be marked with a letter or number (e.g. 1 for Sunday, 2 for Monday etc.) or the date (including the eggs that are left on the nest). Thus, the farmer will know which eggs are the freshest. The most recently laid one or two eggs should be left in the nest each day to encourage the hens to continue laying. Once a hen becomes broody, and if the owner wants her to produce chicks, a number of fresh, fertile eggs can be selected from those in storage and placed under the broody hen (see Section 6.4.2).

Some people believe that taking eggs from the nest may cause a hen to abandon it—this may occur, but is rare. If the farmer is removing several eggs from a nest that already has a good number present, especially when the hen is broody and sitting, this should be done in the evening when it is dark. It may also help to dust your hands with wood ash before collecting eggs so as not to leave a human smell on the eggs.

If a farmer has a problem with hens laying their eggs in remote, inaccessible nests, they should keep the hens in their house with nests for a few days for part of the morning (until about 10 or 11 o'clock) to help break this habit, as most eggs are laid before midday.

Laying hens can be identified in the following ways:

- Check the width of the bones around the vent (Figure 12). With non-laying birds, only one finger can be placed between the two pubic or 'pin' bones and two fingers between the pin and breast bones. Laying hens can have a space of two to three fingers between the pin bones and four to five fingers between the pin and breast bones—depending on the size of the chickens and size of your fingers.

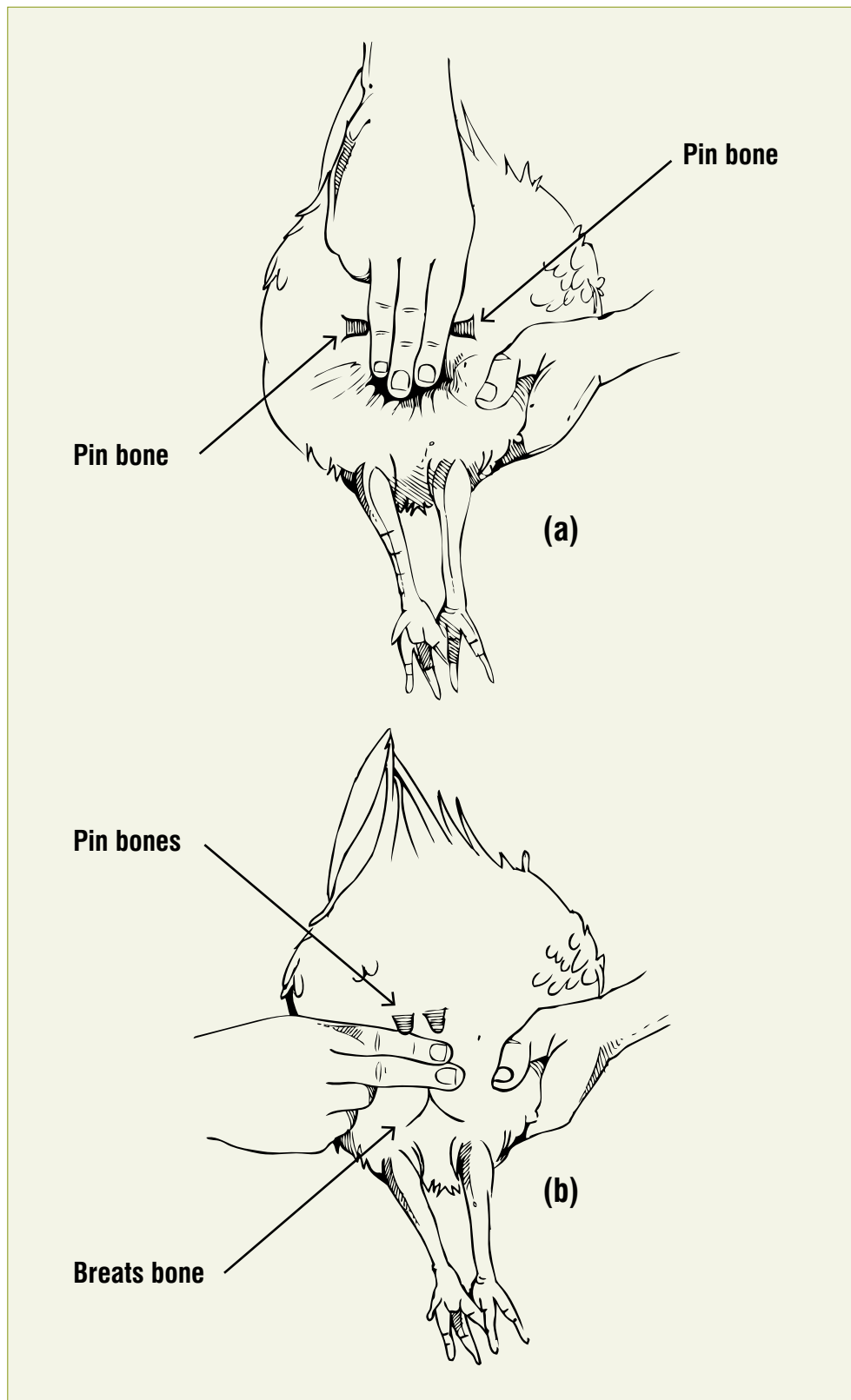


Figure 12. Two to three fingers can be placed between the pin bones on laying hens (a); in non-laying birds, only two fingers can be placed between the pin and breast bones (b).

- Look at the comb. Adult hens with a very small and pale comb are not in lay and are probably either moulting or in poor health. If hens in poor health do not recover they should be separated from the flock, since they are not productive and may transmit disease to the healthy birds. A small, pale comb is normal in moulting birds.
- Look at the vent. A non-laying hen has a puckered vent while a layer has a large, oval, moist and bleached vent.

The following are some other steps that farmers can take in looking after laying hens:

- To ensure a high fertility rate in eggs, a flock should have one rooster for every 10–15 hens, plus one extra rooster in the flock in case the other gets hurt or dies. So if a farmer has 10 hens then there should be two males, and if they have 20 hens, they should keep three (not four) roosters. If there are too many roosters, they will fight and fertility will not improve. If an egg has not been fertilised by a rooster, then no chick will hatch (Figure 13).

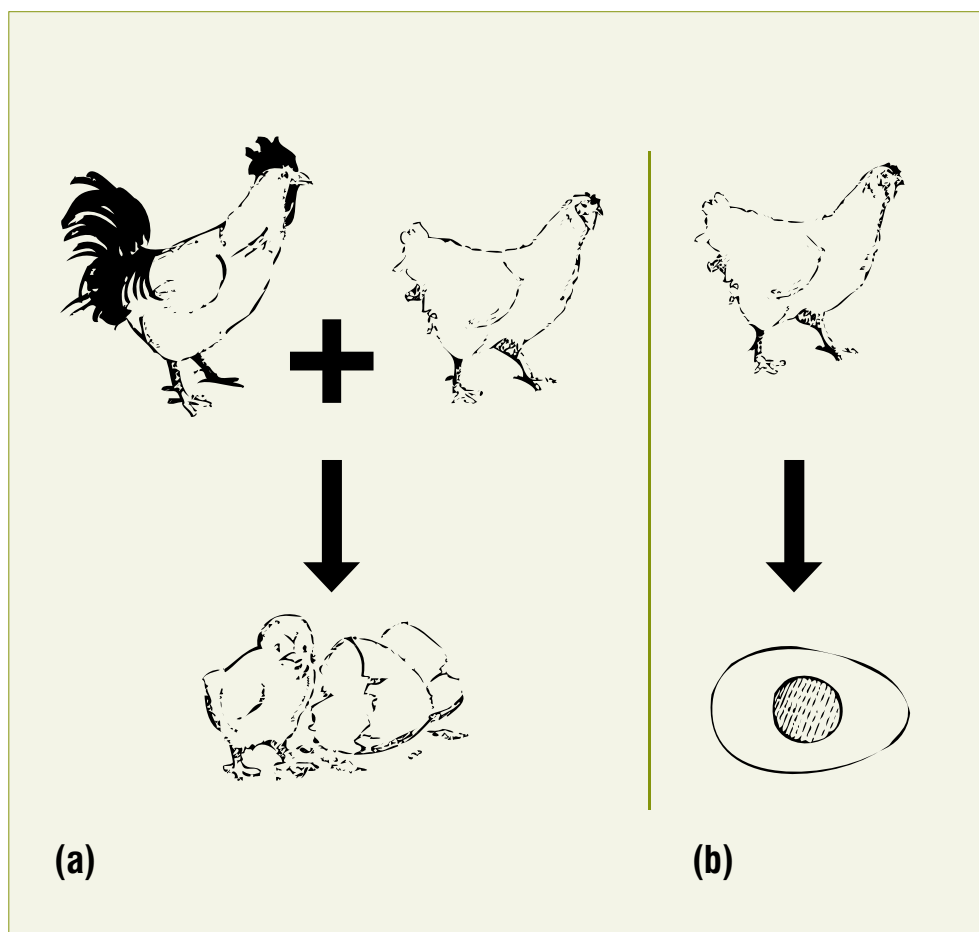


Figure 13. A chick is produced when a hen has mated with a rooster before laying the egg (a). If the hen has not mated with a rooster, then the egg will not develop into a chick (b).

- When a hen is about to lay, she looks for a quiet, safe and dark place to lay the eggs. Hens tend to lay their eggs in places where there are already eggs. For this reason, several hens sometimes use one 'community' nest;
- It is advisable to provide sufficient nests for all hens in a flock, to avoid hens choosing places for nesting where the eggs cannot be found, are exposed to bad weather, or are easily accessible to predators (see Section 4.6).
- Eggs that are removed from the original nest chosen by the hen and then placed in another nest may be rejected by the hen.
- Hens lay the most eggs during their first year in production. Thereafter, production decreases rapidly, especially after the second year of age. Thus, to ensure a high level of egg production in a flock, hens should not be kept for longer than 2 years.
- Identify the hens that produce many eggs. Also, watch how well they sit on their eggs and how well they raise their chicks. This will help the farmer to choose which hens make the best mothers. Keep the pullets produced by hens which are good layers and which show good mothering ability as replacement stock.
- It is important for farmers to observe their hens and note which are the better layers. The ones that lay few or no eggs should be culled (i.e. eaten or sold).

Under village conditions, a hen produces 3–4 clutches per year on average. Laying eggs takes about 2 weeks and brooding another 3 weeks. The hen will then take care of her chicks for about 8–12 weeks before she starts to lay eggs again. If feed availability and predation are not a concern, chicks can be separated from hens at around 6 weeks of age to encourage the hen to come back into lay more quickly.

6.4.2 Brooding and hatching

Once a clutch of eggs is laid, village hens usually become broody. (They sit on the nests for most of the day and may even sleep there. They are aggressive and make a characteristic squawk when approached.) A broody hen will incubate the eggs and then look after the chicks that hatch. She sits on the eggs for 21 days, leaving the nest for only short periods to get feed and water.

A hen can lose a lot of weight while she is incubating the eggs. Ensure that water and some supplementary feed are nearby to minimise this effect. Since she has depleted her calcium reserves to lay the clutch of eggs, it is important to also provide her with a good source of calcium during this period to build up her bones and to encourage her to commence laying as soon as possible after rearing her chicks. If the hen has to leave the nest for long periods to look for feed and water, the eggs may cool down excessively, resulting in poor hatchability and chick survival.

To test that the hen is definitely broody and will not abandon the nest, the farmer can put two or three old eggs under her. If she stays on the nest for 2 or 3 days, it indicates that she is truly broody. The old eggs can then be taken away in the evening when it is dark and replaced with 8–12 of the fresh, stored eggs. Very small or very large eggs should not be set—choose well-shaped, strong-shelled eggs. Do not set eggs from very young hens, as these usually do not hatch well.

The farmer should control the number of hens that are allowed to hatch eggs at any one time. The most favourable time is when there is more feed available for the hen and her chicks (harvest time or when the SFRB is rich) and when the weather is not too hot or too cold. It should also be taken into account that in some areas the hens lay eggs and go broody only at certain times of the year.

If the farmer does not want a broody hen to hatch eggs she can be placed in a small, separate cage in a cool, shady place. Keep the cage off the ground and cover the floor with wire or small branches to allow good air circulation. Make sure the hen has water and feed. In a few days she will lose her broodiness and after a while will start laying again.

If possible, it is good practice to separate a broody hen from other birds so that she is not disturbed while incubating her eggs. However, if this means that the nest must be moved, it may well lead to the hen abandoning the nest. So the move needs to be done carefully, preferably at night.

After 21 days of brooding, the chicks will hatch. Note the following points at hatching:

- Do not disturb a hen during hatching, because low temperature and/or low humidity have a negative effect on the hatching rate.
- Discard the eggs if a hen has been sitting on them for longer than 21 days. To make sure that the eggs do not contain living embryos, they are best candled before discarding (see Section 6.4.3)
- Hatching might take longer if the hen cannot completely cover all the eggs with her body, or when the clutch consists of eggs from different hens. In this case, the hen may abandon the eggs that are not already hatched to look after the newly hatched chicks. If an owner is concerned about this, they could remove dry chicks from the hen and keep them in a warm and safe place until the evening, when all of the chicks have hatched.

6.4.3 Candling eggs

Candling will provide information on whether an embryo is developing inside the fertilised egg and whether this embryo is alive. To check whether a chick is developing inside an egg you can hold the egg in front of a bright light (e.g. a paraffin lamp, a candle, a torch or a light bulb; Figure 14) inside a dark room. Candling can be done at about day 6–8 after a hen has started brooding a clutch to determine fertility and once again around day 17–18 to identify viable eggs and those containing dead embryos or bacterial rots. Eggs containing

bacterial rots and dead embryos should be discarded as they are a potential source of infection for the hatching chicks. White eggs are easier to examine than brown eggs.

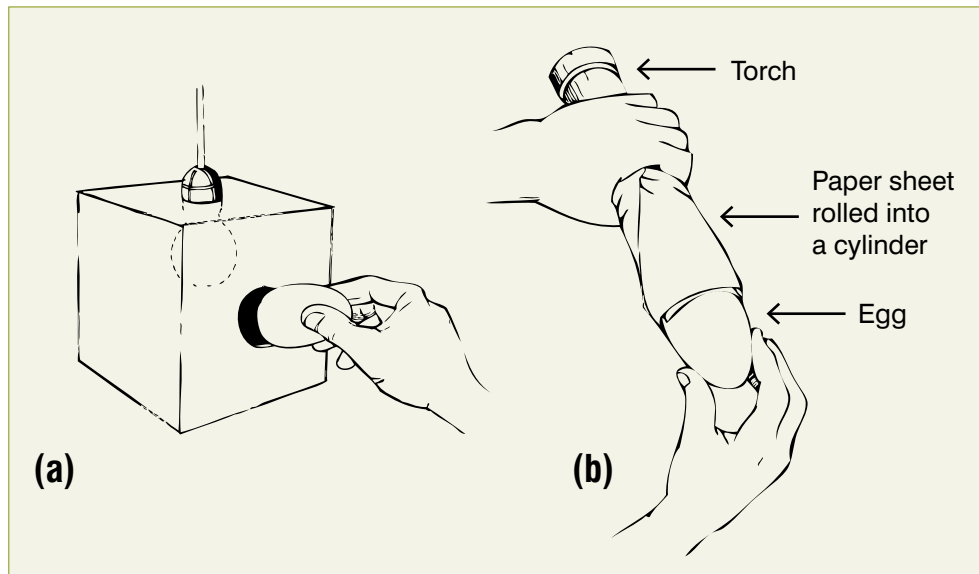


Figure 14. Eggs can be candled using a lamp (a) or a torch with a paper funnel adjusted to give a tight fit around the egg (b).

At 6–8 days you can see the shadow of the embryo, which might move in response to the light, as well as a fine net of blood vessels (Figure 15a). Eggs in which no embryo is developing are completely clear and may be removed and used for cooking. (Place the eggs in water first to ensure that they are not bad—good eggs will remain on the bottom of the container while bad eggs will float). In a fertile egg after 9–10 days of incubation (Figure 15a and b), the clear air cell in the blunt end of the egg takes up about one quarter of the volume of the egg, and the embryo, its membranes and fluids fill the remainder of the egg, allowing almost no light to pass through. There is a clear line separating the embryo etc. from the air cell.

Development of a chick inside the egg

Within 2 days of brooding the head and body of the embryo form. Fine blood vessels can be seen when candling the egg. From day 3, the chick's heart starts to beat. By day 7 of brooding, feathers, beak, head and stomach can be seen on the **embryo** (Figure 15a and b). At day 15, only a little **albumen** remains inside the egg and the plumage is complete. By day 19, the chick and the remaining **yolk** fill the egg completely. Shortly before hatching, the egg yolk is pulled into the chicks' abdomen via the navel to form the 'yolk sac'. The chick then starts to pick the eggshell just below the air cell using the 'beak tooth' which looks like a small thorn on the tip of its top beak.

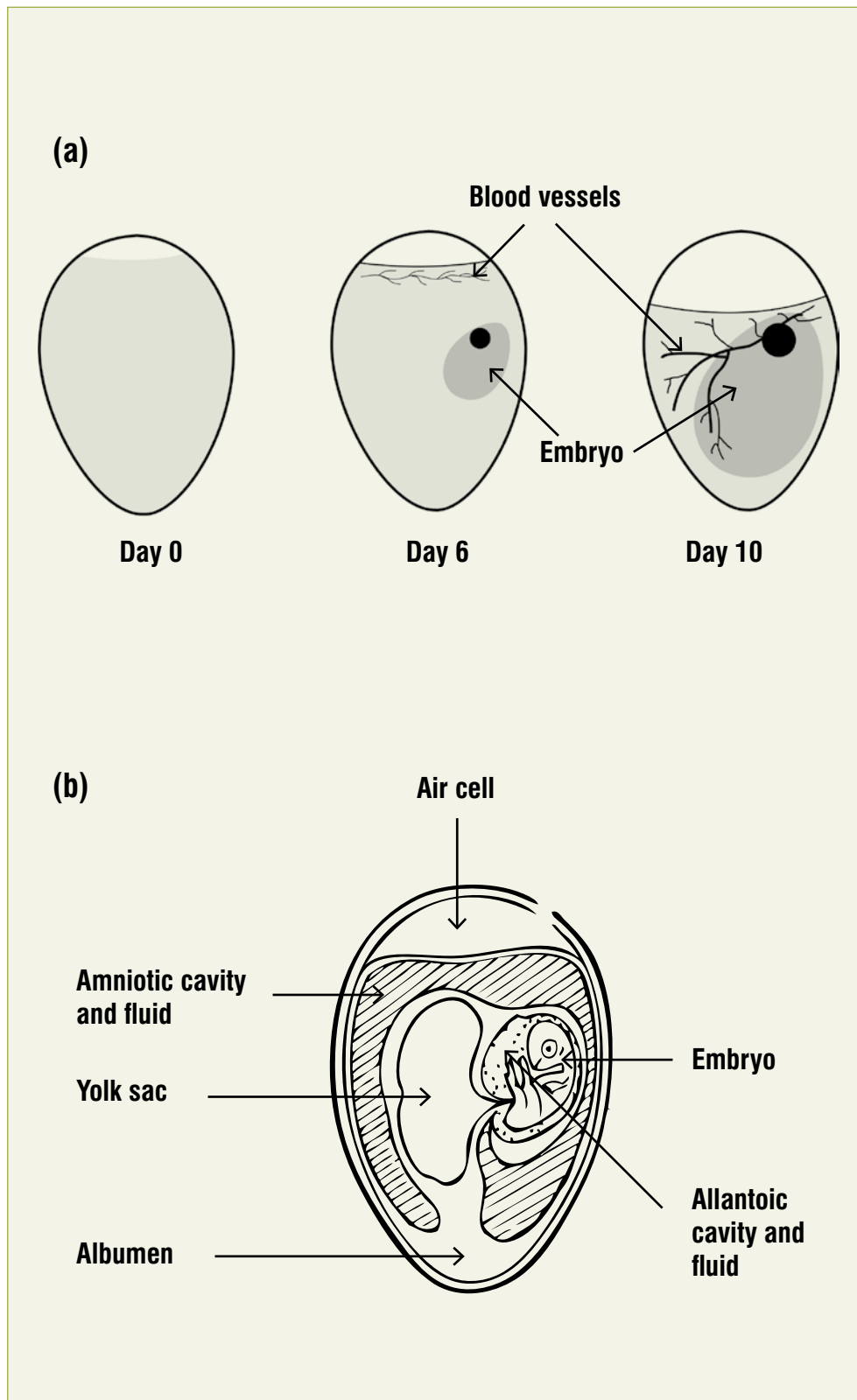


Figure 15. Drawings of a chick embryo developing inside an egg. The illustrations in (a) represent the development of embryos from day 0 to day 6 and day 10, as seen when candling an egg. The embryo in (b) has been developing for approximately 9 days.

6.5 Raising young chicks

Newcastle disease is a major cause of chick mortality, but chicks are also the age group most vulnerable to other diseases, predators, and environmental and nutritional problems. Although the local breeds of chicken are much better at mothering their chicks than exotic breeds, there are still many situations in a village that are beyond the mother hen's control. For this reason, newly hatched chicks need special care during their first 4–5 weeks of life. If extra care is given for these first few weeks, then there is a much greater chance that the birds will survive and grow into healthy, productive adults.

6.5.1 Feeding and nutrition

Young chicks have a limited ability to scavenge for feed and they can expend a large amount of energy just to find enough feed to survive. However, confinement of chicks for 2–6 weeks can be costly and labour intensive. An alternative is to provide a small amount of supplementary feed to young chicks and allow them to scavenge for most of the day with the hen.

To provide extra water or supplementary feed specifically for young chicks, a small enclosure that chicks but not adults can enter, can be used for feeding. This is called 'creep feeding' (Figure 16).

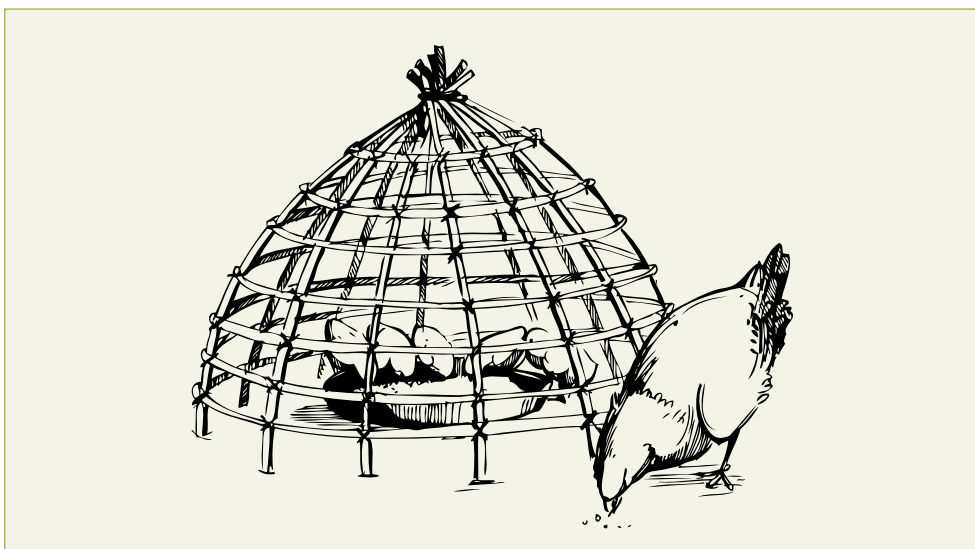


Figure 16. A creep feeder can provide a small quantity of feed specifically for chicks and not adult birds. This is useful when the quantity of feed available is limited. Clean water should also be readily available.

Clean, fresh water should be provided in a trough appropriate for young chicks (Figure 17). The trough should be low enough for the chicks to drink the water easily without getting wet or drowning, and have a broad base to prevent it from being tipped over. Pebbles may be placed in the trough when the chicks are very small.

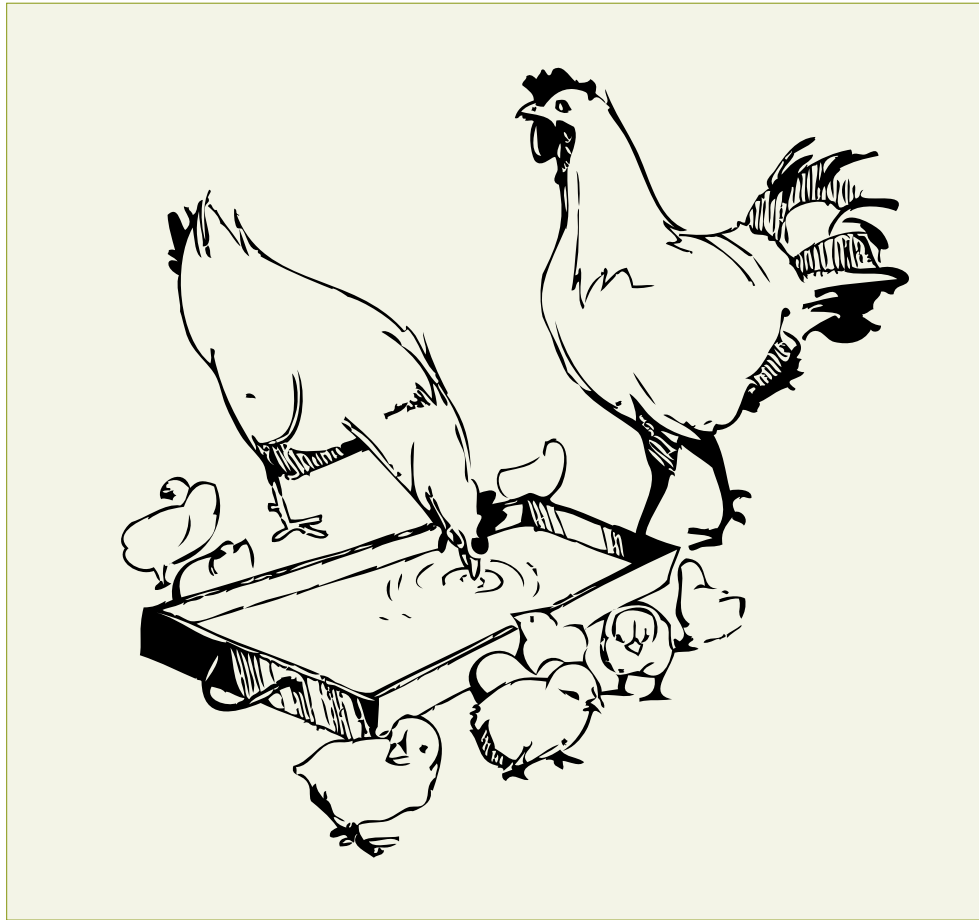


Figure 17. A low, shallow water trough containing a small volume of fresh water is appropriate for both chicks and adult birds.

What can be offered to young chicks for supplementary feeding?

A range of feedstuffs available from village resources can be used to supplement the diet of young chicks. Such feedstuffs include leftover food, maize meal, maize (corn), rice, cereals, green leaves, worms, and a range of insects and their larvae. In addition, it may be possible to utilise materials such as dried leaves from shrub legumes, cowpeas or pigeon peas, which could be specifically planted around houses. If available, a hard-boiled egg chopped into small pieces can also be offered to very young chicks.

Maize, rice and other grains should be crushed or pounded before being offered to young chicks, to enhance their digestibility. Soaking crushed maize in water for a short time before offering it to chicks will also enhance its digestibility.

If a farmer is reluctant to provide grains that could otherwise be used by the family, then the bran left over after milling could be given. Bran is not an ideal supplement for chicks, however, because it has a high fibre content and only moderate levels of proteins and energy. Young chicks have very limited capacity to cope with high-fibre feedstuffs.

What feed should be given to confined chicks?

If the chicks are confined for the first 2–3 weeks, their diet should contain an appropriate mixture of energy, proteins, vitamins and minerals (see Chapter 5—Nutrition), such as maize bran, crushed maize or wheat **plus** shrub legumes, fruit or any other green feed. This diet can be enriched with protein by offering termites or other insects to the chicks. A hard-boiled egg chopped into small pieces might also be added to the ration from time to time. The overall diet should contain more than 20% proteins and, because of limitations as to how much birds can physically ingest, the energy level should also be moderately high (>11.7 megajoules of metabolisable energy per kg).

Chicks may be fed household leftovers but problems may occur if the feed contains too much salt (sodium chloride). High levels of salt will result in watery droppings. The overall diet should not contain more than about 0.3% salt.

If commercial feed is available and affordable, small quantities can be provided to avoid malnutrition in young birds, including those that scavenge with the hen for all or part of the day. One kilogram of a good-quality commercial chick starter feed will be enough to feed a clutch of 10 chicks for the first 10–12 days of life. If feed is bought for chicks it should be especially designed for this age group. Do not feed layer mash to young chicks, because the nutritional needs of laying hens differ greatly from the needs of young chicks that still have to grow. If commercial feed is provided to give young chicks a good start, do not change the diet abruptly. Mix the feed they have been eating for a few days with the feed they are to be offered in future, to allow the chicks' digestive systems time to adapt and also to accommodate differences in palatability. Otherwise they may stop eating, or the new feed may cause diarrhoea.

Remember to always provide clean water to confined chicks.

When confining chicks remember:

- Confined chicks need to be fed a balanced diet daily.
- Chicks in free-range systems need their mother hen to teach them how to survive. If chicks are confined to protect them during their first days of life, the mother hen should be confined with them. For the chicks to learn scavenging, the whole family should be set free after no longer than 2 weeks confinement.
- After being confined for some time, chicks need supplementary feeding for a few more days until they have learnt how to survive from scavenging. This can be supplied through creep feeding.

6.5.2 Protection from diseases

The following steps should be taken to minimise exposure of chicks to diseases:

- Nests should be cleaned before or after each clutch to minimise the risk of infection.
- Brooding hens should be treated against fleas and other external parasites, to avoid infestation of newly hatched chicks (see Section 11.6).
- Blood-sucking external parasites are very harmful to young chicks, which should be regularly checked for infestation with external parasites (especially fleas and mites) and treated as soon as an infestation is noticed.
- If possible, hens with young chicks should be housed separately from the flock (especially where elevated houses prevent chicks from entering). Avoiding close contact with other birds by keeping them separate overnight also decreases the risk of infectious diseases that might spread from the older chickens to the young chicks.
- Prevent chicks from scavenging in places where there are many droppings from adult chickens. These droppings might contain coccidia, which can cause severe disease in the chicks (see Section 11.4).
- Since nutritional, environmental and other factors (see Figure 22 in Chapter 8) directly affect the chicken's health status, good husbandry is especially important for young chicks, which are not used to coping with harsh conditions.

6.5.3 Protection from predators

The best way to protect chicks from predators is to keep the young birds in a pen. However, this is not always practical in an extensive production system, because confined chickens need to be offered feed and water regularly.

- To decrease the risk of predation, extra feed and water can be provided for chicks near the home so that they do not roam too far. Offering feed under a roof or tree, for example, will help to hide young chicks from avian predators such as eagles and hawks.
- Hens with young chicks should be housed at night to protect the chicks and their mothers from predators and harsh conditions.
- Where chicks are confined, it is important to ensure that the house and/or cage is constructed in a way (see Chapter 4) that keeps out snakes, rodents and other predators. Internal feeders and waterers are preferable, and the spacing between the wire or bamboo slats on the cage is very important in preventing access by snakes and other predators.

6.6 Breeding

Although village chickens are not as productive as commercial chickens, due to suboptimal housing, management and feeding, their genetic potential is rarely fully exploited. The village chicken is arguably the best bird for the conditions existing in rural villages and, in the vast majority of situations, it is not advisable to introduce exotic breeds at this stage (even if such are readily available). The productivity of indigenous chickens can be significantly improved over time by selecting only the healthiest males and females with the best production and conformation for breeding purposes. Using the existing chicken breeds and strains will also mean that they will retain their ability to survive under harsh conditions.

Remember that village chickens have many advantages over commercial birds. They are easiest to look after; are more resistant to many common diseases; can survive better under difficult conditions; know how to scavenge for their feed; are good at brooding, hatching and raising their young; and have better camouflage and capacity to escape predators (including the ability to fly).

Interbreeding between closely related birds can be avoided by obtaining, by purchase or exchange about once every 2 years, chickens (especially males) from more distant villages. The farmer should make sure there is no disease present in the chickens and should keep them isolated from the rest of the flock for at least 14 days after they are obtained.

It is important to maintain the correct mating ratios; that is, not have too many or too few males for the number of hens. The general guide is to have one rooster for every 10 hens, plus one extra rooster (in case one gets hurt or dies). So if a farmer has 10 hens, there should be two males, or if they have 20 hens, they should keep three roosters.

Breeding aims to increase productivity by using the best available genetic material to produce offspring. To achieve this, only birds that perform well should be allowed to mate, while other birds should be culled from the flock. When selecting birds for breeding, farmers should look for chickens that:

- are healthy and robust
- grow and produce well with the feed available
- have well-developed breast muscles (especially in roosters)
- have a deep, rounded body (especially in hens)
- are neither too big nor too small
- are confident and healthy (even showing signs of aggressiveness in the male)
- have lively eyes and a full, red, moist-looking comb
- are fast growing
- are good egg producers
- have a good hatching rate
- have good mothering skills.

Younger hens have better productive ability and fertility but birds that are more than 2 years old may still be used for breeding if they have desirable genetic characteristics. If the farmer wants to introduce the naked neck or frizzled feather genes into the flock, then male birds with these characteristics should be used. Naked neck and frizzled birds have been shown to be more tolerant of high temperatures. Birds showing any inherited disorder should be culled.

Different breeds of village chickens have been recognised in many countries. In Tanzania, for example, at least four distinct ecotypes/breeds have been recognised (Table 6), and in northern Laos, farmers also recognise four different types of local chickens—the large chicken (*gai yok*), the medium chicken (*gai lat*), the dwarf chicken (*gai jeh*) and the fighting cock (*gai tee*).

Table 6. Characteristics of different breeds of local chicken in Tanzania (Buza and Mwamuhehe 2001)

Breed/Type	Characteristics
<i>Kuchi</i> or <i>Kuza</i>	Short beak with few feathers; heavy with good meat; lays few eggs (7–10) per clutch; 4 months laying interval; mature size big; much preferred due to its size and weight
<i>Poni</i> or <i>Kishingo</i>	Small; lower weight; many feathers; lays up to 20 eggs per clutch; good mothering ability; 4 months laying interval
<i>Mbuni</i>	Moderately large; no tail; lays up to 15 eggs; laying interval 3–4 months; more vulnerable to diseases
<i>Tongwe</i> or <i>Msumbiji</i>	Short and stout; small and of low weight; lays about 20 eggs per clutch; good mothering ability; preferred by producers but not buyers because of small size; laying interval 3–4 months

6.6.1 Introduction of exotic breeds

In commercial chicken production systems, productivity is increased by introducing better-performing breeds. Some of these ‘improved breeds’ are also promoted for improving village chicken production. Before introducing these more productive birds into a village flock the following points should be considered:

- Low productivity of local breeds is related to poor nutritional and husbandry conditions as well as a lower genetic potential. Under optimal conditions, even village chickens will perform better.
- The harsh conditions of most village chicken production systems will not allow ‘improved breeds’ to perform as well as they would in commercial systems, even if they are afforded special care.
- Village chickens are adapted to harsh environmental conditions such as scavenging for feed, being exposed to various diseases, and hiding and flying to escape from predators. Exotic breeds have been developed for commercial systems and are accustomed to high-quality feed and regular health care. They are more susceptible to diseases and predators and are

not as good at scavenging for feed. Exotic breeds will therefore need more care than traditional breeds. They will need more supplementary feeding, provision of water and proper housing, and protection against predators.

- Commercial breeds are very likely to be more susceptible to local diseases, whereas village chickens, over the generations, have adapted to cope with a number of diseases and parasites.
- Commercial hens often make poor mothers. Many breeds do not go broody and hence will not sit on the nest to hatch eggs. After their chicks have hatched, the mother may not know how to teach them to scavenge for feed and may not care for the chicks.
- Better-performing birds are often sold as chicks from 1 day to 6 weeks of age. Young chicks are more vulnerable to poor conditions than are adult birds and more likely to suffer under them.
- Comparisons between the egg production of commercial layers and indigenous hens are often misrepresented by not accounting for the extended period of time that the village hen spends hatching the eggs and caring for the brood of chicks before she recommences laying.

For these reasons, if a farmer wishes to introduce exotic breeds into the flock they should consider the following suggestions:

- Do not buy young chicks unless you have experience in raising motherless chicks.
- Buy only healthy-looking birds.
- Determine if the birds have been sexed. There is little or no value in purchasing culled, layer strain male chicks.
- Ask the seller how the chickens have been kept (housing, feeding) and whether the birds have been vaccinated (especially against ND).
- Keep the new chickens separate from the village flock at first (for 14 days if possible) to prevent them from getting sick with any disease that might occur in the village flock and to confirm that the new birds are disease free.
- If chickens are used to being confined they will not know how to scavenge or protect themselves from predators. For this reason, newly acquired birds of commercial breeds have to gradually get used to the free-range system. They should be kept confined and fed commercial feed for 3 weeks before being allowed to move around in a fenced area and gradually given more locally produced supplementary feed. They can then be given longer periods of freedom to scavenge for feed over another 1–2 weeks. Interbreed the improved breeds with the local breeds as soon as possible, so as to gain some of the benefits of both breeds in the offspring. This needs to be done initially on a small number of birds to ensure that the resultant stock have desirable qualities and do not possess unwanted characteristics.

6.6.2 Meat production versus egg production

Purposeful breeding aims to get either more eggs or more meat. Big chickens with thick breast muscles often produce fewer eggs because they convert the feed into muscle rather than eggs. Similarly, good egg producers are usually smaller because they convert more feed into eggs rather than into muscle. The maintenance requirements of large birds are also greater than for small birds.

If breeding aims to increase egg production, more emphasis should be put on the reproductive and mothering performance of the hens, while breeding for meat production should focus mainly on characteristics of rapid growth and size.

If a farmer intends to 'improve' their flock with exotic breeds, they have to decide whether to introduce birds known for good egg production or for good meat production. However, some improved breeds are known as 'dual-purpose breeds', which means the birds are bigger than average (with more meat) and produce a good number of eggs as well. They do not grow quite as large as the purely meat breeds and do not produce quite as many eggs as the purely egg breeds, but are somewhere in between the two.

Whether or not exotic breeds are introduced, the farmer should be encouraged to always select the best birds for breeding within their flock and eat or sell chickens with low production.

6.7 Meat production (sale and consumption)

A healthy and productive chicken flock has the capacity to increase in numbers and allow the off-take of more birds for consumption, sale, barter and other purposes. Depending on the availability and cost of feed for the additional birds, chicken farmers should have more money available for essential household expenses, and will improve their family's diet by making more chicken meat and eggs available for consumption.

In certain areas, there are traditions restricting the consumption of chickens and eggs. These traditions may gradually change as production starts to improve. Extension staff can also assist by promoting the consumption of chicken meat and eggs. The nutritional value of chicken meat should be promoted, as well as the value of eating chickens and eggs for young children and pregnant and breastfeeding mothers.

Extension staff should collaborate with colleagues working on human nutrition within the ministries of health and education to raise the awareness of families about good eating practices and the contribution that chickens and eggs can make to good health.

6.7.1 Nutritional value of chicken meat

Meat from village chickens contains highly valuable proteins, vitamins and minerals, and relatively little fat. As a result of genotype and the scavenging

diet, the fat consists of over 60% unsaturated fatty acids and a relatively high proportion of omega-3 fatty acids, which are very beneficial in membrane formation in developing babies and children.

Why do we need proteins?

The human body constantly needs proteins. Each adult needs to consume 45–55 g of proteins daily. While absolute amounts depend on age and body weight, growing children and nursing mothers need a higher proportion of proteins in their diets.

Every cell of the body contains proteins. An adult's body contains about 12 kg of proteins. Furthermore, hormones and enzymes, which are necessary for all essential functions of our body, cannot exist and work without proteins.

This means NO life without proteins!

6.7.2 Selection of chickens for consumption or sale

When selecting chickens for consumption, sale, barter or other purposes, both optimal use of the available feed resources and breeding factors should be considered: **chickens that perform well should remain in the flock for further production and breeding while unproductive birds should be culled from the flock** (Figure 18). In this way, a farmer will not waste valuable feed resources on unproductive birds while at the same time the quality of the flock will gradually be improved.

The large, fast-growing chicks are usually the male birds. These are called cockerels and they are best eaten when they are young as only a few mature male birds are required for breeding.

When culling chickens from the flock, the following points should be considered:

- Cull cockerels for consumption or sale at about 4–5 months of age. Keep only the best cockerels for breeding.
- Sell or eat the hens that are not laying well.
- Sell or eat hens that are older than 2 years, as egg production and meat quality rapidly fall after this age.
- Keep female birds that lay and mother well for further production.
- Select the best-performing birds for breeding (see Section 6.6).

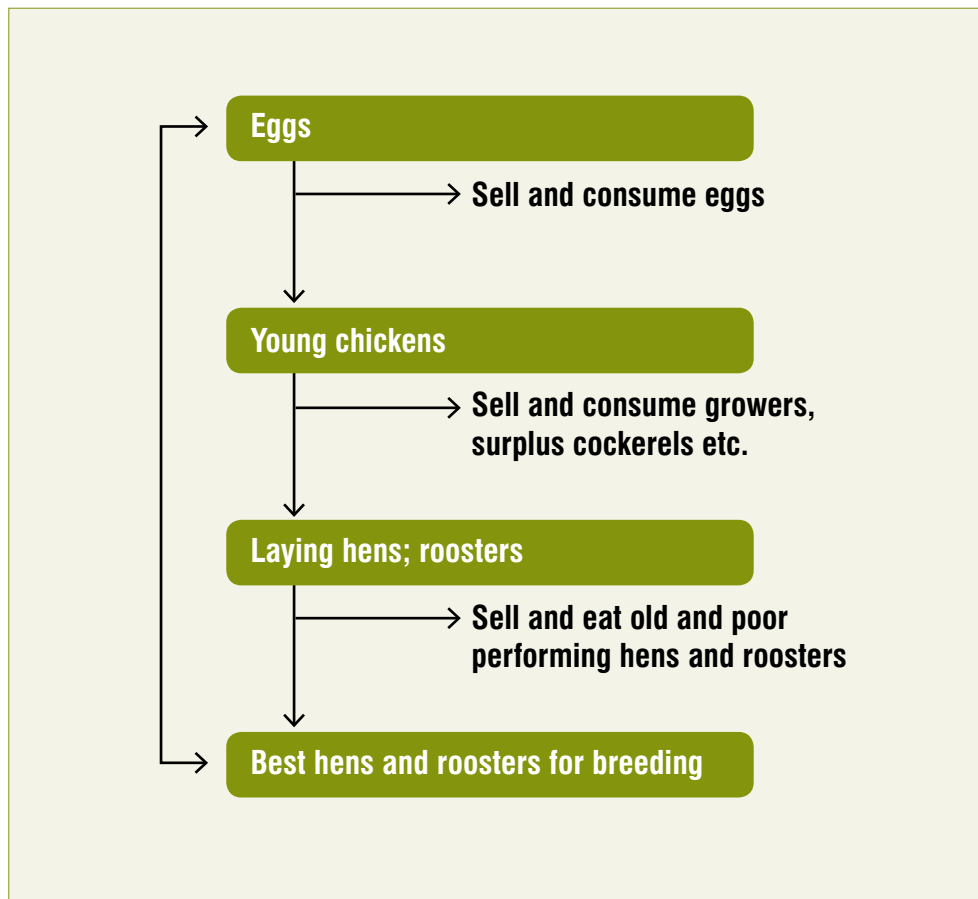


Figure 18. The selection process required for improving a chicken flock

6.7.3 Marketing surplus chickens

For many farmers, village chickens are a living bank account. The sale of chickens or eggs can resolve many of the money problems that rural families face, such as the payment of school fees, purchase of clothes or medicines or essential food items like oil or salt. The sale (or barter) of chickens can also enable farmers to acquire other domestic animals such as pigs, sheep, goats and cattle.

Economic studies have shown that although an increased supply of village chickens may slightly lower the price of those chickens, farmers will be able to sell more birds and their total income will be higher. Urban consumers in many regions have a preference for village chickens over intensively produced broilers and it is estimated that a very large increase in village chicken production would be needed before consumers in urban areas became oversupplied with chickens. Prices of village chickens (per bird and, even more markedly, per kg) are generally higher than intensively produced chickens and, if prices were to fall along with a more plentiful supply, it would be expected that urban consumers in most societies and cultures would eat more village chickens and fewer intensively produced broilers.

Questions concerning an increased off-take (in terms of sale and/or barter):

- Where can the eggs and birds be sold at a good price?
- When are the best times to sell chickens or eggs?
- Is it better to sell chickens or eggs?

Instead of selling chickens only when money is needed, birds or eggs should also be sold or consumed to maintain an optimal flock size throughout the year (see Section 6.2). Furthermore, farmers can plan ahead to produce and sell more birds before public holidays when people like to prepare feasts with meat.

If feed is scarce, it is best to sell eggs instead of taking the risk of raising chicks. On the other hand, chickens should be raised for sale when feed for scavenging is available in abundance, to make use of this cost-free resource.

Tips for extension staff to help with marketing surplus chickens and eggs:

- Inform chicken traders in central markets of areas where farmers are vaccinating against ND. Tell them that they will usually find chickens to buy if they make the effort to visit these areas. Newcastle disease also causes problems for chicken traders, because it can be difficult for them to buy birds at a reasonable price after an outbreak. Traders can also lose money if birds purchased from many different houses and areas become infected with ND and die before reaching the market.
- Encourage local communities to select their own chicken traders. Just as the community can choose community vaccinators, they can also choose people to take their surplus birds and eggs to central markets for sale. In this way, the farmers are more likely to get a fair price for their birds, and the profits involved in chicken trading will stay within the community. Training may be required to ensure that sales are fairly distributed and that trips to central markets are made when buyers are more likely to have money (e.g. the first week after government salaries are paid) and when major festivals are about to take place (e.g. religious or other holidays).
- Organise local market days, maybe monthly, and invite chicken traders, restaurant owners etc. to attend.

6.7.4 Food safety

Sick, dying or dead birds should NOT be consumed. They should be buried in a deep pit away from water sources and beyond the reach of predators. Consume only healthy birds from healthy flocks.

As apparently healthy birds might also be incubating a disease, and to improve food safety in general, the following precautions should also be taken.

Keep clean:

- wash your hands with soap before handling food and again (frequently) during food preparation
- wash your hands with soap thoroughly after handling poultry meat
- wash and sanitise all work surfaces and instruments used to prepare meat for cooking
- protect kitchen areas and food from insects, pests and other animals.

Separate raw and cooked food:

- separate raw meat, poultry and seafood from other foods
- use separate equipment and utensils, such as knives and cutting boards, for handling raw foods
- store food in containers to avoid contact between raw and prepared foods.

Cook food thoroughly:

- cook poultry meat, eggs and blood thoroughly
- foods such as soups and stews should reach boiling point. For meat and poultry, make sure that juices run clear, not pink.

Safe slaughtering practices

If an apparently healthy bird selected for slaughter is incubating a zoonotic disease such as HPAI, **the most dangerous period to the handler is during the slaughter and preparation of the bird**. In addition to the virus inside the bird, there will also be large numbers of virus particles on the feathers around the vent and on the head. Birds should be placed in scalding water (70 °C; this is approximately when steam comes off hot water but before it boils) for a minute before having their feathers plucked or their feathers burnt off in a fire. Scalding will also make it easier to remove (i.e. pluck) the feathers.

6.8 Egg production (sale and consumption)

Eggs can be used to produce more chicks, but once ND is under control and chick husbandry is improved, not all of the eggs are necessary to produce offspring. Many of the eggs laid can be collected and either sold or eaten by the farmer and their family. The eggs are therefore a useful source of extra income and a very good source of nutrition for all members of the family.

Families should generally be encouraged to eat more eggs when they own a productive chicken flock. In some regions, it is traditional to prohibit the consumption of eggs by women and children. Overcoming these traditions and gaining recognition for eggs as a valuable source of nutrients will help to improve nutrition in these regions. In areas where ND control and improved husbandry have been successfully introduced, consumption of eggs has increased. It is likely that most traditions prohibiting consumption of eggs developed because of the need to ensure that most eggs laid could hatch to produce replacement stock in the face of high mortality.

The development of an egg

All of the eggs that she will ever produce are already present in a young hen in the form of ova, which can be found in the **ovary** as tiny, whitish, bubble-like structures (Figure 19). When the hen is in lay, the ova grow one at a time to form yellowish egg yolks. Each ovum takes about 2–3 weeks to mature to a yolk. During the laying period, one egg yolk or **follicle** is released from the ovary every day and falls into the **infundibulum**, a funnel-like structure at the top of the oviduct. In the **oviduct**, albumen is deposited around the yolk and then, further along, in the **isthmus**, two shell membranes are formed to surround the albumen. After the egg is 'plumped' with water, the membranous egg moves into the **uterus** or 'shell gland' where the shell is deposited. The time taken from release of the follicle from the ovary until lay is usually a little over 24 hours.

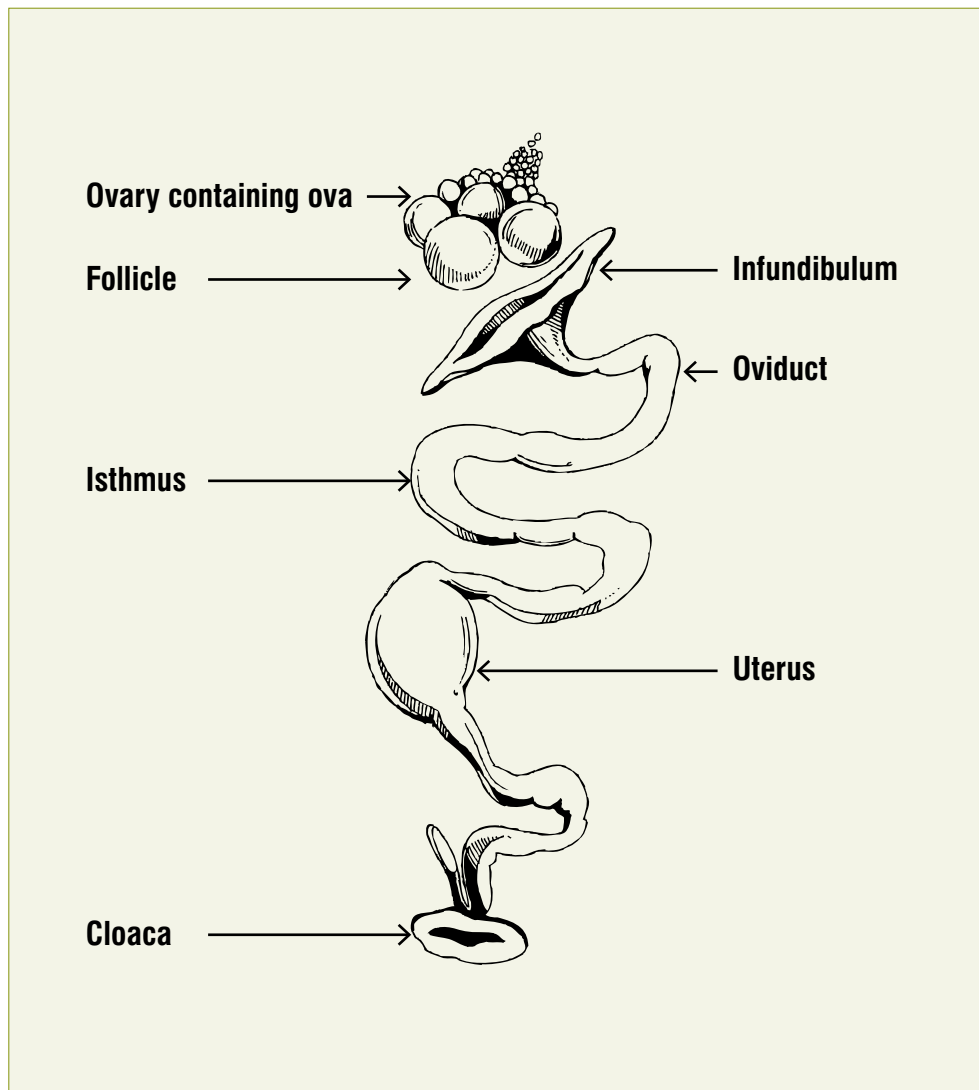


Figure 19. Diagram of the female reproductive tract of a chicken

6.8.1 Nutritional value of eggs

Eggs provide a range of essential nutrients and can make a substantial contribution to a healthy diet, especially for growing children, pregnant and nursing women, and HIV-positive individuals.

Each 100 g of eggs (a weight less than that of two eggs) contains about 13 g of proteins, 11 g of fats (in the egg yolk), 1 g of carbohydrates and 74 g of water (mainly in the albumen). The proteins contained in an egg are easily absorbed in the intestine and are therefore of high value for humans—even higher than the proteins contained in milk. In addition, a variety of minerals and vitamins (except vitamin C) are concentrated in eggs (Table 7). Research has also revealed that eggs contain several specific nutrients that have health-promoting properties, such as folic acid and iodine.

Table 7. Nutrient contents of 100 g of eggs

Main nutrients (g)		Vitamins (mg)		Minerals (mg)	
Proteins	13	E	2.02	Phosphorus	216
Fats	11	A	0.27	Potassium	147
Carbohydrates	1	K	0.05	Sodium	144
		B2	0.31	Calcium	56
Water	74	B1	0.10	Magnesium	12
		B6	0.08	Iron	2.1
		Folic acid	0.07	Fluorine	0.1
				Iodine	0.01

Extension workers should collaborate with colleagues working on human nutrition within the ministries of health and education to raise the awareness of families about good eating practices and the contribution that chickens and eggs can make to good health.

6.8.2 When to take eggs for sale or consumption

Eggs can be taken from every clutch before the hen has started to brood. Once the hen is brooding, the development of the embryo commences in fertile eggs (i.e. when a hen has mated with a rooster before starting to lay eggs; see Figure 13). It is recommended that these eggs be left with the hen. However, when a hen has not mated with a rooster before laying eggs, these eggs will be infertile and no chick will develop inside. Infertile eggs can be eaten even if the hen has sat on them for a few days. They can be identified by candling (see Section 6.4.3). These brooded eggs should be hard boiled (at least 10 minutes) or fried before consumption, to destroy any germs that might have penetrated through the eggshell.

It is advisable to consume or sell eggs instead of breeding chicks in times when the chance of survival for the chicks is low, such as when

- there is not enough feed for the chicks to survive (because of the season of the year or because too many animals are competing for the SFRB)
- the flock is already large and a further increase in stocking density is likely to cause problems
- chicks would be likely to suffer due to heavy rainfall or other seasonal and climatic influences.

6.8.3 Egg storage and conservation

How should eggs be stored?

With fertile eggs (when the hen has mated with a rooster) the embryo will start to grow even at ambient temperature (above 20 °C). Eggs should therefore be kept in a cool, shady place. A basket or box containing sawdust or bran placed in a hole in the floor in the coolest part of the dwelling makes a good store. For short-term storage, the way in which the egg is positioned is not important but, for long-term storage, there is some merit in storing the eggs with their pointed ends uppermost. Eggs for incubation should not be stored for longer than 2 weeks.

Do not store eggs kept for consumption beside items with a strong smell, as the eggs easily absorb the smell through the shell and the whole meal prepared with one of these eggs might be spoiled.

How long can eggs be stored before consumption?

If kept in a cool, shady place, a fertile egg will be suitable for home consumption for about 2 weeks, but it is desirable to use them before this if possible. In eggs that are not fertile, no embryo will start to develop but—as with fertile eggs—germs might enter through the shell and multiply inside the egg if it is stored for a long time at temperatures above 20 °C. Infertile eggs should therefore also be used within about 5–7 days if possible.

Eggs with a **broken shell** should be used immediately and consumed only after they have been cooked for some time (hard boiled, fried or well cooked with a meal).

How can fresh eggs be distinguished from old, bad eggs?

Place eggs in a container of water. Old eggs, which may be bad and which should not be eaten, will float in the water because a bubble-like chamber of air (the air cell) inside the egg gets bigger with the age of the egg (see Figure 20). This air chamber is smaller in fresh eggs, which will therefore stay at the bottom of the container filled with water.

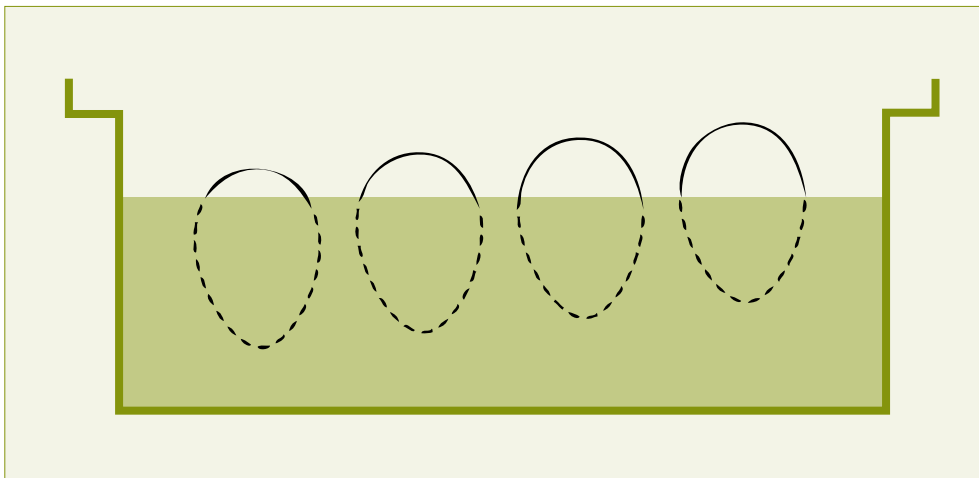


Figure 20. The freshness of whole eggs can be determined by floating them in water. Fresh eggs with a small air cell will sink lower (perhaps completely) in the water (eggs to the left) than will older eggs, in which the air cell has increased in size. The older egg is therefore lighter and so sits higher in the water (eggs to the right).

Fresh eggs can also be distinguished from old ones by the height of the albumen (the white or clear part of the egg) once an unboiled egg is opened and put on a dish (see Figure 21). The albumen of fresh eggs is quite high (maybe half as high as the egg yolk). In older eggs the albumen becomes watery and lies flat on the plate; the egg yolk is also flatter.

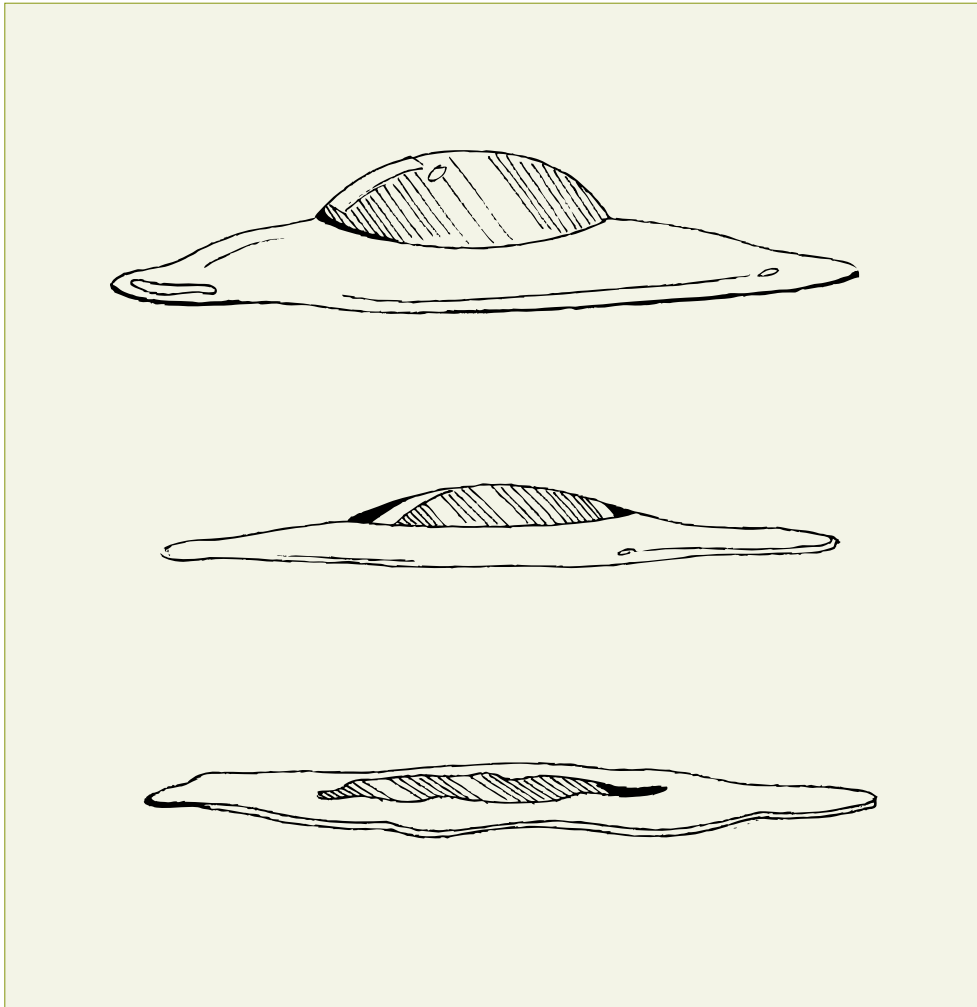


Figure 21. The freshness of an open egg can be estimated by breaking the egg onto a flat surface. The yolk will sit higher than the white in a fresh egg (top). As an egg ages, it will lose all structure, becoming completely flat (bottom).

How can eggs be preserved?

The quality of albumen declines very rapidly when eggs are stored at room temperature, especially in hot climates. Refrigeration is effective in maintaining quality for several months (Table 8). Oiling eggs on the day of lay will preserve their quality for several weeks. Wipe the egg with a little cooking oil after cleaning the shell. This will close the small pores in the eggshell and prevent moisture and carbon dioxide from escaping from the egg. The oil film also prevents germs from entering, provided the shell is clean.

Hard-boiled eggs can be stored for several weeks. These eggs might also be oiled to preserve their quality for even longer periods. Another possibility is to store raw eggs in water glass (sodium silicate) solution. Eggs will keep for several months in water glass if covered and stored in a cool place. The water glass solution is made by mixing one part of water glass (sodium silicate) to five parts of previously boiled but cooled water.

Table 8. Approximate safe storage times for eggs

Type of storage	Approximate length of storage
Eggs with a broken shell	Use immediately and do not store
Fresh eggs (fertile and infertile) stored in warm conditions (above 20 °C)	1–2 days. If unsure of the age of the eggs, test to see if they are spoilt, and hard boil or cook them well before consumption.
Fresh eggs (fertile and infertile) stored in a cool, shady place	5–7 days
Oiling egg on the day of lay and kept in cool, shady conditions (use cooking or vegetable oil)	2 weeks
Hard boiling eggs on the day of lay	3 weeks
Hard boiling and oiling fresh eggs	4–5 weeks
Stored in water glass (1 part sodium silicate to 5 parts of boiled and cooled water)	Several months
Refrigeration (where the temperature is constantly maintained around 4 °C)	4 weeks

6.8.4 Egg quality

The quality of an egg depends on:

- whether it is clean or dirty
- how long it has been stored
- the health status of the hen that laid it
- whether or not it is fertile.

Can dirty eggs be consumed?

Eggs should be cleaned before they are sold or consumed, as the dirt on the eggshell is likely to contain germs and may cause people to get sick. Wipe eggs with a dry cloth soon after collecting them. Do not wash eggs with water because that will destroy a very thin protective covering on the eggshell which protects the egg from germs.

Can eggs that have been taken from a brooding hen be consumed?

Once the hen is brooding, the development of the embryo will start in fertile eggs (if the hen mated with a rooster before starting to lay eggs). It is recommended that fertile eggs be left with the hen. Infertile eggs (which do not contain a developing embryo) might be taken from a brooding hen for consumption. The latter can be identified by candling the eggs at day 5–7 of brooding (see Section 6.4.3).

Can eggs cause disease in humans?

Some eggs might be contaminated with germs such as salmonella that can cause diarrhoea, especially in young children and sick and older people. Most of these germs are destroyed by heat, so, to avoid diarrhoea, eggs (at least

those of unknown origin) should be eaten only after being thoroughly cooked (e.g. hard boiled or well fried). It is always best to consume eggs that are as fresh as possible to avoid germs that may multiply inside the egg.

Does the colour of the egg yolk indicate its quality?

The colour of the egg yolk may vary from light yellow to orange, depending on the feed the chicken has eaten. The colour may reflect the vitamin content of eggs produced by scavenging or 'free-range' chickens that do not have access to commercial diets. Changes of the egg yolk to a greenish or brownish colour may be caused by drugs or toxins (Table 9).

Do stains or small spots in the albumen influence the egg quality?

Small stains or 'meat' spots in the eggwhite (albumen) are often caused by small amounts of coagulated blood that accompany the yolk at the time of its release from the ovary. They have no effect on the nutritive value or safety of eggs.

Why do some eggs smell like fish?

While eggs might smell like fish if the chicken's feed contained too much fish, some hens produce eggs smelling or even tasting like fish even if they are not fed fishy feed. The smell might then be caused by a substance called trimethylamine which can be produced after hens are fed rapeseed (also known as canola). The production of trimethylamine in a hen is an inherited characteristic and, if only certain hens are producing strongly smelling eggs, these birds should be slaughtered or, alternatively, not fed rapeseed. These hens can also be identified by opening their beaks and smelling their breath to see if it has the same strong smell.

Eggs may also have a fishy smell if the hen is suffering from salpingitis, an infection of the reproductive system.

6.8.5 Diseases and disorders affecting egg quality

Diseases in hens, as well as poor husbandry or nutrition, might affect egg production. A hen in bad condition will produce fewer or even no eggs. The quality of eggs may also be affected by several diseases and disorders. Table 9 summarises the types of changes in egg quality that can occur, and possible reasons for these changes.

Table 9. Reasons for reduced egg quality

Sign	Cause or contributing factor	
	Non-infectious	Infectious
Shape of the egg:		
Small size of eggs	Low body weight Imbalanced ration (lack of protein) Lack of water High ambient temperature Toxins	Infectious bronchitis Newcastle disease Diseases affecting the liver
Changes in the egg shape	Toxins	Infection with adenoviruses Infection with mycoplasmas Newcastle disease
Egg shell:		
Dirty shell	Diarrhoea in the hen Dirty nest	Spirochaete infection
Thin, perhaps cracked, shell	Lack of calcium, phosphorus and vitamin D3	Newcastle disease Infectious bronchitis Egg drop syndrome (EDS; adenovirus infection)
Lack of hard shell	–	EDS Avian influenza
Pale shell	–	Infection with pneumovirus Infectious bronchitis EDS
Rough shell	–	Infectious bronchitis
Albumen (eggwhite):		
Watery albumen	Old egg Toxins	Infectious bronchitis Diseases affecting the liver
Slightly pink albumen	Feeding cottonseed ^a	–
Egg yolk:		
Greenish colour	Feeding cottonseed ^a	–
Brownish colour	Using piperazine for deworming	–
Watery egg yolk	Old egg	Infectious bronchitis
Stained, spotted egg yolk	(Depending on the pigments contained in the ration)	Coccidiosis Worms

^a Cotton plants contain gossypol, a natural toxin causing the change in colour.

6.9 Record keeping

A more active and interested farmer will spend some time each day observing their chickens.

The keeping of records is a very useful management tool. Where someone in a family can read and write, simple records will help the individual farmer as well as extension workers and other technical people to identify problems and optimise production.

Some of the production parameters that would be useful to record include (for each hen and her progeny):

- mortality (clinical signs and/or suggested cause)—flock statistics
- general laying ability (number of eggs per clutch)
- number of clutches per year
- number of chicks hatched
- number of chicks reared (to, say, 8 weeks of age)
- number of chickens and eggs sold
- number of chickens and eggs eaten
- vaccination and other treatments applied (when and with what).

7 Disorders related to poor husbandry or nutrition

Poor husbandry and nutrition will result in low productivity and may lead to disease or even death of the chickens. Disorders caused by poor husbandry or nutrition cannot spread from one bird to another (they are not infectious) but often the whole flock or age group is affected because all of the birds are living under similar conditions. Tables 10 and 11 give an overview of possible consequences of poor husbandry and nutrition.

Table 10. Chicken disorders caused by poor husbandry (other than nutrition)

Sign	Cause or contributing factor
Drop in productivity	High temperature, lack of water, overcrowding
Respiratory distress	High temperature, lack of water, overcrowding
Respiratory signs	Poor-quality air in the chicken house (due to high amount of wet faeces), overcrowding Chicken house does not protect the birds from rain or wind (leaking roof, wall with holes, poor location)
Diarrhoea	Moist chicken house, moist areas around the troughs leads to infectious diseases; dietary problem
Feather pecking Cannibalism	Crowded chicken house and other stresses
Lesions on the feet	Rough and/or dirty floor in the chicken house

Table 11. Chicken disorders caused by poor nutrition

Sign	Cause or contributing factor
Low productivity	Insufficient or poor-quality feed
Low hatching rate	Lack of vitamins
High chick mortality	Lack of vitamins or trace minerals, lack of feed or poor-quality feed
High susceptibility to any disease	Lack of vitamins, trace minerals or proteins
Retarded growth of body and feathers	Lack of vitamins or trace minerals
Soft legs that can bend in chicks	Lack of minerals (calcium, phosphorus) and vitamins (vitamin D)
Fractured legs and wings in laying hens	Lack of minerals (calcium, phosphorus) and vitamins (vitamin D)
Curled toes, deformed legs	Lack of vitamins (B vitamins)
Thin eggshells, eggs without shell	Lack of minerals (calcium, phosphorus) and vitamins (vitamin D)
Diarrhoea	Bad-quality feed (contaminated with infectious agents) Carbohydrate fractions in certain grains and grain legumes High salt levels
Blue comb	Lack of water
Central nervous signs	Lack of vitamins (B vitamins)
Sugar-like layer on inner organs (gout)	Lack of water, surplus of minerals, lack of vitamin A
Enlarged yellow liver	Lack of dietary proteins, surplus of carbohydrates or fats in the ration
Swollen kidneys	Lack of water, too much salt in diet

