PRODUCTION GUIDELINES
for Small-Scale Broiler Enterprises

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Production Guidelines for Small-Scale Broiler Enterprises

Report to the
Water Research Commission

by

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- Guidelines on Management of Working animals (WRC Report No. TT 569/13)

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TABLE OF CONTENT

1 INTRODUCTION

1.1 What is a small-scale broiler enterprise?

An enterprise is a business that trades goods or services to consumers with a view of making a profit and to increase the wealth of its owner(s). A broiler is a type of chicken (*Gallus domesticus*) that was specifically bred for efficient meat production. Broiler breeds grow much faster than layer breeds or traditional dual-purpose breeds. Furthermore, broiler chickens have desirable carcass confirmation, require low amounts of feed per unit mass of meat produced, and typically reach a live weight of about two kilograms in just under 40 days.

Small-scale commercial broiler production follows a well-established production system. Basically, it involves the rearing of day-old broiler chicks, obtained from a reputable hatchery, until they reach the desired body weight, which typically is attained at the age of six to seven weeks. It is at this stage that broilers are ready to be sold to the public, local traders or abattoirs.

Broiler enterprises are often categorised on the basis of batch size (the number of broiler chicks being reared at the same time). Broadly speaking, broiler enterprises that produce batches of 2000 broiler chicks or less can be categorised as small-scale enterprises. So, a small-scale broiler enterprise can be defined as a business that rears broiler chickens in batches of 2000 birds or less, and that sells these chickens (and poultry manure) in order to make a profit and to increase the wealth of its owner(s).

It is useful to identify additional sub-categories within the main category of small-scale broiler enterprises. Again, batch size is a useful criterion for defining the different sub-categories, because of the relationship between batch size and target market. Small batches of broilers can easily be sold directly to consumers living in the neighbourhood of the enterprise. Direct marketing becomes increasingly more difficult as the batch size

rises above 200 birds and almost impossible when the batch size exceeds 500 birds. When large numbers of birds (more than 500) need to be sold within a short period of time (less than one week), it is usually necessary to sell a portion to street traders. These street traders usually operate their business using a bakkie and they purchase many birds at a time. However, invariably they insist on a (substantial) discount compared to the price individual consumers who purchase one or two birds at a time are prepared to pay. This discount is necessary to enable the trader to make a profit from his or her business, which is buying, transporting and selling broilers. Once batch size exceeds 1000 birds, even selling broilers to traders may not secure a market for all the birds within a short period of time, at which stage selling to an abattoir should be considered. This reduces the price per bird even further. The channels that have to be used to market broilers is closely related to batch size capacity of the broiler enterprise, which is a useful criterion for the categorisation of small-sale broiler enterprises (see Table 1. The gross margin per broiler (profit) is typically highest when all birds in a batch can be sold within a few days to consumers. Lower gross margins per bird will be realised when selling to traders, and even lower will be obtained when selling broilers to abattoirs.

TABLE 1: Sub-categories of small-scale broiler enterprises

Scale-based sub-category	Batch size capacity (number of birds)	Target market
Micro	<50	Consumers
Mini	50-199	Consumers
Regular	200-500	Consumers and small traders
Extended	501-2000	Small traders, abattoirs and consumers (<25%)

Compared to their medium- and large-scale counterparts, small-scale broiler enterprises have certain strengths but also some weaknesses. Their main strength is the availability of a local market for live birds, which enables small-scale broiler producers to sell their

birds at higher prices than medium- and large-scale enterprises are able to do. Their main weakness is the relatively high prices they pay for feed and other inputs, often as a result of high transportation costs. Selling an entire batch of market-ready birds within a period of a few days is another challenge for many small-scale broiler enterprises. Every day a bird that has reached the target live-weight remains in the house, the gross margin (profit) on that bird is reduced, because it continues to consume feed, which costs money.

It is clear that running a small-scale broiler enterprise is risky. Generally, risk increases as batch size gets larger. The main risks are:

- Mortality of the chicks due to unfavourable environmental conditions or disease;
- Inability to sell the broilers when they have reached the target weight.

Following these guidelines should help you to manage these risks.

1.2 How were these guidelines compiled?

The information contained in these guidelines was obtained by conducting a survey of small-scale broiler enterprises in the area around Thohoyandou, and by conducting a series of broiler production experiments in the broiler house at Dzindi Irrigation Scheme (Itsani). In addition, literature on broiler production was consulted.

1.3 What can you learn from these guidelines?

These guidelines have been compiled to provide owners of existing small-scale broiler enterprises and people interested in starting a new small-scale broiler enterprise with practical information on broiler production and marketing, including all the materials needed to produce broilers effectively and the practices that need to be followed to limit risk. Even though the empirical work for these guidelines was done in Vhembe (Limpopo Province), the guidelines can be used in other parts of South Africa as well.

2 GUIDELINES FOR SMALL-SCALE BROILER PRODUCTION

2.1 Key issues in broiler production

Running a successful broiler enterprise depends on:

- Maintaining environmental conditions (in the broiler house) as close to optimum as possible;
- Obtaining good-quality day-old chicks of the correct breed;
- Providing the chicks with the correct nutrition (water and feed) in the desired quantities at all times;
- Preventing the chicks from getting ill;
- Marketing all the birds in a batch as soon as they are ready for this purpose.

In the rest of this chapter guidelines on how to manage these five key issues are presented. Since broiler production occurs in broiler houses, which play an important role in creating optimum environmental conditions, housing is dealt with in the first part. The next part deals with the equipment that is needed to run a successful and sustainable broiler enterprise. The materials (consumables) needed to produce broilers are presented in the third part, which includes an explanation of why these materials are important. The fourth part describes the activities that make up a broiler production cycle. The final part is concerned with marketing and the budget of small-scale broiler enterprises.

2.2 Broiler housing

Unlike with indigenous chickens, it is not possible to rear broiler chicks out in the open. Broilers require specific environmental conditions in order to grow and stay healthy. Housing plays a critical role in the management of these conditions. Environmental factors that affect growth and health of broilers include temperature, humidity, light

intensity, light duration, light colour and air quality. The quality of the air in the poultry house depends on the rate of air exchange (ventilation). Broiler chickens can be reared in different types of houses but to reduce risk in broiler production, the poultry house should meet a number of minimum requirements. Generally, the cost of a poultry house increases with size and with the level of control over the above-mentioned environmental factors.

Before designing and erecting a broiler house, you need to carefully consider its location relative to your own home and those of your neighbours. Erection of small-scale broiler houses on residential plots is common practice in many parts of South Africa. The main advantage is that the poultry house is located close to the dwelling, providing quick access and a degree of security. The disadvantage is that broiler houses tend to generate unpleasant odours, especially during summer. The smells coming from a broiler house can cause unpleasantness for both the owner and his or her neighbours. Moreover, residential sites tend to be limited in size and may not provide space for expansion of the broiler production business.

The open-sided broiler house is the most commonly used type of broiler house in small-scale broiler production and will be the only type of house dealt with in these guidelines. It costs less to build and operate than a controlled-environment house but requires more hands-on involvement of the producer to maintain favourable environmental conditions inside the house. The main environmental management activities are control of the side curtain openings and the use of heaters but they can also involve the use of fans and misting systems.

An open-sided house should be located on well-drained land in a location that allows for natural air movement. It should be built so that direct sunlight does not fall on to one of the side walls during the hottest part of the day in summer. House orientation should be such that the long axis of the house lies east to west. Preferably the open-sided poultry house should have a high roof pitch, because this assists natural ventilation, as it

increases the movement of air by convection (hot air rising and cooler air sinking) and reduces the amount of radiant heat from the underside of the roof that reaches the level of the house (just above the floor) where the birds are living.

The dimensions of the house (length and width) should be selected based on the desired batch size (number of birds grown during a production cycle) and the resources (funds, building materials) available for the erection of the house. Commonly used building materials include bricks (cement or conventional), wood (roof beams), concrete (floor and foundation for brick walls) and insulated corrugated iron (roof).

The open-sided broiler house has sidewalls and end walls, which differ from each other, but all four walls must rest on concrete foundation. The sidewalls are solid at the bottom and consist of wire netting higher up. The solid side walls should between 25 cm and 80 cm in height relative to the floor of the house. Hexagonal wire netting (also known as chicken mesh) that stretches all the way to the top is then used to construct the rest of the side walls. Depending on the size of the house, solid columns at regular distance from each other may be necessary to provide support for the roof structure. Side walls should have adjustable, reinforced plastic curtains that completely cover the wire netting. Adjusting these curtains (opening and closing) provides a degree of control over temperature and ventilation inside the house. Partial or complete opening of the curtains is used to reduce the temperature and closing the curtains to increase the temperature. End walls of open-sided broiler houses are usually solid, and one of the side walls should contain the door that provides entry to the house.

The floor of the open-sided broiler should consist of a concrete slab with a smooth surface. Making the surface smooth helps to clean the house effectively in between batches. For the same reason, smooth plastering of the solid sidewalls and the lower parts of the end walls is recommended. Corrugated irons sheets are used for the roof of the open-sided broiler house. These sheets are fastened to wooden beams that make

up the roof frame. Before attachment insulation material is placed below the sheets. This helps to reduce temperature fluctuation in the house.

Figures 1 to 4 show different designs of open-sided broiler houses. The open-sided house with slanted roof (Figure 1) is the cheapest to construct and is best suited for the production of small batches but offers least control over high temperatures. The open-sided house with pitched roof (Figure 2) offers somewhat better control over high temperatures and is also better suited for large batch sizes. The open-sided poultry house with differential slanted roof (Figure 3) and the open-sided house with pitched roof and roof nook ventilation (Figure 4) offer superior control over high temperatures but may require more heating during cold weather. The open-sided house with pitched roof and roof nook ventilation is the most expensive to construct and should be considered for large batch sizes only.

OPEN-SIDED POULTRY HOUSE WITH SLANTED ROOF

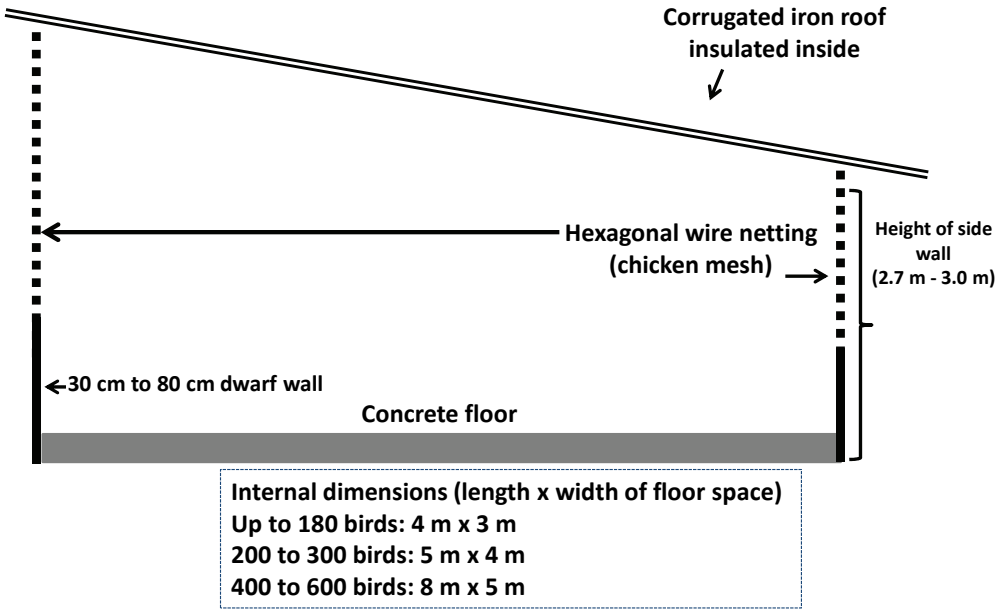

FIGURE 1: The open-sided poultry house with slanted roof

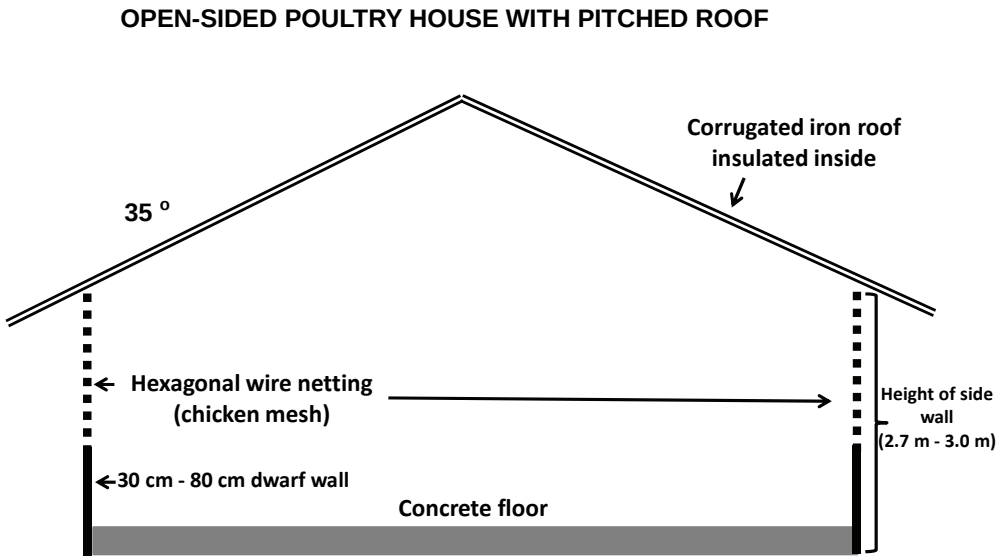

FIGURE 2: The open-sided poultry house with pitched roof

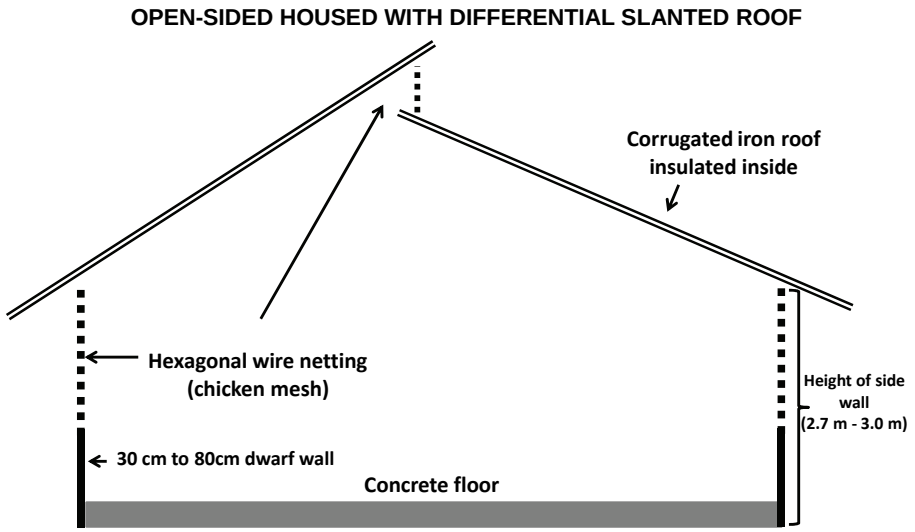

FIGURE 3: The open-sided poultry house with differential slanted roof

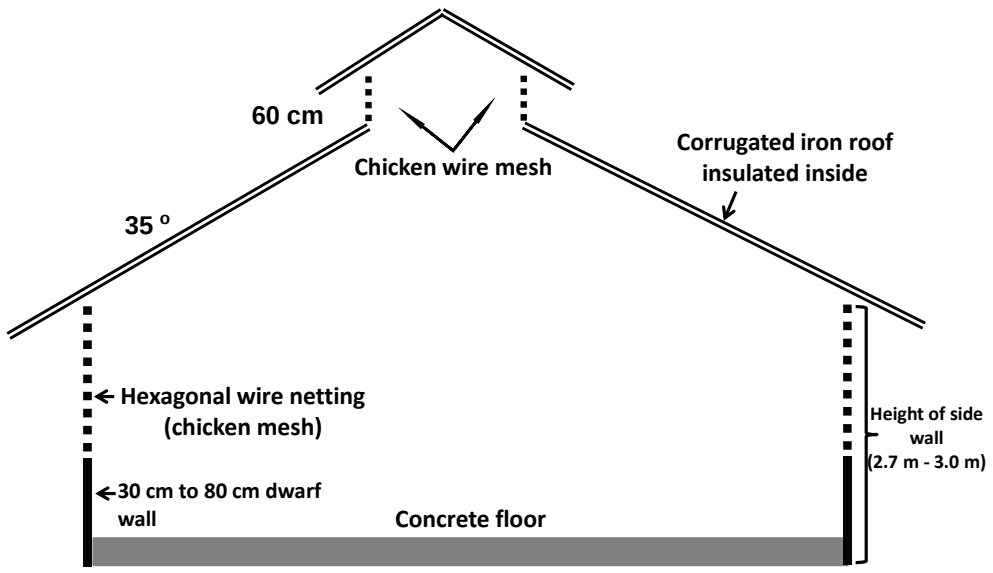

FIGURE 4: The open-sided poultry house with pitched roof and roof-nook ventilation

The stocking densities of broiler chickens in open-sided broiler houses should range between 10 and 15 birds per m^2. Table 2 provides the internal dimensions (floor space) for a selection of poultry houses that suit smallholder production. Also indicated are the number of broilers that can be grown inside these different size houses.

TABLE 2: Internal dimensions, floor area and number of broilers for a selection of broiler houses

Internal dimension (length x width) of selected poultry houses	Floor area	Minimum of 10 birds per square meter	Maximum of 15 birds per square meter
		Total number of birds	
6 m x 3 m	18 m^2	180	270
9 m x 4.5 m	40.5 m^2	400	600
15 m x 6 m	90 m^2	900	1350

2.3 Equipment

To produce broilers it is necessary to have equipment to provide heating, water and feed. During their growing period the requirements of the broilers change and the equipment that takes changes into account must be available.

2.3.1 Heating equipment

Chicks cannot regulate their own body temperature until they are about a week old. Therefore, the poultry house must be kept warm at all times during this period and as close as possible to the optimum of 32^{o}C and preferably not lower than 28^{o}C. Preheating the house before arrival of the chicks is vital as floor temperature at chick placement is as important as air temperature. Temperature and relative humidity should be stabilised at least 24 hours prior to chick arrival. After seven days of growth, the part of the chick's brain that controls its body temperature matures as a result of digestion of feed, supplemental heat and exercise. As a result, the optimum temperature for growth (and the need for heating) is gradually reduced. Table 3 shows the optimum temperature as a function of the age of the chicks.

TABLE 3: Optimal temperature as a function of the age of the chicks

Age in days	Temperature (^{o}C)
1-7	32
1-14	29
15-21	27
22-28	24
29-35	21
36 and older	21

During brooding (first three weeks of growth) it is best to confine the chicks to a designated brooding area in which spot brooding or partial-house brooding is practised. This will conserve heat and minimise heating cost. The temperature of the environment in which the chicks are placed should be monitored carefully. This is best done by placing a minimum and maximum thermometer at chick height in the brooding area (see Plate 1). This thermometer should be read every day at the same time (conventionally at 8 o'clock in the morning). The minimum and maximum thermometer will indicate both the lowest (minimum) and the highest (maximum) temperature that was reached in the brooding environment during the past 24 hrs. Information from monitoring minimum and maximum temperature should be used to modify conditions in the brooding area or the poultry house as a whole. When necessary the temperature can be raised by turning up the heaters or reduced by increasing ventilation achieved by opening the curtains.

PLATE 1: Monitoring temperature using a minimum and maximum thermometer placed at chick height in the area where feed and water are positioned

To achieve the optimum temperature in the brooding area, spot brooding, partial-house brooding or whole-house brooding is used. In spot brooding, use is made of localized heat sources, such as infrared lamps. In spot brooding the temperature is only raised in

the area around the heat source (spot) and not in the rest of the house. This allows the chicks to come closer to the heat source when seeking more warmth or move away from the heat source to cooler parts of the brooding area when they feel too hot. In this way, chicks continuously select the temperature they prefer.

In partial-house brooding, a portion of the building is cordoned off using a curtain to serve as the brooding area. This brooding area is heated uniformly to the desired temperature, whilst the temperature in the rest of the house remains largely unaffected.

In whole-house brooding the entire poultry house is heated uniformly. This approach is mostly used in large, sophisticated poultry houses and in very small poultry houses.

In small-scale broiler production, spot brooding and partial-house brooding are most commonly used. Spot brooding is well suited for use in buildings with poor insulation, whilst partial-house brooding suits houses that are well-insulated. Canopy and radiant heaters are used in spot brooding and partial-house brooding. Examples of such heaters are gas heaters, infrared gas brooders (See Plate 2) electric infrared lamps and electric heaters.

PLATE 2: Infrared gas brooder

Besides monitoring temperature in the brooding area using a minimum and maximum thermometer, optimisation of the temperature in this area can also be achieved by observing chick behaviour. The relationship between brooder temperature and chick behaviour when using spot brooding is illustrated in Figure 5. When the brooding temperature is optimal, chicks will be evenly spread throughout the brooding area and will make ‘happy’ noises. When the temperature is too low, the chicks will congregate close to the source of heat and make loud highly-pitched distress calls. When the temperature is too high, the chicks will move away from the source of heat and will be quiet. They will be seen panting with drooping head and wings. Crowding of the chicks in one particular part of the brooding area, in a pattern that appears unrelated to the source of heat (both close and far from the source) indicates that an environmental factor other than temperature is affecting their behaviour. This could be light, noise or other factors. The cause for such aberrant behaviour should be identified and the problem solved.

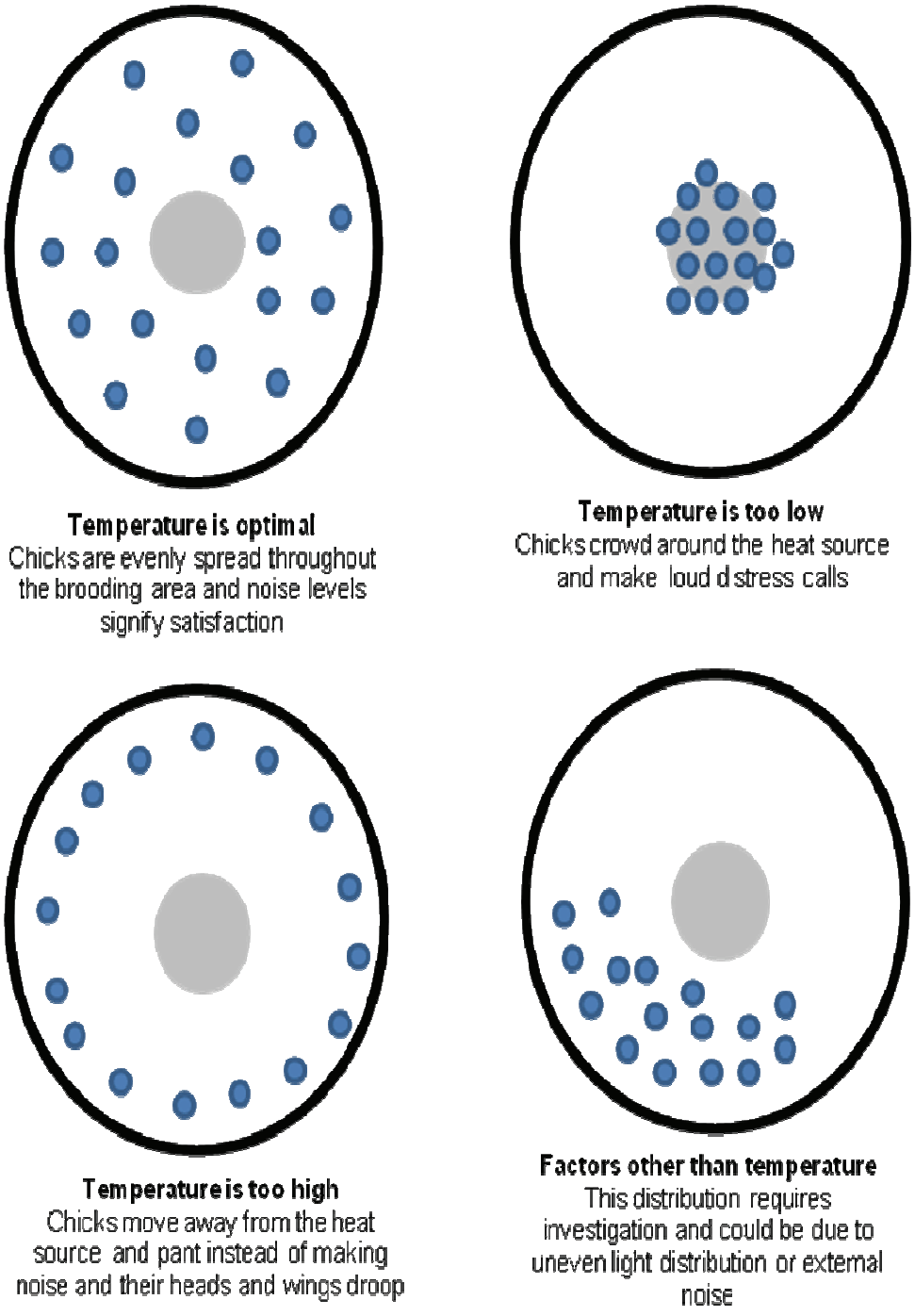

FIGURE 5: Effect of temperature on chick behaviour in spot brooding

The relationship between brooder temperature and chick distribution when using partial house or whole house brooding is illustrated in Figure 6.

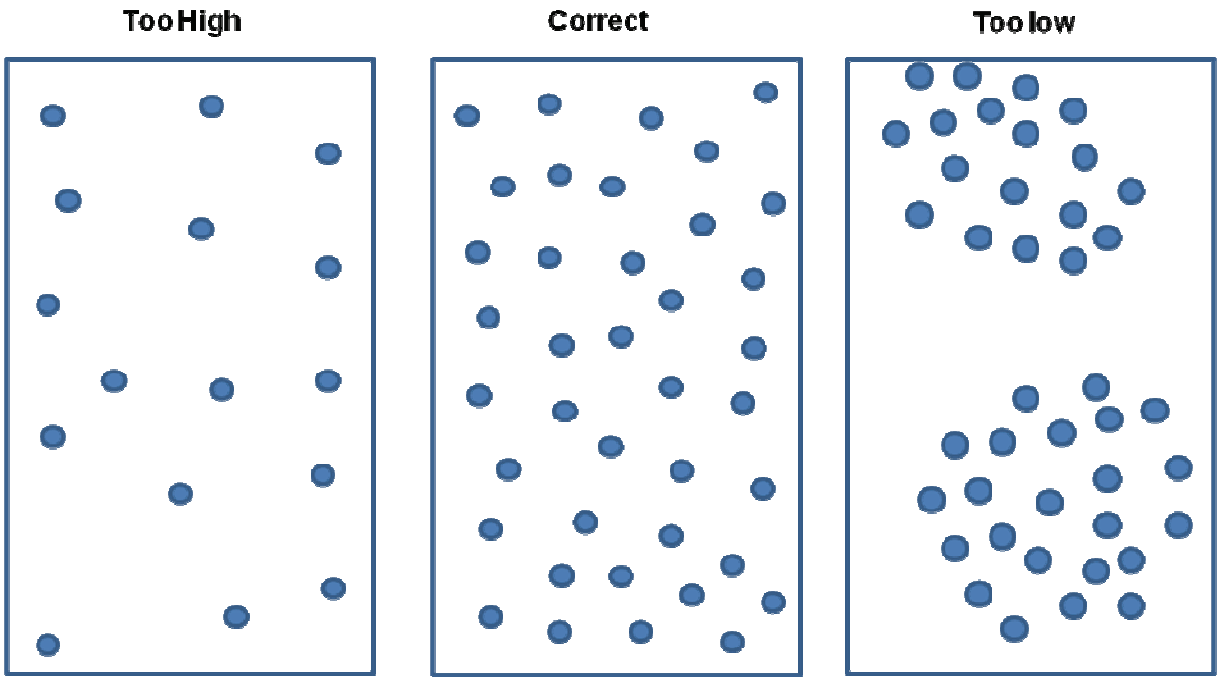

FIGURE 6: Effect of temperature on chick distribution in partial house or whole house brooding

It is very important to respond to any evidence that temperature of the brooding environment is not optimal by increasing or lowering the temperature as the need may be.

2.3.2 Feeding equipment

It is important to use equipment that has been designed specifically to provide broiler chicks with feed. Equipment that restricts feed intake reduces weight gain. During the first three weeks of growth, day-old feeder trays (Plate 3) should be used. These trays are placed in the brooder area at a density of 1 tray per 33 chicks (3 trays per 100 chicks). Chicks jump into these trays to feed. Feed levels in these trays need to be monitored frequently (twice per day) to ensure that feed is available at all times.

Plate 3: Day-old feeder trays should be used during the first three weeks of growth

Once the chicks are three weeks old, the flat chick feeders should be replaced with tube feeders. A tube feeder (Plate 4) consists of a tube that is 20 cm to 40 cm in diameter and about 50 cm high. To the bottom of this tube an adjustable pan is fitted. The gap between the tube and the pan is adjusted to regulate the amount of feed that flows from the tube into the pan, and therefore the level of feed in the pan. The tube feeder acts as a feed reservoir and needs to be replenished less often than flat chick feeders. One tube feeder is adequate to provide feed to between 10 and 12 birds. This means that 8 to 10 tube feeders are needed per 100 birds.

PLATE 4: Broilers feeding from a tube feeder suspended above the floor of the broiler house

Tube feeders hang from ropes that are attached to the roof structure. Using these ropes, the elevation of the pan above the floor must be adjusted regularly to match the size of the birds (the same is done for suspended bell drinkers). The pan of the tube feeder should be at the same height as the back the broilers (see Figure 7).

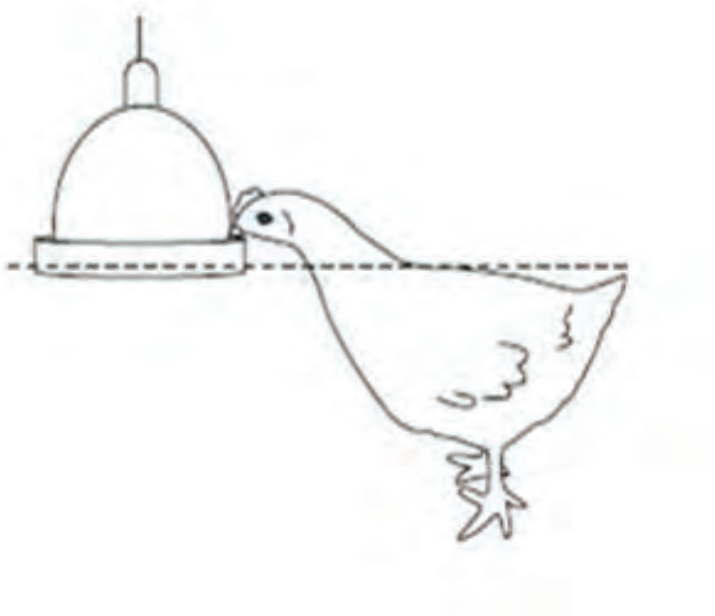

FIGURE 7: When using suspended tube feeders and bell-shaped drinkers, which can be done as soon as the chicks are about three weeks old, the feed or water level should be at the same height as the back the broilers grows (drawing from Aviagen.com)

It is important that feeders are kept clean at all times to avoid diseases being spread by consumption of contaminated feed.

2.3.3 Drinking equipment

Broiler chicks must be supplied with fresh, clean water throughout the growing period. There is a direct relationship between the amount of water a bird consumes and the amount of feed it will eat. If the water supply is inadequate, birds stop eating and growth will be retarded. During the first three weeks of growth water should be provided by means of chick founts (Plate 5). Chick founts pan and jar drinkers that are filled with water manually. The jar is filled with water and once filled the pan is placed on top of the jar, and then turned around enabling water to flow from the jar into the pan as the chicks are consuming the water (Plate 5). One chick fount can easily serve 33 chicks, which

means that 3 chick founts per 100 chicks is ideal but manufacturers claim that one chick fount per 100 chicks is adequate.

PLATE 5: Chick founts are ideally suited to provide water to young birds

Water in the chick founts must be replaced every day. The chick founts must be cleaned thoroughly before they are refilled and placed back in the brooding area (Plate 6).

PLATE 6: Chick founts are cleaned daily before being refilled with clean, fresh water

One of the disadvantages of chick founts is that they can cause the floor in the brooding area to get wet. If this happens, the bedding material should be replaced to avoid any negative effects on chick health. It is important that both water and feed are within easy reach of the chicks as shown in Plate 7.

PLATE 7: Arrangement of feeders and drinkers should make both feed and water easily accessible to the chicks

Chick founts can be used during the entire growing period, but should be placed on a brick once the birds grow bigger. Preferably, chick founts are replaced with bell drinkers when the birds are three weeks old, which is also the time when day-old feeder trays are replaced with tube feeders. Bell drinkers are equipped with a valve mechanism, which controls the water flow into the pan using the weight of the water in the pan. They are ballasted by the weight of the water in the bell, which reduces swinging and associated spillage of water. Bell drinkers (Plate 8) are suspended above the floor. They hang on a rope attached to the roof structure, enabling adjustment of the elevation of

the tray above the floor (see guidelines on tube feeders in section 2.3.2). One bell drinker is adequate to provide water to at least 75 chicks.

PLATE 8: Adjustable bell drinkers are used to supply water to birds that have reached the age of three weeks and older

2.4 Materials

Various materials are required to produce broilers successfully. These materials are consumed during the broiler production cycle, which starts when the chicks arrive and ends when the broilers have been sold and have left the broiler house. They include day-old broiler chicks, feed, vitamins and veterinary supplies and bedding material.

2.4.1 Day-old chicks

When producing broilers, it is critical to purchase the correct breed of chicks. Broiler breeds have been developed specifically to produce as quickly as possible good quality (meaty) carcasses and strong bones to carry the exceptionally high amount of meat. The Ross breed, which is the white-coloured chicken shown in Plate 9, is most commonly used by small-scale broiler producers in South Africa. Day-old broiler chicks should be purchased from reputable commercial hatcheries.

PLATE 9: Ross is a widely used broiler breed in South Africa

2.4.2 Broiler feed

When their nutritional requirements are met in full, broilers can grow from a 55 g chick to a chicken that weighs 2 300 g in a period of 40 to 42 days. Broilers require more than fifty nutritional elements in balanced and adequate quantities to maintain the various biological processes necessary for life, growth and health. Broadly speaking, these

nutrients are water, energy, protein, vitamins and minerals. All of these nutrients must act in concert to assure optimal growth of the skeleton, muscles, internal organs, fat and feathers of the birds. Meeting the protein and amino acid requirements of broiler chicks is of special concern when formulating broiler diets. These requirements change as the chicks grow up and that is why the use of phased diets is recommended. Each diet is formulated specifically to meet the nutrient requirements of broilers at a particular stage in their growth. In large-scale broiler enterprises as many as five different diets are used during a production cycle but the use of three different diets is common practice in small-scale broiler production.

During the first three weeks of growth, the protein and amino acid requirements of the chicks are very high. During this initial period of growth the birds are fed a high (22%) protein diet. In the feed trade this diet is known as the '**starter**' diet, which may be offered in mash or pellet form.

After three weeks of growth, the protein and amino acid requirements of the birds decline and this is catered for by feeding the birds a medium (20%) protein diet during week 4 and 5 of the growing period. In the feed trade this diet is known as the '**grower**' diet and is slightly cheaper than the 'starter' diet.

During the sixth and last week of growth, the birds are fed a low (19%) protein diet, which is known as the '**finisher**' diet, which is slightly cheaper than the grower diet.

It is important to realise that the daily feed consumption of young chicks is much lower than that of older birds. As a result, even though the chicks are fed the 'starter diet' for three weeks, which is half of the total growing period, they consume a smaller quantity of feed during the first three weeks than during the next two weeks of growth as well as the final week of growth. In practice this means that the mass of the 'grower' and 'finisher' diets that are consumed by the birds exceeds the mass of 'starter' diet

consumed. This is evident from Table 4, which shows the typical feed consumption of broiler chicks during each of the three growth stages as far as diet is concerned.

TABLE 4: Feed consumption of broiler chicks on a three-phase diet over a 42-day growing period

Broiler diet	**Age of chicks** (days)	**Mass of feed consumed by a single broiler chick** (kg)	**Mass of feed needed for 100 broiler chickens** (kg)
Starter	0-21	1.1-1.2	110-120
Grower	22-35	1.3-1.5	130-150
Finisher	36-42	1.4-1.5	140-150
Total	**0-42**	**3.8-4.2**	**380-420**

Broiler feed should be as fresh as possible and should not be stored on-site for longer than three months. For this reason, it is recommended that new feed is purchased for every batch of broilers. On site, feed must be stored appropriately. The bags of feed should be placed on wooden pallets to allow for air circulation. Storage conditions should ensure that the feed remains dry at all times and that it is protected from birds, rodents and insects, as well as from dust. The broiler feeder must regularly clean to remove old, wet and clotted feed.

2.4.3 Vitamins and veterinary supplies

Health management is of extreme importance in broiler production. When broiler chicks get ill they do not grow well and more importantly they often die. Every chick that dies represents a considerable financial loss. It is generally accepted that chick mortality must be kept below 5% (out of 100 chicks 5 chicks die during production) to remain profitable but with good health management, chick mortality can be kept below 2%.

Table 5 shows the most common diseases that affect broilers and the symptoms of these diseases.

TABLE 5: Common broiler diseases and their symptoms

Disease	Symptoms
Infectious bronchitis (IB)	Gasping, wet eyes, coughing, swollen sinuses and death. This disease spreads very rapidly!
Newcastle disease (ND)	Gasping, rattling, loss of appetite, coughing, huddling, paralysis of legs, twisted neck (stargazer), walking backward, death. This disease spreads very rapidly!
Coryza	Thick smelly nasal discharge, swollen sinuses, ruffled feathers, difficult breathing.
Mycoplasma	Difficult breathing, ruffled feathers, nasal discharge, rattling, facial and nasal swelling, weakness, swollen joints, yellowish faeces.

Health management in broiler production is based on preventing diseases, not curing them. Disease prevention is achieved by the application of sound bio-security measures, aimed at minimizing the exposure of the chicks to disease-causing organisms, and optimum nutrition and vaccination, aimed at providing the chicks with a degree of immunity against diseases.

To provide your broilers with additional vitamins at critical times you should have Stresspac or Immunostress available at all times. These products contain multi-vitamins and have been formulated specifically for chickens. They are dissolved in the drinking water and administered to the chickens in this way.

Vaccination starts before the chicks arrive. Reputable hatcheries vaccinate their broiler chicks against Marek's disease, Newcastle disease and infectious bronchitis before delivery. Names of vaccines that are used in broiler production appear in Table 6. Most of these are sold in a quantity that is sufficient to vaccinate 1000 chicks and need to be kept in a refrigerator until the time of administration. Consult with a qualified advisor or expert extension officer when purchasing vaccines.

2.4.4 Energy for heating

Heating requires a source of energy. Gas and electricity are the two most commonly used sources of energy used in small-scale broiler production. When using gas heaters, it is important to have sufficient gas on site to prevent any interruption in the heating of the brooding area. For the same reason, it is essential that you purchase enough units when using pre-paid electricity. To ensure sustained supply of energy, you should monitor daily energy consumption. In the case of gas, you should weigh the gas bottle daily at the same time. This can be done using a spring scale. The daily loss of weight of the gas bottle is the mass of gas used during the previous 24 hrs. You can estimate how many days a gas bottle will last by dividing the total mass of gas in the bottle at the time of purchase by the daily use of gas. For example, assume you have a bottle containing 17.5 kg gas at purchase. Daily use is 3 kg. Dividing 17.5 kg by 3 kg per day gives you 5.83 days. This means that you can expect the gas bottle to run empty during day 6 and a full gas bottle should be available on that day.

2.4.5 Bedding material

Broilers are usually reared on a floor covered with bedding material. This bedding material should be absorbent and should not present a risk of injury. Wood shavings (sawdust) and cut wheat straw are examples of suitable bedding materials. The bedding material must be evenly spread in the poultry house in a layer of about 2 cm thick. When the bedding material is spread unevenly areas where the layer is too thick will

restrict the movement of the chicks and this can affect access to feed and water leading to a reduction in flock uniformity.

2.4.6 Cleaning materials and disinfectants

Before starting a production cycle, the broiler house and all the equipment being used should be cleaned and disinfected. The first step in this process involves the physical removal of most foreign material on the floor using a spade and a broom and is referred to as ‘dry cleaning’. This foreign material consists mainly of the litter (excretions and bedding material) left on the floor by the previous batch of broilers. This material can be sold as fertiliser but should be stored well away from the broiler house. Dry cleaning the house is followed by wet cleaning. This involves thorough scrubbing of the floor and the walls with water to which a detergent and a disinfectant has been added, followed by rinsing and removal of all washing water from the house. All equipment must receive the same treatment. Finally, all surfaces of the house and all equipment that will be used to produce the next batch of broilers must be disinfected by spraying them with a disinfectant. Products that can be used for this purpose include Virukill with poly dimethyl ammonium chloride as active ingredient or Virkon with potassium monopersulfate as active Ingredient.

2.5 Running a broiler production cycle: activity plan

The activity plan for running a broiler production cycle can be subdivided into three parts, namely preparation for the arrival of the chicks, production, and marketing.

2.5.1 Preparing for the arrival of the chicks

It goes without saying that all equipment and materials must be on site before the day-old chicks arrive. In preparation for their arrival, the poultry house, the area surrounding the house, and all the equipment that will be used during production must be thoroughly

cleaned and disinfected (see section 2.4.6). After this has been done, the bedding material is spread over the floor of the brooding area (see section 2.4.5). During brooding (first three weeks of growth) it is best to confine the chicks to a designated brooding area in which spot brooding or partial-house brooding is practised (see section 2.3.1 for details). This will conserve heat and minimise heating cost. The day-old chick feed trays and fount drinkers must be arranged and concentrated in this confined area as well. If practical, further reduction of the cost of heating can be achieved by starting with a small brooding area and then enlarge this area as the chicks grow, until they reach the age of 21 days when the entire house floor is made available. Heating of the brooding area should commence a day before arrival of the chicks to ensure that the optimum temperature is achieved when the chicks arrive. You need to decide on the vaccination programme you intend to apply and ensure that the vaccines are available on site. Remember that most vaccines need to be stored in a refrigerator to remain effective.

2.5.2 Production activities

Day 1 to 21

On the day of arrival, the day-old feed trays are filled with starter diet and the chick founts are filled with clean water. Both feed trays and drinkers are placed in the brooding area. Quenching the thirst of the chicks upon arrival is most critical, because they have been without water during their travel from the hatchery to the broiler house. Chick founts must be cleaned and filled with fresh water on a daily basis.

Feed trays should be filled regularly so that the chicks can eat as much as they want. Ensuring that feed is available at all times is called *ad libitum* feeding. When applying *ad libitum* feeding, best practice is to fill the feed trays only partially (about 1 cm high) and replenish the feed frequently. Filling the trays to capacity is not recommended, because chicks jump into the trays and scratch around, and when the trays are filled to capacity,

the scratching causes more feed to be spilled out of the trays and go to waste than when the trays are only partially filled. Feed trays should be cleaned as soon as there is evidence of old clotted feed or droppings in the trays.

Chicks are most vulnerable to diseases and infection during the brooding stage, which is taken as the first three weeks of growth. As a result, the risk of mortality (chicks dying) is greatest during this period. For this reason, it is essential that recommended health management practices are applied on time and according to instructions. Central to health management is the prevention of diseases, which is achieved using vaccination. An example of a suitable vaccination programme is presented in Table 6 but there are a number of choices available to achieve similar outcomes. What is important is that you have a suitable programme and that you apply it rigorously.

TABLE 6: Vaccination programme for use during the first three weeks of broiler growth

Age of the bird (days)	Disease or condition	Vaccine or supplement	Route	Procedure for 1000 birds
Day 1	Newcastle disease or infectious bronchitis	TAD IB/ND vac Hitchner B1	Spray or eye-drop	Spray chicks with distilled water or dematerialized water
	Stress	Stresspac or Immuno-stress vitamin	Water	Dissolve 1 gram in every 2 litre of drinking water
Day 2	Stress	Stresspac or Immuno-stress vitamin	Water	Dissolve 1 gram in every 2 litre of drinking water
Day 3	Mycoplasma	Tylosine/ Fosback plus-T	Water	Dissolve 1 gram in every 2 litre of drinking water
	Stress	Stresspac or Immuno-stress vitamin	Water	Dissolve 1 gram in every 2 litre of drinking water

TABLE 6: continued

Age of the bird (days)	Disease or condition	Vaccine or supplement	Route	Procedure for 1000 birds
Day 8	Newcastle disease	TAD ND Lasota	Water	Dissolve 10 g skim milk powder into 5 litre of water, wait for 30 minutes and add the 1000 doses vaccine.
	Stress	Stresspac or Immuno-stress vitamin	Water	Dissolve 1 gram in every 2 litre of drinking water
Day 12	Gumboro disease	TAD Gumboro (CU-IM) or TAD Gumboro Forte	Water	Mix 18 g skim milk powder into 9 litre of water, wait for 30 minutes and add the1000 doses vaccine; **or** Dissolve 1 Cavamune tablet in 100 litre water.
	stress	Stresspac or Immuno-stress vitamin	Water	Dissolve 1 gram in every 2 litre of drinking water
Day 16	Gumboro disease	TAD Gumboro (CU-IM)	Water	Mix 22 g skim milk powder into 11 litre of water, wait for 30 minutes and add the 1000 doses vaccine.
	Stress	Stresspac or Immuno-stress vitamin	Water	Dissolve 1 gram in every 2 litre of drinking water
Day 20	Newcastle disease	TAD ND Lasota	water or spray	Mix 30 g skim milk powder into 15 litre of water, wait for 30 minutes and add 1000 doses vaccine
	Stress	Stresspac or Immuno-stress	Water	Dissolve 1 gram in every 2 litre of drinking water
Day 21	Stress/change nutritional or feed phases	Stresspac or Immuno-stress	Water	Dissolve 1 gram in every 2 litre of drinking water

Day 22 to 35

It is generally accepted that once the broiler chicks are 21 days old, they are no longer in the brooding stage. At this age they enter a phase of rapid weight gain and to a large extent they are able to control their own body temperature, reducing or eliminating the need for heating (see Table 3 for guidelines on optimum temperature). On day 22, the full floor area is covered evenly with bedding material (about 2 cm thick) and made available to the chicks. Day-old feed trays are replaced with tube feeders that are suspended at the correct elevation above the floor (see section 2.3.2 for guidelines on the correct elevation) and the tube feeders are filled with the grower diet. Chick founts are replaced with bell drinkers, which are also suspended at the correct elevation above the floor). The main activities during the two-week grower phase are monitoring the tube feeders and bell drinkers and replenishing them in time to avoid any interruption in feeding or drinking.

If the chicks show any symptoms of mycoplasma, add Tylosine or Fosbac Plus T to the drinking water at the rate of 1 gram per 2 litres of water. Additional vitamins should be given to the birds when they are subject to stress, which can arise as a result of temperatures that are too high or too low, vaccination, illness or, nutritional change (change in phase feeding). This is done by adding Stresspac or Immuno-stress to the drinking water. Evidence of cannibalism (broilers start pecking at each other causing loss of feathers) is dealt with in the same manner.

Day 36 to 42

From day 36 onwards, the grower diet is replaced with the finisher diet. As during the grower phase, the main activities during the finisher phase are monitoring the tube feeders and bell drinkers, and replenishing the feeders and drinkers when necessary, are the main activities during the finisher phase.

2.5.3 Marketing the broilers

Once the broilers have reached the desired live weight of about 2100 to 2300 grams, they should be marketed as soon as possible. Broilers that remain unsold in the house continue to feed, and in this way they reduce profits. The most profitable way of marketing broilers is to sell them life to individual consumers (see Figure 8).

FIGURE 8: Sale of live broilers to local consumers

Selling to broilers individual customers has the advantage of being able to charge high prices, but the size of the market is limited. For this reason, it is recommended that the availability of broilers for sale is advertised by word of mouth and by using a sign posted near the entrance of the enterprise.

Fairly large numbers of broilers can be sold at once when marketing the birds to hawkers, but hawkers demand substantial discounts. Typically hawkers operate bakkies that are equipped with cages for the transportation of chickens. They move around daily and target places of likely sales, such as pension pay-out points. In 2013, the price charged for live chickens ranged between R44 and R60 per bird, with prices being affected by type of customer (individual consumers or hawkers), the size of the bird and the presence of competition (remoteness tended to increase the price). Examples of small-scale broiler enterprise budget are presented in Table 7 for 2008 and 2013.

TABLE 7: Examples of small-scale broiler enterprise budgets for 2008 and for 2013

	2008		2013	
Expenditure per chicken	**Rand**	**%**	**Rand**	**%**
Day-old chicks	5.09	21.5	5.50	13.8
Feed	16.05	67.8	25.75	64.5
Transport	0.53	2.2	2.00	5.0
Sawdust	0.45	1.9	0.75	1.9
Energy	0.41	1.7	1.25	3.1
Medication	0.34	1.4	2.00	5.0
Labour	0.60	2.5	2.00	5.0
Other	0.22	0.9	0.70	1.8
Total production cost	**23.69**	**100**	**39.95**	**100**
Gross income	**30.00**		**52.00**	
Gross margin per chick	**6.31**		**12.05**	