



# Poultry Production

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## 1 INTRODUCTION

The poultry industry in South Africa (SA) is one of the most important contributors to the country's Gross Domestic Product (GDP) (DAFF, 2017). It is the largest in the agricultural sector in SA, accounting for approximately 22% of the country's agricultural income (SAPA, 2012).

The poultry industry is also nutritionally important to the South African population, accounting for roughly two-thirds of all animal protein consumed. Poultry is an important sector due to the large consumer market for chicken products, including meat and eggs, and the relatively low cost of chicken meat compared to other types of meat. So, poultry plays a vital role in addressing key national development goals as well as improving the standard of living of people by alleviating poverty and creating employment opportunities.

Poultry can be categorised into two major types of production, namely, the broiler industry and

the egg industry. The South African Poultry Association (SAPA) represents all poultry farmers (small-scale, emerging, and large commercial poultry farmers) across these three lines of production (DAFF, 2014).

There are vast differences in the competitive dynamics of the broiler chicken and egg industries, due to the fact that chicken meat can be frozen and stored for a long time, whereas eggs are more perishable. As a result, the broiler market is more susceptible to import competition.

The need in South Africa to produce more poultry meat in a climate smart way is ever increasing as poultry is the most consumed protein in South Africa (SAPA, 2019). A large part of this module deals with is climate smart pest and disease management.

### Training objectives

This training module is an aid for extension workers to help small scale and subsistence farmers. As such, this module will deal mostly with chicken farming, as these farmers do not traditionally keep other poultry such as ostriches.

Upon completing the training module, an extension practitioner should be able to:

- Understand South African poultry production and farming systems
- Describe [climate change](#)
- Explain how climate change affects poultry production; and
- Describe the role of poultry production in Climate-Smart Agriculture (CSA).
- Outline the main climate-smart strategies for poultry production
- Determine [adaptation](#) and [mitigation](#) requirements

## 1.1 BROILER PRODUCTION



Source: ARC Poultry Production Manual.

South African broiler production systems range from simple subsistence farming to highly technologically advanced integrated businesses that compete on a global scale. Cobb 500 and

Ross 308 are the primary genetic stocks, but Arbor Acres, Hubbard, and Hybro are also present. In South Africa, the majority of poultry meat consumed is chicken, with a small amount of imported turkey meat. Because a large proportion of broilers are raised above 1500 m above sea level, ascites is a concern during the winter months and must be managed accordingly.

Rainbow Limited and Astral are the two largest producers of broiler meat in South Africa, accounting for approximately 46% of the market share in broiler meat production (DAFF, 2019). [Figure 1](#) shows the top seven producers and their percentage share of meat broiler output; it should be noted that there are hundreds of small producers ("other producers") with a combined share of 25%.

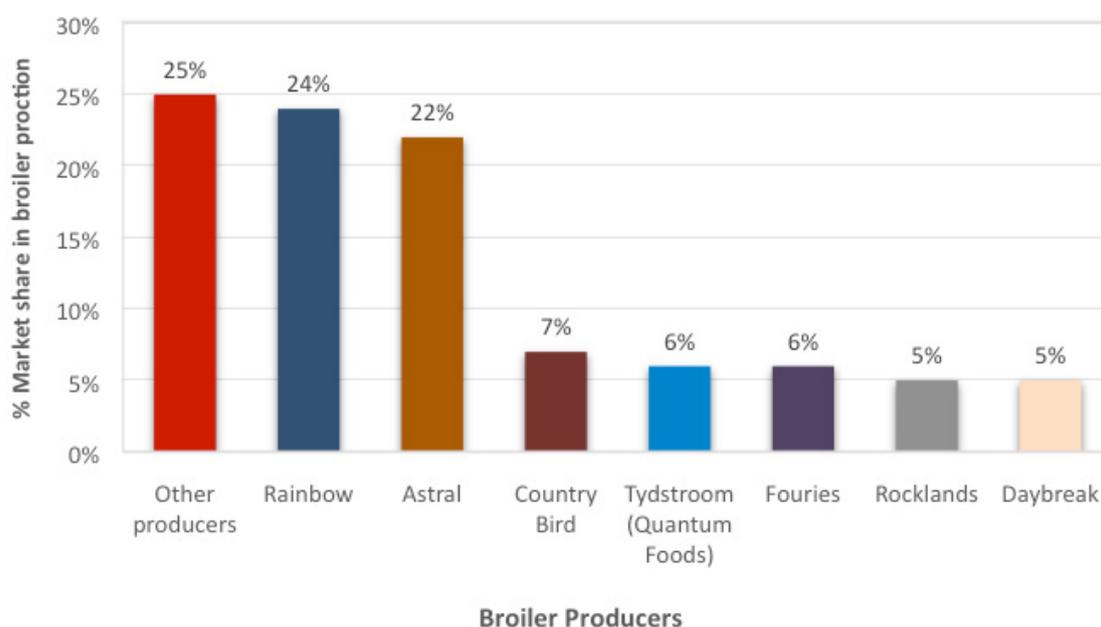


Figure 1 Market shares in the broiler meat industry.

Source: Department of Agriculture, Forestry and Fisheries (DAFF) from USDA Foreign Agricultural Service.

### **Production and supply chain**

- “Grandparent” chicks are sourced from (international) suppliers of high-quality genetic lines, reared, laid eggs, and day-old “parents” are hatched
- Parent chicks are reared, eggs are laid, and day-old chicks hatch
- Broiler feeding
- Feed milling
- Meat processing
- Distribution to customers

*“As the major producers are starting to focus on the front-end of the supply chain (e.g. value-adding and distribution), broiler production under contract by smaller producers is on the increase.”* (South African Poultry Association (SAPA), 2014).

### **Suppliers of poultry**

Breeding for the production of day old chicks in large numbers is an expensive endeavor that only large corporations can afford. As a result, large breeding companies provide day-old broiler chicks or layers at the point of lay to farmers.

Genetic material used in breeding programs is typically imported from other countries as grandparent stock. They are the result of many years of intensive selection to improve economically important characteristics. Small business owners will find it difficult to breed their own grandparent stock because it is expensive and genetic material of the same high quality is difficult to obtain. Importing foreign genetic breeding material into South Africa is subject to stringent health requirements and lengthy intensive quarantine periods.

<b>Broiler lines and country of origin</b>	
Ross	United Kingdom
Cobb	United States of America
Hybro	Netherlands
Hubbard	United States of America
Arbor Acres	United States of America

### **Feed stock**

The profitability of the poultry industry is heavily reliant on the price of chicken feed, which can account for up to 75% of a producer's total costs. In turn, chicken feed is reliant on maize, which accounts for more than half (50%) of broiler feed, and soybean prices. Although there is no difference between white and yellow maize (other than the colour), yellow maize is typically used as animal feed, whereas white maize is milled into maize meal for human consumption. Argentina is the primary supplier of soybean meal. It is difficult to pass on changes in feed prices to consumers, so producer profitability is volatile.

### **Diseases**

Despite the emphasis on precautionary measures, the risk of an outbreak is always present.

### **Consumer demand**

South Africans consume approximately 1.8 million tons of broiler meat each year. SA's per-capita consumption in 2014 was (prices as of January 2015):

- 36 kg of broiler meat (R50 kg<sup>-1</sup> fresh)
- 17 kg of beef (R65 kg<sup>-1</sup> fresh)
- 5 kg of pork (R72 kg<sup>-1</sup> fresh)
- 3 kg of mutton (R114 kg<sup>-1</sup> fresh)

In South Africa, the R50 kg<sup>-1</sup> price for chicken portions compares to the R11 kg<sup>-1</sup> average landed price for chicken meat in January 2015. This demonstrates the extent to which import tariffs protect the South African chicken industry.

Since 1993, South Africans' consumption of poultry has more than doubled (Grobbelaar et al., 2010). Economic growth, interest rates, and inflation rates, among other things, have an impact on the demand for broiler meat. Lower-income groups, in particular, use their extra disposable income to eat healthier.

### **Imports**

Tariffs and anti-dumping duties are the main drivers of broiler meat imports into South Africa, due to the large difference between the landed price of chicken and the sale price of domestically produced chickens.

A stronger Rand exchange rate reduces the cost of imports and puts downward pressure on chicken prices. A weaker Rand, on the other hand, protects domestic industry from foreign competition. While these things are difficult to predict, it appears likely that the Rand's weakness will continue for some time. Even with the weakening of the Rand, the landed price of imported chicken is significantly lower than the price of domestically produced chicken.

Whilst [SA](#) has since liberalisation been a net importer of poultry, since the 2008 financial crisis imports have increased.

- From 2010 to 2018, demand increased, production increased, and imports increased.
- Domestic chicken consumption increased by 380 thousand tonnes between 2008 and 2017.

- However, only 27% was supplied by domestic production, while 73% was imported.
- Factors influencing domestic production's competitiveness and sustainability in comparison to imported products
- The cost of feed is causing more imports rather than domestic production.
- Leading exporters like Brazil and the United States produce at a lower cost than South Africa, owing to lower feed costs.
- Feed costs products imported into South Africa from these countries face an import tariff.
- Unfair trade practices by exporting countries have put an undue strain on profitability, resulting in limited domestic production growth.
- Anti-dumping duties of R9.40 per kilogram are levied by South Africa on bone-in chicken pieces originating in the United States.

### **Reasons for Tariffs**

The South African Poultry Association cites the following reasons for import tariffs:

- "The local poultry industry requires protection to ensure survival."
- Avoiding job losses due to import competition.
- Ensuring that the region's food security concerns are addressed."

### **External pressures placed on reducing tariffs**

- Friendly political alliances must be maintained. A simple examination of the levels of chicken imports from various countries gives the impression that the South African government has more stomach for erecting barriers to those countries with which it does not feel

politically connected (hence the large imports from Brazil). However, this ignores Brazil's comparative advantage due to lower feed costs – it would be interesting to learn how Brazil's feed costs compare to, say, those in the United States.

- Maintaining a beneficial trade agreement. For example, [WTO](#) membership, AGOA, and [EU](#) trade agreements (in the 1990s, [SA](#) agreed that EU imports of poultry would be duty-free as part of the Trade and Development Cooperation Agreement).

### Exports

- Chicken exports from South Africa are increasing, primarily to Botswana, Zimbabwe, and Mozambique. [SA](#) producers compete with most international counterparts and outperform other countries such as Ethiopia, Kenya, Malawi, and Angola, which are even less competitive.
- Brazil and the United States remain the leading global exporters producing at a lower cost.

## 1.2 PRODUCTION OF EGGS



Source: *Farming South Africa, 2019.*

Unless fertile eggs are desired for hatching, males are not required in an egg production flock. A hen can lay an egg without being mated.

While edible, such an egg is infertile and will not hatch. These are the eggs that are referred to as "table eggs" for human consumption. Breeders have developed layers that mature at a young age after many generations of selection. Each year, the rate of advancing sexual maturity corresponds to a half-day earlier onset. Changes in egg weight from hatching to maturity have increased by up to 0.35 g year<sup>-1</sup>.

Because eggs are perishable, they cannot be easily transported over long distances (unlike broiler meat). The advantage is that production usually follows consumption, so there is less of that dreadful international competition. One of the major challenges is keeping fresh eggs from the producer to the consumer.

Commercial egg production is dominated by ([DAFF, 2019](#))

- Nulaid (37%)
- Highveld Cooperative (12%)
- Eggbert (7%)

### From the Chicken to the Egg

- **Breeders:** Import genetic stock (known as grandparents) into South Africa as day old chicks. Hyline and Lohmann are the two genetic breeds for laying eggs; both are imported:
- **Lohmann;** both imported: Lohmann is imported by Lohmann SA, which is a joint venture between Golden Lay Farms and Pioneer Foods. The grandparents lay eggs, which hatch into day old chicks known as "parents." Pioneer Foods sells parent stock through its Nulaid division, and Golden Lay sells it through Avichick. The parents are raised to maturity and produce fertile hatching eggs; the eggs are incubated, and the day-old chicks that hatch are known as pullets.

- **Hyline SA** imports Hyline grandparents, an American breed, and raises parent stock that produces "hatching eggs for day old commercial layers." Hyline SA sells day-old pullets to independent rearing farms and does not participate in the rearing of lay hens.

Pullets are reared on farms until they are 18 weeks old and ready to lay commercial eggs, at which point they are referred to as Point of Lay Hens. The first eggs, which are small in size, are laid at 21 weeks of age. Some egg producers in South Africa rear their own Point of Lay Hens because the quality of rearing has a direct impact on the efficiency with which the hen produces eggs during her laying phase.

Nulaid, Highveld, and Eggbert eggs are produced at a feed conversion ratio of 2.2 kg per kg of egg. Eggs come in a variety of sizes and are graded. Point of Lay hens live for about a year before being slaughtered and sold as spent hens (often in the rural areas through informal traders). The time span between the grandparent stage and the killing of the hens is nearly three years.

There are 3 quality grades for eggs:

1. **Grade A** – sold at retail markets for household use. These are sized (Jumbo are at least 70 g, X Large at least 63 g, Large at least 56 g, medium at least 49 g, small at least 42 g & Pee Wee is less than 42 g).
  2. **Grade B** – used mostly in bakeries
  3. **Grade C** – sent to egg breakers for processing
- Eggs are also categorised as Organic Free Range, Omega 3-enriched, Free Range, Barn, Grain fed, and Commercial
  - Packaging and value addition (liquid egg) – large corporations have subsidiaries that carry this out

- Public distribution is primarily handled by the five major retailers (PnP, Shoprite, Spar, Woolworths, and Massmart), as well as SMMEs and informal traders
- Feed is supplied by Meadow, Epol, and Afgri, which collectively own 75% of the industry
- Avichick, Nulaid, Boskop, and Rossouw Hyline all have hatcheries

### **Barriers to Entry**

- Limited access to finance or working capital to purchase inventory and cover overhead costs.
- The inability to grade, package, transport, and bar code eggs.
- Regional and national supply constraints for major supermarket chains.
- Inadequate training, knowledge, and capacity in the management and operation of the poultry operation.

### **Demand and Supply**

Demand for eggs is primarily driven by population growth and real economic growth. The supply is dispersed across the provinces. Because of the long production cycle, supply is inelastic in the short term. To manage the supply-demand imbalance, producers set the price of eggs weekly, based on the number sold the previous week.

Astral Foods (ARL), Quantum Foods Holdings Limited (QFH), RCL Foods Limited (RCL), and Sovereign Food Investments are among the poultry companies listed on the JSE.

In terms of supplying chicken feed, AFGRI is a major player.

### 1.3 PURE BRED LINES - DUAL PURPOSE BREEDS



Source: Chris Daly.

These are generally heavy pure breeds that were previously used for both egg production and meat production. These breeds do not produce eggs and meat at a high enough rate and are inefficient, but they may play an important role in developing countries where resources are limited (no access to hybrids, high temperature, housing, feed supply and feed quality, disease and hygiene). They'll become broody and lay their own eggs. When the eggs hatch, half of them will be males, which can be raised and sold as meat. Males are usually of no value for meat

in modern, industrialised (commercial) egg production and may have to be destroyed. As a result, female chicks are more expensive. Old standard breeds such as the Australorp, Rhode Island Red, New Hampshire, and Potchefstroom Koekoek are available and sold as dual-purpose breeds in South Africa. Indigenous chickens are more likely to be free-range, with no active cooling or ventilation.

Most chickens will scavenge for food rather than being fed, and their growth rates are generally low when compared to birds on commercial farms. They are also more susceptible to disease, parasites, and predator attacks. In contrast to imported breeds, indigenous African breeds thrive with low input costs. These breeds will perform well in semi-intensive systems, producing a reasonable amount of meat but not as much as commercial broiler or layer lines. Despite the fact that these breeds have limited commercial application due to their slow growth and maturity, their meat texture, flavour, and inherent adaptability are enviable. They play a vital role in climate-smart livestock production, particularly in communal and small-scale farming systems.

## 2 BASIC PRINCIPLES FOR POULTRY HOUSING

### 2.1 DETERMINANTS OF POULTRY FARMING

- **Farm location:** To determine the location of your farm, you must first determine where your market is
- **Farm layout:** The houses must be properly oriented in order for enough heat and wind to enter the house. The distance between the houses is critical to preventing disease transmission from one to the other
- **Type and design of housing:** The purpose of housing is to protect poultry from the elements while also providing a comfortable environment for optimal production
  - » Temperature
  - » Humidity
  - » Ventilation
  - » [Ammonia](#)
  - » Floors
  - » Lighting (for commercial set-ups)

### 2.2 HOUSING

The goal is to keep out mice, rats, and birds from eating valuable poultry feed and spreading disease, as well as to protect birds from dogs, cats, snakes, rats, and other pests and thieves.

Basic requirements for the buildings are that they should:

- be rain proof
- not be prone to flooding
- protect poultry from direct sunlight
- be wild bird proof (difficult to achieve)
- have enough space
- be easy to clean out
- have a solid door with a lock
- have sufficient lights to support production

Housing type can be either naturally ventilated or environmentally controlled as shown in the examples in [Figure 2](#) and [Figure 3](#).



**Figure 2** Photo of environmentally controlled poultry house.  
*Source: ARC Poultry Training manual.*



**Figure 3** Photo of naturally ventilated poultry house.  
*Source: ARC Poultry Training Manual.*



**Figure 4** Photo of Free-range poultry system.

## 3 POULTRY FARMING SYSTEMS

### 3.1 INTENSIVE SYSTEM

This system requires a substantial amount of capital (capital intensive). The following are the features of this system:

- Appropriately designed housing must be created as part of this system.
- Chickens are housed in crowded conditions.
- To be profitable, only the most productive chickens should be retained.

As a consequence of sufficient balanced feed, water, disease control, and proper management, the development rate and egg production becomes outstanding and rewarding for an entrepreneur.

### 3.2 SEMI-INTENSIVE SYSTEM

Capital is needed for this system. The characteristics of this system include:

- Provision of housing (three birds per square meter) and equipment
- Provision of supplementary feed
- Provision of a safe environment for chickens to freely roam (one square meter per chicken)

Growth rate and egg production are enhanced as a result of enough balanced diet, water, and proper management practices. This system is well suited for niche markets.

### 3.3 EXTENSIVE SYSTEM (FREE-RANGE)

This is the oldest system known. The characteristics of this system involve:

- Kept by people that do not spend money on the chickens.
- They do not provide the chickens with housing.
- The chickens are forced to scrounge for their own water and food

The growth rate and egg production are both very poor as a result of inadequate nutrition and water. Furthermore, nutritional deprivation makes chickens more susceptible to illnesses.

## 4 CLIMATE CHANGE



*Sarah Wild and Siphso Kings, 2019.*

[Climate change](#) is a wide term for a variety of global events caused mostly by the burning of fossil fuels, which releases heat-trapping gases into the atmosphere. These phenomena include not just the rising temperatures associated with global warming, but other changes such as sea-level rise.

The characteristics of climate change include, among others:

- Prolonged dry spell (draught)
- Severe rise and fall of environmental temperatures
- Prolonged or shortening of season length
- Undesirable variations of rainfall distribution
- Intense wind speed

Climate change continues to have devastating results for countries all over the world, including South Africa. Climate change impacts South Africa in the following ways, and others:

- Higher average annual temperature
- Higher maximum temperatures
- More hot days and more heat waves
- Higher minimum temperatures
- Fewer cold days and frost days
- Reduced average rainfall
- Rising sea levels
- Increased fire risks

- Increase in the frequency and intensity of extreme weather events, including floods, droughts, and storm surges

According to reports, these changes have resulted in a decrease in poultry output and productivity. Droughts and interruptions in water supplies are also a concern since raising and processing chicken consumes a lot of water. To fulfill hygienic requirements, [water quality](#) is critical in every form of chicken production and farming.

Due to the increased frequency of extreme events and the unpredictability of weather patterns, climate change is already having an impact on agriculture and food security. This can result in reduced output and revenue, as well as a rise in food costs. Economic development and food security will be harmed in the end. As a result, there is a pressing need to mitigate the detrimental impacts of climate change on poultry production in order to satisfy rising meat and egg demand.

Climate change necessitates collaboration and skill upgrades among extension services, researchers, and trainers in order to stay up with rapidly changing industry requirements.

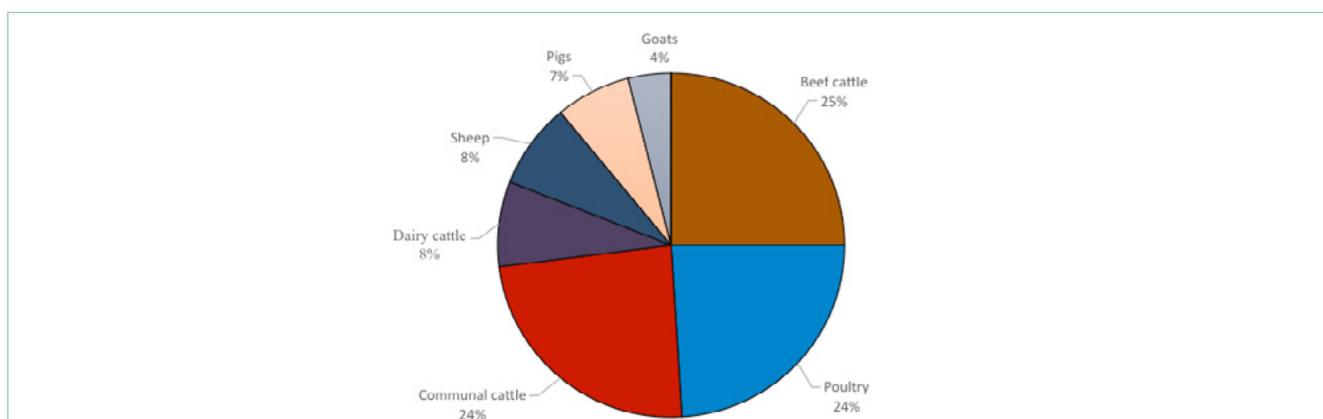
To achieve better outcomes, services must be integrated and involve all stakeholders on a local, national, and worldwide level, including the public, commercial, and non-profit sectors, industry value chains, and educational institutions. Because greenhouse gases (GHGs) released in one nation can impact output in another, and over- or underproduction of a commodity in one location influences commodity pricing on the global market, climate change has both local and global effects.

## 5 CONTRIBUTION OF POULTRY TO CLIMATE CHANGE

- Agriculture's contribution to climate change is estimated to be between 18% and 20% (Moeletsi & Tongwane, 2015)
- The livestock industry contributes around 5% to 10% of the total agricultural output. Poultry has the least carbon impact per unit product of all of them
- Poultry farming is thought to be environmentally friendly

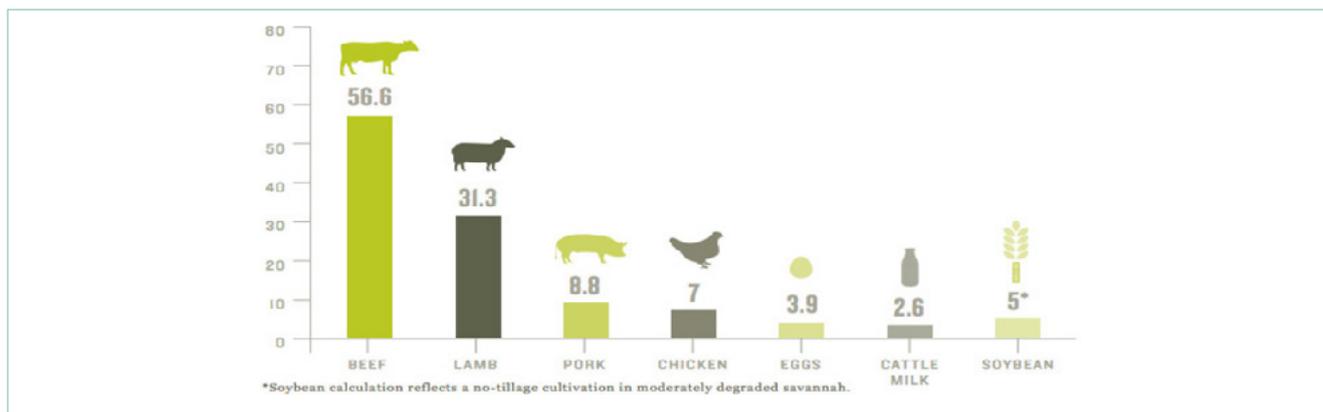
### 5.1 METHANE EMISSIONS

Enteric methane production is lower in poultry (0.3%). Manure treatment has the biggest impact on methane emissions. The amount of  $\text{CH}_4$  released is determined by the manure management system, the circumstances in which the manure is stored, and the makeup of the manure. Methane is mostly produced by liquid-stored manure (anaerobic fermentation by methanogenesis). The intense production technique, where chickens are confined in doors, produces a lot of methane. The following [Figure 5](#) and [Figure 6](#) indicate the levels of methane and greenhouse emissions, respectively:



**Figure 5 Methane emission from manure management per animal category.**

Source: Moeletsi & Tongwane, 2015.



**Figure 6 Greenhouse emission per kg of meat.**

Source: Chatham House "changing climate, changing diets", 2015.

## 5.2 NITROUS OXIDE EMISSIONS

- Nitrous oxide is produced in poultry when high-protein diets are fed to chickens. Protein that escapes the ileum is putrefied in the caecum. Toxin metabolites such as [ammonia](#) are produced during putrefaction. The nitrification and denitrification processes convert ammonia to nitrous oxide.
- In most poultry production systems, manure is handled as solid.
- Nitrous oxide is produced by dry-stored manure (through aerobic decomposition)
- Poultry manure nitrogen accounts for 8.8% of nitrous oxide emissions.
- The amount of  $N_2O$  produced and emitted by manure is determined by:
  - » Chicken feed digestibility and composition
  - » Manure management practices
  - » Environmental conditions
  - » Duration of waste management
- Manure quantities are high during growth phase and winter season

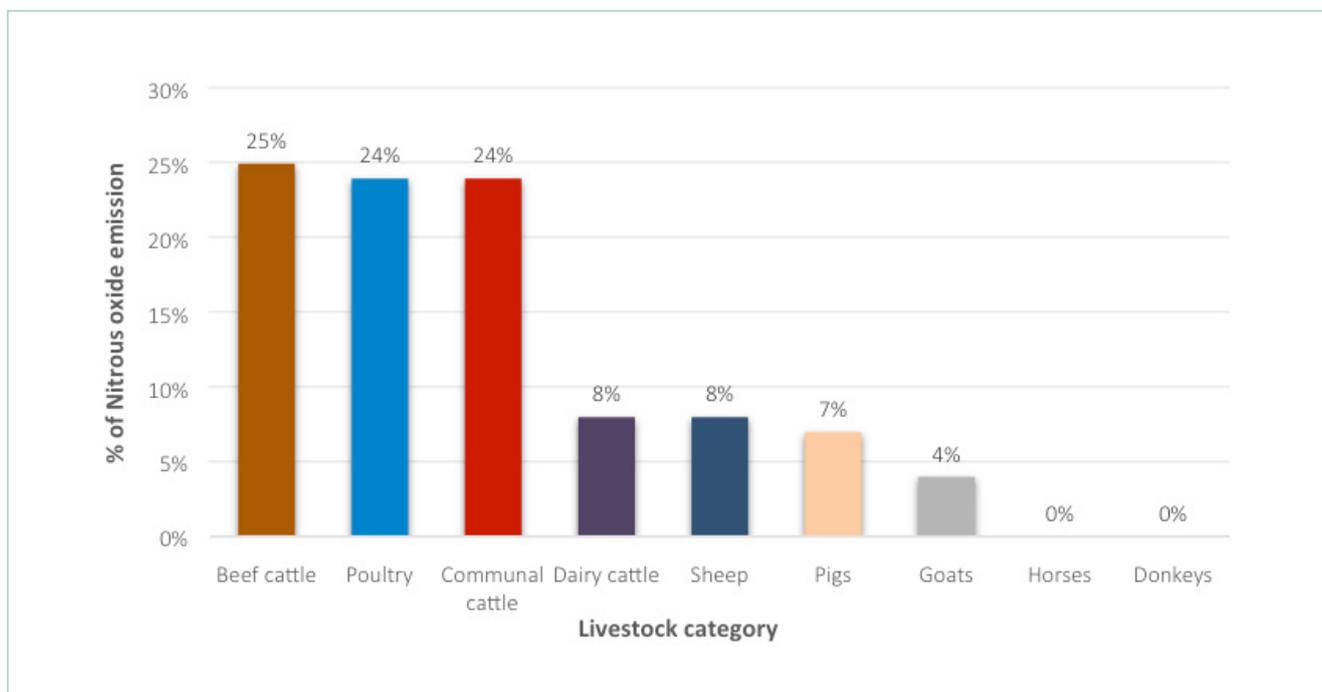


Figure 7 Nitrous oxide emission from manure management per animal category.  
Source: Moeletsi & Tongwane, 2015.

## 6 EFFECTS OF CLIMATE CHANGE ON POULTRY PRODUCTION

Climate change has a negative impact on poultry production. Climate-induced heat stress is the most prevalent cause of reduction in poultry productivity, particularly in tropical climates. It has an impact on chicken welfare and production by altering the natural body temperature of chickens (ranging between 40°C and 42°C). Chickens lack sweat glands. As a result, they control their bodies through various thermoregulatory systems.

- **Effect of heat stress on poultry production**
  - » Reduced feed intake and feed conversion efficiency
  - » Reduced egg size and production
  - » Sudden rise in poultry mortality
- **Effect of heat stress on behavioural activities**
  - » Spend less time feeding [emaciated]
  - » More time drinking water
  - » More time panting with open mouth
  - » More time flapping wings
  - » Less time moving or walking [skeletal disease]
  - » More time lying down/resting
  - » Increased cannibalism
- **Effect of heat stress on reproduction**
  - » Decreased reproductive efficiency
  - » Reduced luteinizing hormone
  - » Decreased donadotropin releasing hormone
  - » Reduced fertility in cocks
- **Effect of heat stress on physiology and immunoglobulin**
  - » Increased heart and pulse rate
  - » Low levels of circulation of antibodies
  - » Lymphocytes
  - » Low levels of immunoglobulin
  - » Suppression of phagocytic activity of blood leukocytes
- **Effect of heat stress on oxidative stress**
  - » Increased malondialdehyde levels
  - » Decreased superoxide dismutase
  - » Decreased catalase activity
  - » Increased Heat shock protein 70 gene
- **Effect of heat stress on carcass characteristics**
  - » Reduced carcass weight
  - » Decreased chicken cuts weight
  - » Reduction in egg and meat quality

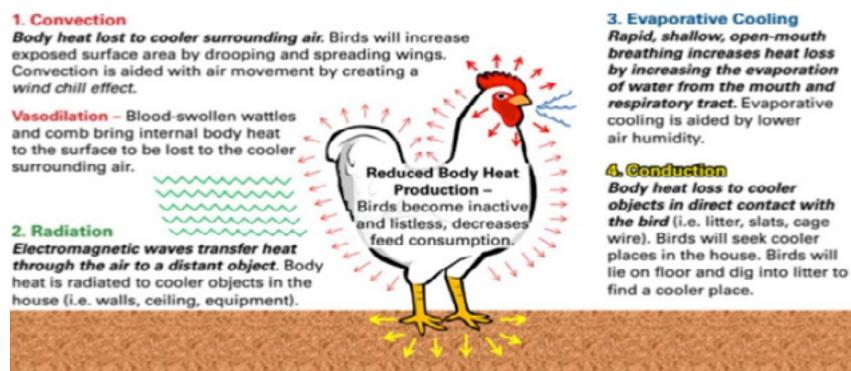


Figure 8 Thermoregulatory mechanisms of chickens.

Source: <https://www.hyline.com/ViewFile?id=ff054c39-aa45-43ae-adbe-1488017266f1>.

## 7 CLIMATE-SMART POULTRY PRODUCTION

Climate-Smart Agriculture (CSA) is sustainable farming that satisfies the demand for safe and sufficient food and fiber while conserving the integrity of ecosystems, and it does so by maximizing the net value to society when all costs and benefits are evaluated (Farmer's Weekly, 2019).

Climate-smart chicken production would be governed by the genotype of the bird within its habitat, using the animal's innate competitive production advantage in the climate. Nutrition, genetics, disease, exposure to parasites, management techniques, climate, rainfall, humidity, heat and cold stresses, advisory services, and farmer competence are all variables that impact production in that [ecosystem](#). The phenotype of a bird is influenced by the interaction of its genotype and environment.

Aims for three objectives of Climate-Smart Agriculture:

- I. To sustainably boost agricultural production to promote fair gains in farm incomes, food security, and development;
- II. To adapt and strengthen agricultural and food security systems to climate change at various levels; and
- III. To contribute to reducing greenhouse gas emissions from agriculture

These objectives are examined at various sizes – from farm to landscape – at various levels – from local to global – and across short and long time horizons, while taking national and local specificities and priorities into account.

Climate-smart chicken production is sustainable farming that addresses the demand for food security in the face of [climate change](#) while conserving ecological integrity. Climate-smart chicken production is governed by the genotype of the bird within its habitat, which capitalizes on the bird's innate competitive production advantage in the climate. Nutrition, genetics, disease, exposure to parasites, management techniques, climate, rainfall, humidity, heat and cold stresses, advisory services, and farmer competence are all variables that impact production in that ecosystem.

There are two different kinds of measures that can be used: [mitigation](#) and [adaptation](#). Mitigation methods aim to decrease and/or eliminate greenhouse gas emissions, whereas adaptation efforts aim to minimize risk and susceptibility to the consequences of climate change. As a result, mitigation targets the causes of climate change, whereas adaptation addresses its consequences.

### 7.1 MITIGATION APPROACHES

#### Reducing greenhouse emissions

The first strategy is to reduce the regions where the chicken business contributes to climate change by emitting greenhouse gases. These are some examples:

- **On-farm energy consumption:** This encompasses both direct and indirect energy inputs. Energy is mostly utilised in heating, ventilation, and air conditioning systems, but it is also used in on-farm transportation, feed preparation, cleaning, waste-burning, and packing.

- **Carbon dioxide (CO<sub>2</sub>) emissions from slaughtering:** The slaughter of poultry in abattoirs is more intense than in other meat industries. Process heat is generated by fossil fuels, while machine operation and refrigeration are supported by electricity usage.
- **Carbon dioxide emissions from international trade (transportation):** Because of the long distances covered and the refrigeration of vessels, international trade in chicken meat has a high carbon footprint. Local transportation, if done in inefficient cars, can also contribute to a rise in the sector's greenhouse gas emissions. With chicken being imported into South Africa from as far away as the United States, Canada, and Australia, and both international and domestic poultry production rising, transportation is a significant potential area for lowering greenhouse emissions in the industry.
- **Greenhouse gas emissions from feed production (indirect contributor):** Feed for chicken production is the most expensive input in the poultry industry. As a result, it is critical to examine the greenhouse gas emissions caused by feed production. The major greenhouse gases produced by feed production are CO<sub>2</sub> (produced when fossil fuels are used to make [fertiliser](#)), and Nitrous Oxide (N<sub>2</sub>O).

#### Enteric fermentation

- Providing higher quality fodder reduces methane emissions because it enhances digestibility
- Increasing feed protein content can enhance digestibility and lower total methane emissions per unit of product
- Supplements, such as feed additives like probiotics and prebiotics, which tend to boost weight growth and decrease feed consumption per metric ton of meat produced, can help minimize enteric fermentation

#### Manure management

- Changing diets is another [mitigation](#) method for manure-related non-CO<sub>2</sub> emissions, because the [GHG](#) content of manure varies depending on diet. In particular, ration composition and feed additives can impact the quantity of [N](#) in urine and faeces, as well as the amount of fermentable organic matter in faeces, resulting in changes in manure-based [CH<sub>4</sub>](#) emissions.
- Maure handling mitigation measures include limiting manure exposure to water (e.g., dry scraping rather than washing into a pond) and transitioning from anaerobic to aerobic management.
- Good manure management is essential for limiting [ammonia](#) gas plumes generated by commercial broiler farms. This entails cleaning the sheds on a regular basis and treating dirty bedding to make it more acidic (so reducing how much ammonia is lost to the air).
- Shortening the time of manure storage and anaerobic digestion are additional alternatives.

#### Improving feeding strategies (Applies to both Mitigation and Adaptation)

- Several effective dietary solutions have been developed to minimize the negative impacts of rising ambient temperatures. The goal is to meet the unique demands of chickens in hot climates by applying water, [nutrients](#), electrolytes, vitamins, and minerals. Management strategies such as feed limitation, fat addition, and excess protein reduction have been seen to reduce the negative effects of heat stress and increase the bird's performance

- Fat addition in feed raises the nutritional content of other feed components, lowers feed retention time in the digestive system, and improves nutrient utilization
- During times of acute stress, the meal should be made up of highly digestible nutrients. As a result, the chicken industry has advocated for the use of high-quality protein and amino acids (methionine and lysine, for example) to decrease heat increase and the harmful effects of high temperatures
- Heat stress causes minerals (Iron, Zinc, Selenium, and Chromium) and vitamins (A, C, and E) to be expelled from the chickens' bodies, resulting in mineral and vitamin deficit. Under severe climatic conditions, food supplementation of vitamins, minerals, and electrolyte balance has been shown to reduce mortality and enhance growth rate of chicken
- Heat stress alters the gut microbiome in an unfavorable way. Lactobacillus strains derived from probiotics may assist to regulate the intestinal microbiota of hens suffering from high temperatures
- Several specific feed additives, including as dietary enzymes, baking soda, zinc bacitracin, and osmo-protective supplements, may also be beneficial in lowering heat-stress mortality
- As a result, the goal is to increase poultry output while preserving the beneficial adaptations provided by breeding techniques
- Exploiting the natural competitive advantages of indigenous genotypes as sources of genes for hardier breeds that might be more robust to weather extremes and higher temperatures predicted under climate change are potential strategies for addressing these risks to the chicken business

#### **Environmental strategies**

- Environmental adjustment is one of the most important elements in reducing the consequences of heat stress. Environmental technical methods, however, cannot reduce heat stress in a chicken farm if nutritional programs, disease management, and poultry genetic status are not ideal. Stressful climatic conditions can be mitigated by employing fundamental design principles to improve chicken farming in hot climates. For example, housing form (semi-open buildings); ventilation (air flow into and out of buildings to remove ammonia, carbon dioxide, and moisture) in hot and humid climates; natural or artificial shade (surrounding plant and grass cover); and water usage
- The quality of the roofing is another element that might help prevent heat buildup. Roofs must be clean, rust-free, and dust-free. A gleaming surface reflects more solar radiation than a dark or rusted roof. Roof reflectivity may be enhanced by using metallic zinc paint or installing an aluminum roof. By using circulating fans, proper ventilation may enhance convective cooling
- Heat stress is associated with both heat production and body heat loss in chickens.

#### **Genetic selection strategies/ altering of breeds (Applies to both Mitigation and Adaptation)**

- Changes in breeding methods can assist animals become more resistant to heat stress and illnesses, as well as boost reproductive and growth development. Climate-smart breeding programs that use heat stress-tolerant genotypes to achieve above-average production efficiency and minimal carbon and water footprints per unit product. Increasing efficiency is environmentally responsible

- Heat stress should be controlled in poultry housing to minimize the negative effects on hens. Ventilation technology can help to reduce stress-related health concerns. Ventilation equipment should be properly installed and serviced on a regular basis. In order to manage an emergency scenario, additional ventilation fans and generators should be available
- It is necessary to install an alarm system that warns to the failure of the ventilation system, which may protect hens from unpleasant or stressful circumstances, particularly during hot weather. As a result, emergency equipment (fail-safe electric panels) should be built to prevent temperatures in chicken housing from reaching more than 5°C over the outside temperature
- Catching and loading chickens should take place first thing in the morning. During the catching and loading processes, ventilation fans or additional mobile fans should be supplied for the uncaught birds. Water should be provided to uncaught birds regularly by lowering the drinkers from time to time, ensuring enough water supply, nourishment, and light for the birds. During the hot summer months, [stocking density](#) is one of the most important considerations
- To minimise heat stress, the number of individual birds kept on a farm should not exceed a specific stocking density. The number of birds should be changed in accordance with the crate design and the ambient temperature. Chicken cages should be placed on the truck to allow for enough ventilation. Fixed crates' ventilation openings must be opened. Bird boxes and/or completely loaded cars should be kept in well-ventilated enclosures. Evaporative heat dissipation is temperature and humidity-dependent, increasing with increasing temperature and decreasing with increasing humidity

### Shifting human dietary trends

- Reducing meat consumption has the potential to dramatically cut [GHG](#) emissions. Because beef accounts for a big fraction of GHG emissions from the livestock sector and is the least resource-efficient animal protein producer, the beef component of the livestock sector has a high [mitigation](#) potential
- More research is needed to understand why populations feel compelled to increase their consumption of animal protein as they rise above the poverty line, as well as why those at the top of the economic ladder feel compelled to improve their diets by reducing meat consumption and returning to a more vegetarian diet

## 7.2 ADAPTATION APPROACHES

### Farmers' perception and adaptive capacity

- One of the issues limiting the success of such adjustments is farmers' willingness and capacity to acknowledge the problem and implement [climate change](#) adaptation and mitigation strategies. It is critical to collect data on farmers' attitudes on mitigation and adaptation strategies. The use of open-ended survey questions or group discussion at workshops to explore individual and group perspectives is one method for gathering information on farmers' perceptions that has been utilised for mitigation and adaptation research
- Understanding farmers' perspectives and incorporating them into rural policy formulation increases the likelihood of achieving food security and environmental conservation goals
- Education, family farm succession, and social contact among farmers and agricultural communities can all help to improve risk perception in farmer decision-making

### Reducing sensitivity to environmental stress

- Other [adaptation](#) techniques include efforts to modify the environment, as well as nutritional and drinking water manipulation. It would be preferable for poultry to be less sensitive to environmental stressors such as changes in physical surroundings, social context, and human handling
- Preparing for high heat and ensuring that housing, transportation, and management procedures are essential
- Poultry farmers should reconsider building design in new builds to more effectively cope with new climate and weather extremes, including the installation of more/new equipment to cope with the heat
- Improved house insulation and thermal performance by taking into consideration its location in the landscape and the reflectiveness of the roof materials. Good insulation offers numerous advantages, including decreased heating expenses in the winter, buffering excessive outside heat in the summer, and minimising condensation and damp-related concerns within the barns
- Making use of natural shade from trees may also be beneficial during the hottest days—this is especially true for free-range systems where the birds require patches of shade to escape to during the day
- Allow ventilation air flow in poultry houses and place air intakes for ventilation and cooling in the optimum areas (such as shaded walls) to draw in cool air

### Advisory services

Climate change poses severe challenges to animal agriculture, demanding coordinated solutions from extension, research, and training agencies. Climate change is a new phenomena that requires individuals who work in extension,

research, and training to constantly learn and improve their abilities in order to stay up with ever-changing sector standards and an increasing knowledge base. Collaboration in service delivery must be holistic and engage all stakeholders at the local, national, and international levels, including the public, commercial, and non-government sectors, government agencies, producers, industrial value chains, and tertiary education institutions.

### Integrated collaborative research

Extension, research, and training services work together to provide integrated collaborative solutions. Learn and improve skills to stay up with ever-changing industry standards. [Mitigation](#) measures and [adaptation](#) assistance will be provided through the integrated joint research, extension, and training services, which will include:

- Creating and sustaining climate-smart breeding programs that employ heat stress resistant genotypes with above-average productive efficiencies while emitting low [GHG](#)
- Using nutritional technologies and practices to reduce the carbon and water footprints in poultry production
- Trying to figure out how climate change affects genotype and adaptation processes
- Conducting comprehensive research
- Developing and using accurate simulation models to predict the impact of climate change
- Collaborating within and across disciplines at the local, national, regional, and international levels, as well as offering multifaceted [climate change](#) solutions in chicken production

## 8 PEST AND DISEASE MANAGEMENT IN POULTRY PRODUCTION

Lower temperatures may facilitate the survival of several key poultry viruses such as Newcastle disease, Avian influenza, and Gumboro. This occurs because chickens like to snuggle closer together in chilly weather. Increased heat and humidity will result in an increase in respiratory problems and intestinal parasites. Increased heat stress also reduces the body's natural immunological defense mechanisms (Mitchell A, 2017). Changing weather patterns also change the migration pathways of wild birds, potentially leading to larger outbreaks of illness in formerly uninfected areas or an increased risk of disease spillover to free range poultry (Trautmann S, 2018).

Because of the greater stocking densities of these animals, [climate change](#) will affect housed poultry less than free range poultry, but infrastructure costs will rise and illnesses will spread more quickly if not controlled with adequate [biosecurity](#) and vaccination. Although free range poultry may be more vulnerable to climatic extremes and disease transmission from wild birds, disease transmission between them may be less. Scientists are always seeking for newer, better ways to battle these diseases through prevention rather than therapy, as this is the most cost-effective approach.

Climate-smart pest and disease management has the following potential benefits:

- Decrease in mortality rates
- Decrease in morbidity rates
- An increase in illness reporting
- Increased productivity
- An increase in fertility
- An increase in income
- Lowering of greenhouse gas emissions

Climate smart pest and disease management for poultry may be split into these categories: biological vector control, resistant breed development, vaccination programs, and parasite control (CCARDESA, 2019).

### 8.1 WHERE TO START?

Examine your target farmers' farming practices. What are the issues that they believe require the most attention right now? What is the primary goal of their agricultural business? How do they check for illness symptoms in their animals? How do they keep track of their animals' whereabouts? What information do they keep in their records? What criteria do they use to decide which animals to keep? What vaccinations, veterinary medicines, and feed additives do they use? Where do they obtain their vaccinations, veterinary medications, and feed supplements? What infrastructures are there? How much labor are farmers able to access? Farming equipment owned by the farmer.

#### What then?

Once you understand how the system works, you can create a plan with the farmers' help based on what they view as their main concerns and on disease monitoring and documentation.

### 8.2 IDENTIFICATION OF A SICK ANIMAL

The only way to tell if an animal is sick is to observe how a healthy animal appears. (FAO, 2021).

### Looking from a distance

If chickens are kept in a chicken house:

- Are the hens distributed equally on the floor?
- Are they huddling in one corner?
- Are they huddling together?
- Is there evidence of wet litter or diarrhea?

### Smell

- Is there a strong smell of [ammonia](#)?
- Are there any additional noxious odors? On the level of chickens (ammonia is heavier than air)

### Sound

Before you enter the house, are the chickens relaxed and making a normal amount of noise?

### Posture of the chicken

- Is the chicken standing?
- Is the neck properly aligned?
- Are the wings smooth and relaxed next to the body?

### Looking at the head

- Is the wattle and comb normal in color (mainly red)?
- Is there a discharge from the nostrils?
- Is the eye colour normal?

### Breathing

Breathing should be smooth and relaxed, and the mouth should be closed.

### Feet

The feet should be correctly positioned, and the animals should not be struggling to carry weight. The hocks should also not be bloated. The legs should not have extensive scaling. Bumble foot should be examined on the feet.

### Vents

Chickens should not be exposed to dry vents if they have not been traumatised.

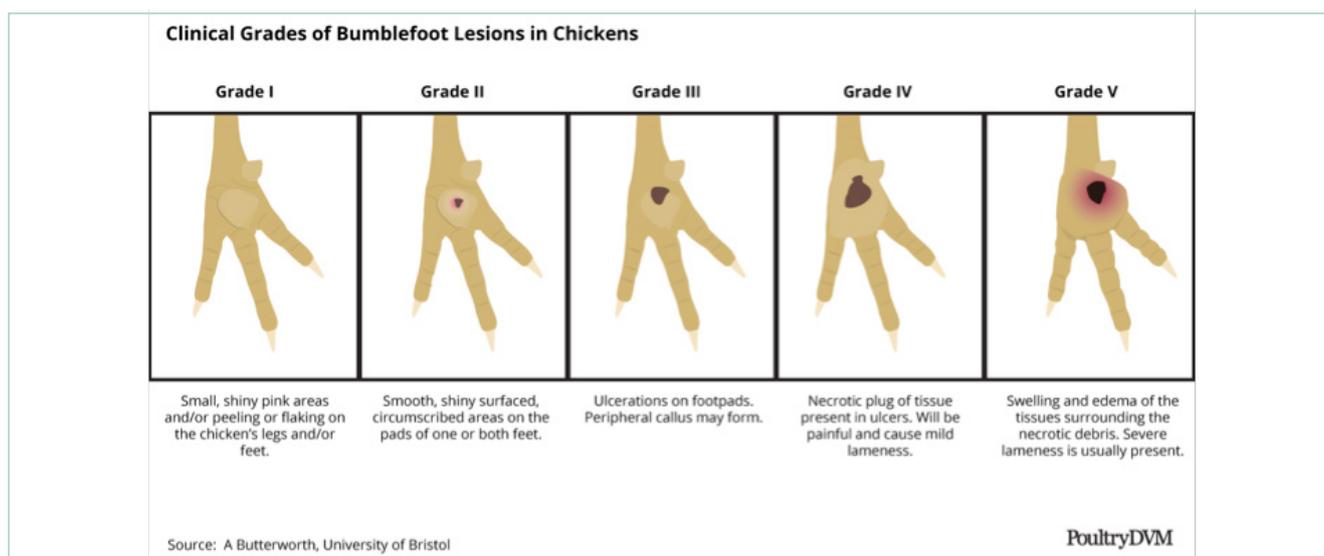


Figure 9 Clinical Grade of Bumblefoot Lesion in chickens.

### Egg production records

A commercial layer's regular egg production ranges from one egg per day to one egg every other day. A decrease in egg production is frequently the first symptom of a sick chicken.

### Egg deformities

The egg should have a regular shape and color. Abnormally formed eggs might indicate illness or nutrition issues.

## 8.3 DISEASE REPORTING

One of the most important functions of the extension officer is to assist in the notification of controlled and notifiable diseases to the authorities, as regulated by the Animal Diseases Act 35 of 1984 and its associated regulations.

Link to the **act**:

<https://www.dalrrd.gov.za/Branches/Agricultural-Production-Health-Food-Safety/Animal-Health/importexport/legislation/diseaseact>

Link to the **regulations**:

<https://www.lawexplorer.co.za/StatutoryDatabase/SubordinateFile/SubordinateFileDownload/5843>

Additional diseases with trade implications are also reported to the Office International des Epizooties OIE through the Department of Agriculture, Land Reform and Rural Development (DALRD), as extension officers do not have formal training in these diseases and are not expected to note them.

According to the Animal diseases, Act 35 of 1984 the definitions:

- '**controlled animal disease**' means any animal disease in respect of which any general or particular control measure has been prescribed, and any animal disease which is not indigenous or native to the Republic. Table 2 of the regulations on the act gives a list of controlled diseases, those pertaining to poultry are noted in [Table 1](#).
- '**notifiable animal disease**' an animal disease specified in Annexure 3

According to the Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA, vectors are insects, birds, or other animals that transfer a disease or pest from one host to another.

### 8.3.1 Controlled Animal Diseases

**Table 1** Controlled animal diseases (in terms of the Animal Diseases act, Act 35 of 1984).

Disease	Clinical signs	Vector
Avian influenza	Loss of appetite, drop in egg production, swelling and blue discolouration of the wattles and combs. Sneezing and coughing. Diarrhoea. Sudden death.	Wild aquatic birds
Newcastle disease	Loss of appetite, coughing, muscle tremors, hanging wings, twisting necks, circling, paralysis. Swelling around the eyes and neck area. Green diarrhoea and a drop in egg production and misshapen eggs.	NO
Psittacosis	Nasal discharge, conjunctivitis, coughing. Green diarrhoea. Loss of appetite. Drop in egg production.	Wild birds
<i>Salmonella enteritidis</i>	Depression, Ruffled feathers, closed eyes, Diarrhoea, vent pasting, loss of appetite, stunting in older birds.	Mice, wild birds, cockroaches, flies, fleas, ticks, mealworms, litter bugs.
<i>Salmonella gallinarum</i>	Depression, ruffled feathers, not wanting to move. Yellow diarrhea, loss of appetite.	Mice, wild birds, cockroaches, flies, fleas, ticks, mealworms, litter bugs.
<i>Salmonella pullorum</i>	Depression, Ruffled feathers, closed eyes, Diarrhoea, vent pasting, loss of appetite, stunting in older birds.	Mice, wild birds, cockroaches, flies, fleas, ticks, mealworms, litter bugs.
Any animal disease or infectious agent that is not known to occur in South Africa.	In the case of these illnesses, there is usually a history of an animal being imported or feed being imported or removed from ships.	

### 8.3.2 Other common diseases

Diseases vary by location, and only a veterinarian is authorized to diagnose and treat diseases under the Veterinary and Paraveterinary Act 19 of 1982, but it is vital to have a general understanding of some of the most prevalent

diseases affected by [climate change](#). Poultry housed in cages are more likely to develop metabolic illnesses, such as diseases that impair bone density, if the proper diet is not provided. Fowl pox is often carried by mosquitoes and can be transmitted from farm to farm if chicken is purchased from one farm to another. The spread

is aided by wet circumstances. The distribution and incidence of internal and external parasites alter as well; for example, coccidial illness in chicken becomes more of a concern under moist circumstances. Roundworms, tapeworms, fleas, soft ticks, and mites are among the other parasites.

### 8.3.3 Zoonotic diseases

These are diseases that are transmitted between animals and people; the most widespread of these diseases that have recently been discovered in South Africa include:

- Avian influenza
- Salmonellosis
- Psittacosis
- Campylobacteriosis

If you become ill, please notify your healthcare provider that your employment requires you to work with sick animals.

### 8.3.4 Reporting of diseases by farmers

Educating farmers on their obligation to report any animals that exhibit indications of sickness to you as the extension officer or to the animal health technician who will contact the veterinarian. It's also a good idea to attempt to avoid the stigma that comes with disclosing some of these disorders. Keep in mind that farmers will only share information with you if you have a good relationship with them. According to the Animal Diseases Act, it is also the obligation of animal owners to report these diseases, and failure to do so is a violation of the law.

## 8.4 BIOLOGICAL CONTROL OF VECTORS

The diseases that are vector-borne will vary according to local conditions; for example, diseases carried by biting flies are more common during the rainy season, when mosquitoes and biting midges are more prevalent. Controlling these illnesses can be accomplished in a variety of methods, including:

- An all-around poultry-raising approach that eliminates litter between batches of chickens
- Fencing in the poultry area to keep other animals out
- Cutting down any trees in the poultry area that may shelter wild birds
- Eliminating vector breeding sites, such as stagnant water where mosquitoes breed
- Do not drink water from an open water source where wild ducks are known to congregate
- Cleaning up any spilt feed and storing feeding bags in rodent-proof containers or rooms. (South African Poultry Association, 2019)

## 8.5 OTHER METHODS OF DISEASE CONTROL

Not all diseases are transmitted by vectors, some other transmission methods include:

- Direct contact between sick animals
- Excretions of the sick animals
- People, clothing and equipment
- Naturally occurring in soil
- Housing not cleaned after sick animals where in them
- Feed and water (CCARDESA, 2019)

### 8.5.1 Biosecurity

- The key to keeping diseases away from your animals is good biosecurity.
- Using an all-in-all-out approach for chicken rearing.
- Separate any ill or dead animals from healthy ones as soon as possible.
- Refrain from allowing visitors to your flocks.
- If you must allow people in, keep a diary to track illness occurrences and notify anyone who have come into touch with your flock if there is an epidemic of a transmissible disease.
- Taking a shower in and out of your poultry unit. Alternatively, ask your employees to shower at home before going to work and again after leaving.
- Wearing PPE that isn't taken from the poultry area except to be cleaned.
- Provide footbaths and hand sanitizer at the front door of your homes.
- Ensure that your equipment and vehicles are disinfected on a regular basis.
- Never lend away your equipment.
- Always start with the healthy animals and work your way down to the ill ones.
- If there are no ill birds, go from the youngest to the oldest.
- As an extension officer, avoid visiting many farms in a row; instead, wait at least a week between trips.
- Between batches of chickens, clean and disinfect your poultry buildings.
- Do not leave any unneeded items lying about that might serve as a breeding ground for vermin

For a more in-depth biosecurity program you can find “A quick guide to the application of Biosecurity on a Poultry farm” on the website <http://www.sapoultry.co.za/home/training-notes.php>

### 8.5.2 Selecting of resistant breeds

Other sections go into further depth about this. In general, indigenous breeds are more resistant to locally prevalent illnesses. Certain illnesses, however, are not endemic to the area, and the idea that local breeds do not need to be vaccinated should be avoided.

If a chicken becomes ill, it is usually culled rather than treated. This ensures the health of the flock.

### 8.5.3 Vaccination campaigns

Many diseases can be avoided or the intensity of the symptoms reduced by using commercially available vaccinations. Certain vaccinations, like as influenza vaccines, are only allowed by veterinary services under certain conditions; please see your veterinarian practitioner for more information.

#### **When planning a vaccination campaign ensure:**

- A schedule is agreed upon with the flock's owners
- Try to visit the farms no more than once a week
- Determine how much the farmers must pay for the vaccinations
- Inquire about the availability of handling facilities
- Verify the availability of equipment and storage to ensure that vaccinations are kept at the proper temperature
- Ensure that there are sufficient trained vaccinators
- Estimate the number of animals that will require immunization
- Ensure that adequate vaccinations have been ordered and are available to carry out the campaign

- Ensure that the vaccine is done at the appropriate time of year for the illness and when the farmers have time
- Essential to ensure that farmers are informed about the benefits of the vaccine and the necessity for revaccination
- Ensure that there is a means to identify vaccinated animals
- Maintaining a record of the vaccinated livestock as well as receipts for payment from farmers
- Determine if it is feasible to continue administering these vaccines to farmers

#### When giving the vaccine:

- Check the batch and expiration dates of the vaccination before administering it
- Ensure that the cold chain was kept intact
- Only use the vaccination in accordance with the manufacturer's instructions
- Do not re-use vaccinations if the label says you can't

- Verify the vaccination dosage
- Look for potential risks to vaccinators and make them aware of them
- Vaccinate only healthy animals
- Never guarantee the farmer that the vaccination will be 100% effective
- Ensure that the vaccine is done at the appropriate time of year for the illness and when the farmers have time

The following is an example of a vaccination program from the University of Pretoria (<https://downloads.swappyworld.com/wp-content/uploads/2019/03/layers-vaccination-table.pdf>).

This information can be combined with current disease trends in the area to create your own practical vaccination list.

**Table 2 Layer vaccination programme.**

Age	Disease	Route
Day old	Mareks	Subcutaneous injection
	Newcastle Disease (NCD)	Eye drop / course spray
Day 14	Infectious Bursal Disease (IBD or Gumboro)	Drinking water
Day 18	Newcastle Disease	Fine spray (Atomist, Turb-air)
Day 20	Infectious Bursal Disease	Drinking water
6 Weeks	Newcastle Disease Infectious Bronchitis	Fine spray
10 Weeks	Newcastle Disease	Fine spray
12 Weeks	Infectious Coryza	Subcutaneous injection
	Fowl Pox	Wing web stab
	Infectious Laryngotracheitis	Eyedrop
13 Weeks	Avian Encephalomyelitis (AE)	Drinking water

14 Weeks	Newcastle Disease	Fine spray
16 Weeks	Newcastle Disease (NCD) Infectious Bronchitis (IB) Egg Drop Syndrome (EDS) Infectious Coryza	Intramuscular injection
<i>Newcastle Disease - fine spray every 4-6 weeks during laying period</i>		

**Table 3 Basic Broiler vaccination programme.**

Age	Disease	Route
Day old	Infectious Bronchitis Newcastle Disease (Avinew/Vitapest)	Eyedrop or coarse spray (Usually done at hatchery)
Day 14	Infectious Bursal Disease (Gumboro)	Drinking water
Day 16 - 18	Newcastle Disease (Avinew)	Drinking Water
Day 18	Infectious Bursal Disease	Drinking water
Day 28	Newcastle Disease (Lasota type) (Only if birds kept longer than 42 days)	Fine spray (Atomist or other)

**Table 4 Broiler vaccination programme where there is a high risk of Newcastle disease.**

Age	Disease	Route
Day old	Infectious Bronchitis Newcastle Disease (Avinew or VH)	Eye-drop or coarse spray (Usually done at hatchery)
Day 14	Infectious Bursal Disease	Drinking water
Day 14-16	Newcastle Disease (Cloned La Sota)	Fine Spray (Atomist or other)
Day 18	Infectious Bursal Disease	Drinking water
Day 25	Newcastle Disease (La Sota type) (Only or if birds kept longer than 42 days)	Fine spray (Atomist or other)

Fine spray application of La Sota type vaccines may cause vaccine reactions in some flocks. A slight “snick” among the birds is normal 3 to 4 days after spray vaccination. This should be monitored and birds treated with an antibiotic through the drinking water if symptoms become more severe or there is an increase in mortality.

#### **8.5.4 Endo- and ectoparasite control methods.**

Endo- and ectoparasite treatment can be done at regular intervals, such as when cleaning out the homes between batches of hens, or when issues are noticed. Internal parasites can be detected by the presence of worms in the faeces of the birds, as well as anaemia (blood loss), poor weight increase, and poor egg production.

External parasites can be found while inspecting birds. Breakages in feathers or scales on the legs are also indicators. Severe infestations will result in lost productivity.

In South Africa, there are relatively few products that are registered for use in chickens.

Mercaptothion (Malasol) can be used to treat external parasites on chickens as well as in the environment, such as mites. Karbadust powder can also be applied to the environment and to birds.

In South Africa, piperazine powder is the sole licensed dewormer for use in poultry. Off-label use of fenbendazole (panacur Bs) in ostriches is permitted (Poultrydvm, 2021). Despite the fact that residues in meat and eggs must be regarded (European Medicines Agency, 2013).

## **8.6 CHOOSING A SOLUTION FOR YOUR AREA**

Many times, a combination of all three of the approaches described above will be required to be effective in managing diseases and pests in your region. None of the approaches will work unless you have the cooperation of your local farmers. It will take a lot of teaching and trust building to gain this support. Farmers must buy into the initiative and make it their own if it is to succeed.

## 9 CONCLUSIONS

Rising temperatures induced by climate change can have a negative impact on production, feed quality, water availability, growth, disease incidence, health, immunological functions, mortality, and reproduction rates, all of which have an impact on productivity. Hotter days imply that poultry in climate-controlled units will demand more energy (for cooling) during the production cycle, raising production costs.

Without climate-controlled units, small-holder and subsistence poultry farmers may battle to manage and sustain producing chickens at optimum temperatures, thereby compromising

the birds' health. Because of the unique and adaptive characteristics of indigenous hens, free-range indigenous chicken farming provides a potential alternative to revitalizing the faltering poultry sector.

Substantial populations of free-range poultry farming may be preferable than indoor and, in particular, cage-rearing. Improving indigenous chickens' contribution to food security is dependent, to some extent, on knowing the influence of climate change on indigenous chicken production and productivity.

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For additional resources see:

<https://www.dalrrd.gov.za/Resource-Centre?folderId=147&view=gridview&pageSize=10>.

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