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Animal Welfare Considerations in Food-Producing Animals

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Abstract

Animals play many important roles in humans' lives. They are a source of food, companionship and wealth. Increasing global demand for food has resulted in the intensification of livestock production. Intensive production systems are aimed at maximising profits by rearing more animals on smaller pieces of land in order to produce more food. The other systems of animal production are semi-intensive and extensive production systems. Of the three systems, the semi-intensive system offers the best option for enhancing animal welfare in all species. Animal welfare can be defined in many ways depending on people's views of animals. The underlying theme of animal welfare is to enhance physical and mental health of animals. Despite improvements in livestock farming techniques over the years, the welfare of farm animals remains a major concern. The major welfare concerns in the livestock industry relate to the rearing and management of dairy calves; the rearing of sows in gestation and farrowing crates; the housing of layer chickens in battery cages and the restriction of feed in broiler parent stock. Good animal husbandry is a basis for promoting the welfare of animals.

Keywords: farm animal welfare, cattle, poultry, pigs

1. Introduction

Over the years, animal production has intensified in order to meet the escalating global demand for food. As a result, many food animals are now reared in relatively small spaces where little attention is paid to their well-being. To maximise on profits, breeding schemes often place emphasis on production traits and pay little attention to other traits that are

necessary for the physical and mental well-being of animals. For example, the breeding of dairy cows over the years has produced a cow that can produce large volumes of milk but with a large pendulous udder that is prone to mastitis [1, 2].

In the modern era, the human-animal bond has become much stronger, with animals forming an important part of humans' lives. This and animal welfare training and research at universities and colleges around the world have helped to increase awareness of animal welfare in modern-day societies. Available research on animal welfare is biased towards farmed animal species due to the large populations of these animals and the high degree of public concern they raise due to their role in human lives [3].

Animal welfare is a difficult concept to define because it has no single definition. It can have multiple meanings and interpretations depending on the background and moral view of the person concerned. There are many perspectives and ethical positions on animal welfare which arise as a result of differences in values and experiences within society. Animal welfare can be defined as 'how well an animal is coping with the conditions in which it lives' [4, 5]. This is the generally accepted definition of animal welfare. In its simplified form, animal welfare is about ensuring that animals are not cruelly treated or caused unnecessary pain and suffering. It describes how well an animal is coping mentally and physically with the conditions in which it lives. In situations where animals manage with little expenditure of resources and effort, the animal's welfare status is said to be satisfactory. In other situations, animals may fail to cope with conditions in their environment resulting in a poor, negative or bad welfare status [6]. In other words, animal welfare refers to the physical and emotional state that is produced in animals by human attitudes and practices, the amount and quality of resources available to an animal and by the environment in which the animal lives. Psychological well-being is particularly important because farm animals are sentient beings, that is, they have feelings and emotions [7] and can therefore suffer psychological trauma. Good and bad experiences are an acceptable part of an animal's life as long as animals are able to adapt. However, physical and mental suffering that exceeds an animal's ability to cope should as far as possible be kept to a minimum.

The five freedoms of animal welfare [8] can be used as a framework for defining and assessing animal welfare. The five freedoms are applicable to farm animals, but require prior knowledge of species-specific wants for successful implementation. The focus of four of the five freedoms is on relieving suffering or doing away with the negative components that have the potential to impair the well-being of animals. However, one of the 'five freedoms' seeks to promote the positive aspects by advocating for animals to be provided with conditions that enable them to express normal behaviour. The 'five freedoms' are essential as a basis for preventing animal suffering and poor welfare. They have gained widespread acceptance by regulatory bodies, industry, animal advocacy groups and the World Organisation for Animal Health (OIE) and have been incorporated into many codes of practice around the world.

There is increasing recognition and awareness that animals need to experience positive emotions to have good welfare and a good quality of life. To promote positive emotions, some authors have proposed a 'sixth freedom' titled 'Freedom to undergo positive experiences' (by providing the conditions necessary to experience positive emotions such as feeling contented, pleasure, relaxed, excited) [9]. Current research is focussed at finding ways of enhancing the well-being of animals by promoting positive states rather than removing or preventing the

negative aspects. Concepts similar to the five freedoms have also been developed and amplified into a five-domain model for promoting animal welfare. The five domains include nutrition, environment, health and behaviour, as well as an overarching mental component [10].

The OIE has produced guidelines on animal welfare aimed at promoting international trade between World Trade Organisation members [5]. Although not mandatory, these standards promote and smoothen trade between OIE member states.

1.1. The five freedoms

1. Freedom from hunger and thirst by providing ready access to freshwater and an appropriate diet to maintain full health and vigour.
2. Freedom from discomfort by providing an appropriate environment including shelter and a comfortable resting area.
3. Freedom from pain, injury or disease by preventing, rapid diagnosis and treatment of diseases.
4. Freedom to express natural behaviour by providing sufficient space, proper facilities and company of the animal's own kind for social interactions.
5. Freedom from fear and distress by ensuring conditions and care which avoid mental suffering (appropriate treatment and surroundings).

The welfare status of animals is not constant. It is ever changing due to the fluctuation of the factors responsible for good or bad welfare. Therefore, the welfare status of an animal can be good, bad or somewhere in between [11] and varies with time. In general, an animal is in a good state of welfare if it is healthy, comfortable, well-nourished, free from pain, fear and distress and is able to express innate behaviour [5]. Good animal welfare requires good husbandry including disease prevention and treatment, humane handling and slaughter, and the provision of suitable nutrition and shelter [12]. Evidence that an animal has a good state of welfare includes having low levels of disease, displaying of innate behaviour, normal reproduction and living longer.

Ensuring animal welfare is a human and collective responsibility that includes consideration for all aspects of animal well-being, including proper management, housing, nutrition, disease prevention and treatment, animal care, humane handling, and, when necessary, humane euthanasia. Domesticated species have retained some of the adaptations of their ancestors, and so they need an environment which allows them to express their unique natural behaviour. Whilst not all natural processes are good for animal welfare, positive natural behaviours that enhance well-being should be promoted [9]. Poor animal welfare can manifest as high mortality rates, poor reproduction, increased incidence of disease, body damage, behaviour anomalies, heavy internal parasite and tick burdens and severe malnutrition. Human concern for animal welfare is based on the awareness that animals are sentient and that they have a valuable role in human lives. All vertebrates (mammals, birds, reptiles, amphibians and fish) are sentient in that they have the capacity to experience pain, distress, suffering, positive and negative feelings [12]. Farm animals are sentient beings, which mean they have feelings and emotions. As a result, they can suffer fear and pain, but also experience pleasure and

happiness. Animals as sentient beings have the ability to evaluate the actions of other animals in relation to themselves and to remember some of their own actions and consequences and to assess risks and benefits [7]. There is still a lack of convergence on which animals are sentient or not among researchers. Sentience is important to welfare because the animal's level of awareness and cognitive abilities influence people's attitudes and therefore their treatment of them. Sentient or not, all living organisms should be handled and treated with the utmost care until scientific evidence proves otherwise. Examples of complex abilities that highlight sentience in some farm animals are given below.

Pigs are capable of using deception [13] and knowledge held by other individuals to search for food [14].

Cattle value social interactions with other individuals [15] and have been reported to remember up to 50–70 other individuals [16].

Chickens can exercise self-control [17] and can show signs of emotional frustration [18].

1.2. Different views regarding animal welfare

Society's views of animal welfare are influenced to varying degrees by cultural beliefs and economic viewpoints. Two divergent views stand out among many—the animal welfare and animal rights standpoints. The animal welfare viewpoint advocates for the judicious use of animals by humans as long as their welfare status is satisfactory and unnecessary pain and suffering is not inflicted. Some in society disagree with the use of animals by humans. They believe that animals should be afforded basic rights so as not to be misused by humans. These are animal rights advocates who view animals as equal to humans and are against the exploitation of animals in any form. An animal rights view is an ethical position in which non-human animals are recognised as having rights that go beyond the basic animal welfare considerations. Some of these rights equate to the rights afforded to humans [19]. Although the two views are often divergent, there is some convergence in that both views seek to improve animal welfare [20]. Some of the views of animal welfare and animal rights advocates are presented in **Table 1**.

1.3. Why are we concerned about animal welfare?

Domesticated animals provide humans with benefits such as meat, milk and draught power. Just as humans expect some personal benefit from a long day of hard work, animals deserve support for the benefits they accord to humans. Therefore, humans have a moral obligation to ensure that animals have a good quality of life [11]. In food production systems, attention to animal welfare can improve productivity, quality, food safety and economic returns [21] and therefore contribute to food security and economic prosperity.

Interest in animal welfare is on the rise around the world. More attention is now placed on animal welfare in research areas, the media and in politics. Animal welfare has been on the agenda of the OIE for over a decade because of its link to animal health and food safety which are in turn linked to human health. A reduction in animal diseases is directly linked to a reduction in zoonotic diseases in humans. In some parts of the world, animal welfare now has great influence on local and international trade of animal products. A link between animal welfare and productivity is well documented. Lame dairy cows have a reduced milk

Animal welfare advocates	Animal rights advocates
Judicious use of animals for human benefit is morally right	Using animals for human benefit is morally wrong
Human interests always come first before animal interests.	Humans interests should not overrule animal interests
Humans should not cause animals unnecessary pain or death	Humans should not cause pain or death at all in animals
Treat animals as humanely as conveniently possible	Treat animals humanely always and eliminate human-made causes of animal suffering
Humane euthanasia/killing of animals	No killing of animals
Objects to cruel practices such as dog fighting, confinement of veal calves, and pregnant sows	Abolish the use of animals in any form, it is exploitation.
	Animals have the same rights as humans

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Table 1. A comparison of different views relating to animal welfare.

production and reproductive capacity [22] which reduces farm profits. The health and well-being of animals can have a direct impact on growth, reproduction or meat quality, and is therefore important to producers, food retailers, customers and others in the supply chain. For the producer in particular, adherence to animal welfare guidelines and standards can increase business profitability by improving productivity and efficiency, as well as by reducing losses [23]. In some countries, it is a legal requirement to provide for the needs of animals. The economic benefits of good animal welfare in the meat industry include [21]:

- Reduced carcass damage due to bruises and injuries.
- Lowered incidence of dark firm dry (DFD) and pale soft exudative (PSE) meat which are candidates for condemnation.
- A reduction in employee accidents during handling and stunning.
- A reduction in labour costs due to the smooth and easy movement of animals through the pens, races and restrainer
- Improved public perception of the meat industry which can serve as a marketing tool.

In this chapter, welfare concerns in farm animals specifically cattle (dairy and beef), pigs and poultry shall be discussed in light of current scientific knowledge. Due to the broad nature of the subject, only the major welfare concerns are highlighted.

2. Farm animal welfare

2.1. Animal welfare concerns on dairy cattle farms

A typical commercial dairy farm herd structure comprises of calves, heifers, cows and bulls that are reared on pastures, indoors or both. In housed systems, cattle depend entirely on

humans for feed, water and shelter. In most cases, mobility and exercise are restricted and there is limited opportunity for animals to select their diet [5]. Pasture systems provide dairy cows with some degree of autonomy over the selection of their diet, and cows have the opportunity to exercise and express some normal behaviours in the space provided. The welfare of housed cattle can generally be considered to be lower than that of animals that are kept outdoors, but this will depend on the overall quality of farm and animal management. A combination rearing system made up of both housing and pasture systems can be the best option for good animal welfare if it is combined with good farm management [5].

Good stockmanship is important for dairy cattle welfare. The stockman's knowledge, skills and attitude determine the standard of welfare on a dairy farm. Good stockmanship is the ability to identify and respond promptly to animals' needs with an attitude of empathy towards animals [23, 24]. Good animal management skills are crucial to providing an acceptable level of animal welfare. Stockman, who is knowledgeable, skilled and experienced in dairy cattle behaviour and husbandry, is an asset to the dairy farm because they can detect and correct welfare issues early [25].

There are a number of activities that are carried out on dairy farms which if not properly managed can negatively impact animal welfare. There have been improvements in some areas of the dairy cow welfare including the productive lifespan of animals, but issues related to lameness, mastitis, calf management, animal handling housing management, pain relief during surgical procedures, employee training, culling, mortality and management of downer cows remain as areas of concern [26]. According to the International Dairy Federation [25], these practices can be grouped into five action areas for the improvement of animal welfare namely stockmanship, feed and water, physical environment, husbandry practices and health management. Good dairy welfare depends on appropriate facilities design, environmental and animal management factors which include the provision of appropriate care and husbandry. Lactating cows and dairy calves are the animals most at risk of welfare problems on a dairy.

2.1.1. Environmental factors and dairy cattle welfare

Depending on climatic conditions, dairy breed and management, heat and cold stress can be a cause of poor welfare on dairy farms. Indigenous breeds are better adapted to withstand the prevailing climatic conditions and are therefore unlikely to suffer from heat or cold stress compared to exotic breeds of cattle. Environmental factors that promote heat stress are high ambient temperatures, high relative humidity, poor ventilation, high stocking rates and a lack of shade. Susceptibility to heat stress is influenced by animal-related factors such as age, breed, body condition, coat colour and density [5]. Heat stress is more of a problem in the tropical and subtropical climates. Affected cattle show a reduced feed and water intake; milk production declines; respiration rate rises; dehydration occurs and their milk production declines. Mortalities may occur in cases of exposure to prolonged high temperatures. With good management, heat stress can be anticipated or detected early. Measures for mitigating heat stress include the provision of fresh water (*ad libitum*), cooling fans, shade and reducing the stocking density especially in housed animals. Neonates and young animals are more prone to cold stress and may die as a result. Shivering and huddling are some of the indicators of cold stress [5].

Good quality air is essential for the health and welfare of confined dairy cattle. Poor ventilation and air quality due to dust particles or gases such as ammonia or hydrogen sulphide may cause respiratory discomfort and infections [5]. The design of facilities, ventilation systems and the type and management of bedding determine the quality of air in the surroundings of animals. Ammonia tends to accumulate in poorly ventilated facilities. It is produced from manure, wet bedding or straw. According to the OIE [5], ammonia levels in the animal environment should not exceed 25 ppm. The rule of thumb is that if the air quality in the environment of cows is not pleasant for humans, then it is most likely to cause respiratory discomfort in cattle as well [5].

Although dairy cattle can withstand different types and levels of noise, exposure to hissing and sudden unexpected noises can trigger stress and fear reactions. Startled animals may panic and injure themselves as they try to escape. The major sources of noise on a dairy farm are ventilation fans, alarms, feeding and other machinery. Equipment operated on a dairy farm should be sited, operated and maintained in a manner that minimises nuisance of noise to the animals. Dairy cattle also require adequate light especially those that are reared indoors. Sufficient light is necessary for animals to feed and express their natural behaviour. Adequate light also permits the inspection and detection of animals that require attention such as injured animals [5].

Resting places for dairy cows need to be well drained to permit comfortable resting. Muddy and hard concrete surfaces do not allow animals to rest comfortably. Due to the risk of pressure sores associated with concrete surfaces, bedding made from straw or other suitable soft material is appropriate. Muddy grounds expose cattle to the risk of foot rot, lameness and mastitis, factors which negatively affect cow welfare. Surfaces of raceways and grounds should be made of non-slip material to prevent claw injuries and fractures due to slipping. Uneven raceway floor surfaces discourage forward movement of cattle in races.

Poor facility and equipment design and maintenance is one of the causes of poor welfare on dairy farms. Poor operation of milking equipment especially with regard to the pressure in the milking machine can cause teat injuries. Improperly designed feeding systems can promote agonistic behaviour resulting in some cows being bullied and underfed. Milking parlours, free stalls, standings, cubicles, races, chutes and pens should be free from sharp edges and protrusions that can injure cattle. The loading facilities including the slope of ramps should permit loading with minimal stress and injury to animals [5].

2.1.2. Animal health management on a dairy farm

Disease burden is a major cause of poor welfare in animals including dairy cattle. The implementation of biosecurity measures that are commensurate with disease risk prevents the entry and spread of diseases on a dairy herd farm promoting good welfare. Biosecurity measures include fencing, controls at the entrances, disinfection procedures, quarantine and testing of new animals before they are introduced into the herd.

For effective welfare, an animal health management program which covers the diseases prevalent in a particular area including internal and external parasites is mandatory. Vaccination of dairy cattle as a preventative measure against disease should be based on expert advice taking into consideration diseases that are prevalent in an area.

Personnel responsible for cattle should be trained and skilled to detect signs of disease in a large dairy herd. Lameness, a painful condition of the legs and feet, is one of the conditions that need to be detected and treated early because of its negative effects on welfare and milk production. Lameness is a multifactorial condition that can be caused by infectious or mechanical causes. Hard surfaces including concrete floors, zero grazing and muddy surfaces are risk factors for lameness [27]. Very lame cows should be taken off hard surfaces and placed on soft surfaces such as bedded pens. A large number of lame cows in a herd are a sign of poor welfare standards on a farm [28].

Non-ambulatory cattle must be identified early and given prompt treatment to prevent further suffering. Management of non-ambulatory animals includes frequent turning of the animal to prevent pressure sores and irreversible muscle damage; the provision of water at all times and feed at least once a day; regular milking to prevent pain from engorged udders. Protection of downer cows from heat and predators is important for their survival. Non-ambulatory cattle are not to be moved except if it is absolutely necessary. If they are to be moved, utmost care should be practised using methods that avoid dragging or lifting the animal in a way that might exacerbate injuries. In cases where treatment has failed or recovery from injuries is unlikely, non-ambulatory animals should be killed on site using humane methods [5].

2.1.3. Nutrition and animal welfare

To produce large volumes of milk, dairy cows require a balanced ration that meets their physiological needs. Special attention should be paid to the quality and quantity of nutrition in the last month of pregnancy with regard to energy balance, roughage and micronutrients. If a balanced ration is not given during this period, the cows may lose body condition and succumb to periparturient diseases. Grain-based and new diets should be introduced slowly to prevent excessive engorgement which can lead to disease. Cows need to have access to palatable roughages such as silage, grass and hay *ad libitum* to promote digestion and normal rumen function. Body condition scoring can be used as tool to monitor the nutritional status of a dairy herd. Any deviation from the acceptable range of body condition score should be promptly corrected [5].

Colostrum is the first milk produced by a cow after giving birth. It contains essential nutrients and antibodies for the protection of newborn calves against diseases. Neonates have a weak immune system. Colostrum serves to provide passive protection of the calf during the period when its immune system is still developing. Management of a dairy farm should be such that all neonates receive adequate colostrum within the first 6 h of birth and not beyond 24 h because the absorption of antibodies from the gastrointestinal tract is negligible after this period. Calves that do not receive colostrum show stunted growth and are prone to respiratory, gastrointestinal and other diseases [5].

Although milk replacer is essential for the healthy growth and welfare of calves, feeding it as the sole source of nutrition after 4–6 weeks of age limits the physiological development of the rumen. Calves over 2-weeks old should have a sufficient daily ration of fibrous feed to stimulate rumen development [5].

2.1.4. The effect of the social environment on animal welfare

Cattle are social animals that show dominance hierarchies. Animal welfare issues may arise from mixing incompatible animals such as bulls. Bulls will naturally fight and injure each other and vulnerable animals such as the sick or injured, very young and very old animals. Horned and non-horned cattle should not be mixed because horned animals can inflict injuries on other animals.

2.1.5. Effect of genetic selection on animal welfare

Selection of animals during breeding should not be based on production traits alone, but also on health- and welfare-related traits [5]. The development and conservation of genetic lines of dairy cattle that reduce animal welfare problems should be encouraged during breeding programs. Examples of such traits include nutritional maintenance requirements, ease of calving, body conformation, temperament, disease resistance and heat tolerance [5]. Dystocia is a welfare risk to dairy cattle. Heifers should not be bred before they reach the stage of physical maturity sufficient to ensure the health and welfare of both dam and calf at birth. Animals observed to be having difficulty in calving should be assisted by a competent handler as soon as possible. When a caesarean section is required, it must be carried out by a competent veterinarian.

2.1.6. The welfare of dairy calves

Newborn calves are susceptible to hypothermia under cold conditions. Therefore, they should be kept warm depending on ambient temperatures. Soft, dry bedding and supplemental heat can be given to prevent cold stress.

Many strategies are used to separate or wean the calf from the cow in the dairy industry. Early separation is done within 48 h of birth, while in gradual weaning, a calf is left with the dam for a longer period. Weaning is stressful to both the calf and the cow especially when a strong bond has been developed. The stress of weaning has a negative effect on the immune system and predisposes calves to pneumonia [29]. Weaning should be made only when the ruminant digestive system has sufficiently developed to enable a calf to maintain growth, health and good welfare. On commercial dairy farms, calves are weaned from their mothers within hours of birth. This causes severe distress to both the calf and the cow, and studies have reported that this may cause long-term negative effects on the calf's physical and social development. However, it can be argued that at early separation, the cow-calf bond is not as strong as it can be.

Most bull calves have little value to a dairy farm unlike female calves that can be raised as replacement heifers. They are slaughtered or sold for veal or beef and are commonly transported over long distances at an early age exposing them to severe stress and hunger [30]. Young calves are at particular risk of thermal stress. Special attention should be paid to management of the thermal environment (e.g. provision of additional bedding, nutrition or protection to maintain warmth and appropriate growth). Individual calf-housing may

facilitate monitoring of health of very young calves and minimise the risk of disease spread. There is now a shift towards rearing calves in groups for better welfare. Calves that are reared in groups should be of similar age and physical size to prevent aggression and competition for resources such as feed. Whether they are reared individually or in groups, calves need space to turn around, rest, stand up and groom [5]. Individual housing in hutches prevents social contact, limits opportunities for movement especially if the calves are tethered. Some housing designs do not permit visual contact with other calves. In other types of housing, the calf can exit the hutch and see other calves especially where the tethering chain is longer. However, group housing can increase the incidence of infectious diseases and aggression among calves [31].

2.1.7. The welfare of dairy cows at the time of milking

Milking, whether by hand or machine, should be carried out in a calm and considerate manner in order to avoid pain and distress. Special attention should be paid to the hygiene of personnel, the udder and milking equipment. The gathering of cows from the paddocks, movement along the race, holding in pens and entering and exiting the milking shed should be carried out calmly. All cows should be checked for mastitis at milking. Milking machines, especially automated milking systems, can cause teat and udder injuries if they are not maintained and operated according to the manufacturer's recommendations. A regular milking routine should be established relevant to the stage of lactation and the capacity of the system. Special care should be paid to animals being milked for the first time. They should be familiarised with the milking facility prior to giving birth. Long waiting times before and after milking can lead to health and welfare problems (e.g. lameness, reduced time to eat). Management should ensure that waiting times are minimised [5]. Under or overmilking should be avoided as milk engorgement and overmilking are both painful [32, 33].

2.1.8. Painful husbandry procedures that can affect animal welfare

Husbandry practices such as dehorning and castration are routinely carried out in cattle for reasons of management, animal welfare and human safety. Practices that have the potential to cause pain should be performed in such a way as to minimise pain and stress to the animal. Such procedures can be performed at an early age or using anaesthesia or analgesia under the recommendation or supervision of a veterinarian. Alternatively, the painful procedure can be replaced with a non-surgical alternative or a decision can be made to use the least painful procedures [34].

Horned dairy cattle are commonly disbudded or dehorned in order to reduce animal injuries and hide damage, improve human safety, reduce damage to facilities and facilitate transport and handling. The selection of polled cattle is a preferable alternative to dehorning. Performing disbudding at an early age is preferred, rather than dehorning older cattle. Thermal cautery of the horn bud by a trained operator with proper equipment is the recommended method in order to minimise post-operative pain and promote wound healing. Disbudding should be done before the horn bud has attached to the skull to reduce pain. The use of anaesthesia and analgesia is strongly recommended when performing disbudding, and should always be used during dehorning. Other methods of disbudding include: removal of the horn buds with

a knife and the application of chemical paste to cauterise the horn buds. Where chemical paste is used, special attention should be paid to avoid chemical burns to other parts of the calf or to other calves. This method is not recommended for calves older than 2 weeks. Operators should be trained and competent in the procedure used, and be able to recognise the signs of pain and complications that may include excessive bleeding or sinus infection.

Ear-tagging, ear-notching, tattooing, branding and radio frequency identification devices (RFID) are methods of permanently identifying dairy cattle. The least invasive approach should be adopted whichever method is chosen. It should be accomplished quickly, expertly and with proper equipment. Freeze branding and hot iron branding systems should be avoided where alternative identification methods exist (e.g. ear-tags). When branding is used, the operator should be competent in procedures used and be able to recognise signs of complications.

2.1.9. Disaster preparedness and management

Plans should be in place to minimise and mitigate the effect of disasters (e.g. earthquake, fire, drought, flooding, blizzard, and hurricane). Such plans may include evacuation procedures, identifying high ground, maintaining emergency feed and water stores, destocking and humane killing when necessary.

In times of drought, animal management decisions should be made as early as possible and these should include a consideration of reducing cattle numbers. Humane killing procedures for sick or injured cattle should be part of the disaster management plan.

2.2. Animal welfare concerns on beef cattle farms

Commercial beef cattle production systems fall into one of extensive, intensive and semi-intensive systems. Animal welfare concerns of beef cattle in different production systems are similar to those of dairy cattle discussed above.

In extensive production systems, cattle are raised outdoors on pasture. Outdoor-reared cattle have the ability to choose their own diet, water, shelter and have ample space for exercise and for exhibiting their natural behaviours, which is good for their well-being. Therefore, extensive systems of production offer many advantages because they are the system that is closest to an animal's natural environment. However, the welfare status of cattle raised in extensive systems also depends on the quality and quantity of available grazing and on how farms are managed. With good management, extensive systems represent the best opportunity to provide cattle with the right conditions for their well-being. Often times however, little effort is put into the management of extensive cattle production systems, resulting in poor cattle welfare. During periods of drought, supplementary feed is required to sustain the health of animals. Due to the size of the farms, it is difficult to inspect the condition of all animals regularly. As a result, some animals may suffer or even die from injuries or dystocia because some of the farms are large. Cattle raised on pastures tend to carry heavy tick and internal parasite burdens. Often, predators have the opportunity to prey on calves and younger animals and cause distress in older animals. Other animal welfare concerns on extensive beef cattle production farms include:

- Heat stress due to lack of shade.
- Mixing of incompatible animals such as bulls which results in constant fights.
- Inadequate monitoring of calves especially for colostrum intake.
- Painful husbandry procedures such as dehorning, castration, animal identification and hot iron branding that are carried out without analgesia.

In intensive beef production systems, cattle are confined and depend entirely on humans for basic needs such as shelter, food and water. Therefore, their welfare is dependent on the quality of management on the farms. High stocking densities can reduce welfare in intensive production systems as disease risk and competition for feed are high. Due to limited space, animals are not able to exhibit some of their natural behaviours. Semi-intensive production systems are a combination of both intensive and extensive production systems. They have the advantages of both systems, and theoretically, semi-intensive systems offer the best welfare compared to the other two.

2.3. Animal welfare concerns on commercial pig production farms

Pigs are one of the first farm animal species in which the negative consequences of intensive production systems on animal welfare were described. Research indicates that pigs have high cognitive and emotional capacities [35, 36]. In the natural environment, pigs are social animals which explore their environment in search of food. In the wild, it is common to see a social group of young and adult pigs. Domesticated pigs have retained most of their ancestor's natural behaviour despite the process of domestication [37]. This means that domestic pigs have a natural urge to display these behaviours but are restricted by conditions in the environment. Many of the welfare concerns identified in the earlier years of intensification such as high stocking densities, poor ventilation, tail biting, tail docking, the use of fully slatted floors and solitary confinement of sows remain a challenge to date [36].

The primary requirement for acceptable pig welfare is the maintenance of good health, provision of adequate space and a conducive environment for animals to express their natural behaviour [36]. To promote good welfare in intensive production systems, space allowance in housing should permit animals to lie down, rest and stand up with no difficulty. Housed pigs must be able to see and have physical interaction with other pigs [36, 47]. Lack of social interaction can result in boredom and can manifest as vices such as sham-chewing and bar-biting. Intensive pig production systems prevent pigs from exhibiting behaviours such as wallowing in mud and escaping from aggressors. It has been reported that the performance of natural behaviours is associated with positive feelings in pigs. More specifically, the presence of spontaneous play behaviour in pigs has been reported to indicate a state of feeling good. Therefore, play behaviour can be used as an indicator of positive or good welfare [36]. In intensive production systems, pregnant sows are commonly confined to gestation crates for most of the 16-week gestation period. Many sows are subjected to restricted feeding regimes [36]. By nature, pigs spend a considerable time of the day foraging for a variety of different foodstuffs. By contrast, in intensive pig farming, the animals get uniform feed only once or twice a day, which limits eating behaviour to a bare minimum. Due to barren

housing conditions, including hard, often wet and slippery slatted floors, pigs generally have no opportunity to comfortably lie down or nest and are hindered in their locomotion. Poor air quality (notably high levels of ammonia) often results in ocular, olfactory and respiratory discomfort. When compared to sows kept in group housing, sows kept in stalls have been shown to spend less time resting, foraging or exploring and more time standing, drinking and engaging in repetitive abnormal behaviours such as sham-chewing and bar-biting which are indicators of poor welfare [35, 38, 39]. Pig houses should be adequately lit to stimulate normal behaviour and must have good ventilation to prevent the build-up of ammonia and heat. Noises around pig houses have been reported to cause fear and distress [36]. Gestation crates are small and narrow with bare slatted floors which expose sows to cold stress, injuries and lameness. In a gestation crate, a sow can only stand up, make a few steps forwards or backwards, but cannot turn around for the duration of its stay. This restriction of movement and the lack of exercise can lead to a reduction in muscle mass and osteoporosis which may result in frequent bone fractures. Higher rates of urinary tract infections have also been reported in confined sows, due to decreased water consumption. Although sows in stalls can see and smell adjacent sows, they suffer from psychological problems due to confinement and a lack of social interaction. As a result, the sows exhibit stereotypic behaviour such as bar-biting and sham-chewing (with nothing in their mouth). Gestation crates have been banned in many countries such as Sweden, United Kingdom and New Zealand. Other countries have reduced the time that sows spend in gestation crates or have introduced group housing to alleviate the suffering of sows. The welfare of sows in group-housing systems is highly dependent on management of the social group and on the feeding system used. Although group housing offers better welfare conditions, it has some drawbacks. For example, it is associated with a much greater risk of aggression and injury, and makes the management of individual feeding difficult. In competitive feeding systems, lower ranking sows in a group may lose body condition due to limited access to feed, while higher ranking sows may dominate the group and overfeed as a result [38, 39]. To overcome these problems, techniques for mixing and managing the nature and sizes of social groups, individual electronic sow feeders (ESFs) and individual feeding stalls that protect sows from one another during feeding have been used with success. The productivity of well-managed group-housed sows is comparable to that of sows kept in individual stalls [39, 40].

Sows are moved to farrowing crates 1 week before farrowing and stay in these crates until piglets are weaned at 3–4 months. Farrowing crates are even narrower than gestation crates, but have additional space for piglets. Bars separate a sow from the piglet area to prevent the sow from crushing the piglets. The small and narrow space of a farrowing crate makes it difficult for a sow to stand up and lie down. As a result, sows spend most of their time lying down. Although these crates protect piglets from being crushed, they seriously compromise the well-being of sows. Due to the limitation of space and other resources, sows are unable to display their natural nesting behaviour and are unable to escape from injury, pain, wet or cold floor and insects. In farrowing crates, piglets face the possibility of starvation if the sow fails to produce milk [39]. The other major welfare issues affecting piglets relate to the painful procedures that are carried out within the first week of life. Teeth clipping, tail docking and castration are routinely performed without anaesthesia and the pain seriously affects piglets as evidenced by the vocalisation.

Tail biting is one of the serious welfare problems associated with intensive pig production systems and can occur at any stage of pig growth in group-housed pigs. Pigs bite each other's tails causing damage which can result in infection which travels up the spinal cord causing spinal abscesses and abscesses in many organs including the lungs. Producers often dock the tails of piglets to reduce the incidence of tail biting. Although intended as a corrective measure, tail docking is a painful procedure that is carried out in many countries around the world. It has been reported that piglets squeal, grunt and attempt to escape during tail docking—indicating that it is a painful and uncomfortable procedure. Lack of enrichment in the pig house (and boredom) can lead to aggression and tail biting. Other risk factors for tail biting include high stocking density, compact floors with no bedding and high levels of ammonia. Many studies have reported that providing pigs with a combination of straw daily, good ventilation and mixing of sex groups can reduce the incidence of tail biting [40–42].

2.4. Animal welfare concerns on commercial broiler chicken farms

Broiler chickens are the most numerous of any farmed land animal in the world. They are raised on intensive, semi-intensive or extensive systems of production. In intensive systems, chickens are confined to a poultry house, while in extensive systems, birds are permanently confined outdoors. In semi-intensive production systems, birds are kept in a poultry house with access to an outdoor area.

One of the welfare concerns in broiler parent stock is the routine, severe feed restriction that starts at early age. If parent stocks are fed *ad libitum*, they would show health and reproductive problems due to their rapid growth rate and size. Diet restriction happens throughout the lifespan of birds, but is most severe during the rearing phase, when birds are fed about 25% of their voluntary intake. Birds that are feed restricted show signs of chronic hunger, boredom, nutritional deficiencies and abnormal behaviour such as persistent pecking at non-feed objects, pacing and aggression [43].

Broiler chickens are bred to grow fast and reach market weight in as short a time as possible. On average, the daily growth rate of broilers has doubled over the years to 59 g per day [44]. Selection for rapid growth has brought about other problems that impair the well-being of birds such as poor bone health, leg deformities, lameness, ruptured tendons and diseases such as ascites and sudden death syndrome. Due in part to genetic selection for faster growth, the rate of muscle deposition for meat in broiler chickens far exceeds the rate of development of the skeleton and cardiovascular system leading to leg deformities, lameness, heart failure locomotion problems footpad dermatitis, breast blisters, joint and skeletal disorders and lung failure [44–46]. The high muscle mass and reduced cardiovascular function in broilers also makes them less tolerant to heat stress. Broilers with leg problems are common in intensive production systems than in other systems. They often spend a lot of time lying on the floor or struggling to walk. It has also been reported that the selection for rapid growth has been at the expense of the bird's immune system, making birds more susceptible to diseases [43].

Overcrowding has the potential to cause welfare problems in chickens that are raised on litter. In overcrowded houses, birds may not reach feed and water and leg problems are prevalent due to the lack of exercise. It has also been shown that increasing chicken densities reduces the duration of preening sessions. In crowded houses, heat stress can be a problem because

more heat is dissipated by the birds than that which is lost from the house. Research has demonstrated that the health and welfare of broilers is compromised at stocking densities above the range of 34–38 kg/m² [47]. Reducing the stocking density is a reasonable means of overcoming this problem, but this may reduce profits. Heat stress can be prevented by providing fresh water *ad libitum*, improving litter quality and ventilation, and the monitoring of humidity in the house.

In crowded houses, the litter may be wet, the air humid and polluted with dust, bacteria, fungal spores and ammonia. Therefore, poor quality litter may negatively affect welfare by exposing chickens to respiratory diseases, contact dermatitis of the feet and hocks and by reducing growth rates. Good quality litter supports the legs and promotes natural behaviours like ground scratching and dust bathing which are indicators of good bird welfare [44].

Broiler chickens are reared in large groups. Any disease that arises is likely to spread within and affect the whole flock. Therefore, disease prevention and management on broiler farms is important for their welfare. The implementation of strict biosecurity measures and health management is an important part of disease prevention. Vaccination of birds against diseases prevalent in a specific geographical area is mandatory to protect the birds. Persons working with chickens need to be trained to recognise diseased birds in a flock so that treatment can be effected before the disease spreads widely [5].

A wide variety of artificial lighting regimes are used to raise broilers. A lighting schedule of 23 h of light and 1 h of darkness has been used to quicken growth. In some systems, the chickens are raised under continuous lighting. Reduced periods of darkness are detrimental to the welfare of birds as they can cause abnormal eye development [48], leg disorders, sudden death syndrome, higher mortality and ascites syndrome. A 4-h period of uninterrupted darkness per day is recommended as a minimum requirement for good welfare of chickens [49]. On the other hand, a lack of brighter lighting may result in uncomfortable, painful changes in the eye, reduced feeding activity and lower growth rates.

Free-range systems offer the potential for higher welfare than intensive systems. They offer more space, an enriched environment but slower growth rates. Birds can express their natural behaviours such as ground pecking, perching, scratching, dust-bathing and foraging [49]. Birds in free-range systems have stronger bones and less problems with pain and lameness, but are prone to predation, internal and external parasites. Semi-intensive systems offer the best of both intensive and extensive broiler management systems.

When broiler chickens have reached market weight, usually between 4 and 6 weeks of age, they are caught and placed into crates for transport to the abattoir. Birds are typically caught by the legs, inverted and carried in groups of 3–4 birds per hand to transport crates. During this process, in addition to fear and stress, leg and wing fractures may occur [50].

2.5. Animal welfare concerns on commercial egg production farms

Commercial laying hens are moved to laying farms just before they start laying eggs, between 16 and 20 weeks of age. They are typically kept until 72-weeks old, when egg production and quality decline. Most commercial laying hens are raised either in battery cages, on deep litter or on free-range systems. The traditional housing of egg-type chickens in conventional cages,

long perceived as the most efficient method of housing laying hens, is now widely considered to have a negative effect on the welfare of hens due to restrictions on bird behaviours such as wing flapping, perching, scratching, dust-bathing and nesting. Laying hens in conventional cages are generally healthy and productive, but the lack of space and barrenness of the environment significantly constrain locomotion and other motivated behaviours such as nesting and perching and leads to osteoporosis [51]. Barren battery cages were banned throughout Europe and replaced with 'furnished' battery cages that offer better welfare conditions for birds, but still restrict some natural behaviours. In addition to feeding and drinking space, battery cages now offer more useable space per bird (750 cm²), litter and facilities for perching, nesting and scratching [52]. Overcrowding in cages can lead to frustration and stress which is manifested as feather pecking and cannibalism. To prevent these vices, the birds are beak trimmed. Beak trimming is a painful procedure that hinders a hen's natural pecking behaviour and the sensory capability of the beak [48]. As a result, Sweden has banned beak trimming and many countries are expected to follow [44]. However, despite many years of research, there are no reliable methods for preventing feather pecking and cannibalism, although risk factors have been identified [53]. Due to overcrowding and the wire cage surface, caged birds are prone claw overgrowth and injuries. The lack of exercise in the cages combined with the constant demand for calcium for egg production can result in weak bones due to osteoporosis. The weak bones are painful and easily fractured during handling or when hens are startled and flap their wings. However, laying hens housed in non-cage and free-range systems have a greater risk of infectious diseases, internal and external parasites, and generally have higher rates of mortality due to disease and cannibalism than hens housed in conventional or enriched cages [54].

Deep litter systems provide the same welfare conditions as has been described for broilers. Hens have freedom and space to move around within a building. Litter is provided by using wood shavings or straw. The house is provided with perches for roosting, nest boxes, foraging and material for dust-bathing. Welfare conditions for free-range systems are as described for broiler chickens raised on the same system. Free-range systems have the potential to provide the best welfare. In these systems, hens are reared under a shed with exit holes allowing birds to access the open-air spaces covered in vegetation. The shed provides the same welfare conditions as in housed birds, while the welfare conditions in the outdoor areas are similar to those for broilers on under an extensive management system as described above. In all systems of hen production, feather pecking can be a major welfare problem.

The means of disposal of unwanted male chicks is one of the major animal welfare concerns in the commercial egg production industry. Millions of male chicks from selectively bred egg-laying strains are not suitable for meat production and so are disposed of by killing at 1–3 days old. Some of the methods used to kill the chicks are not humane. These methods include the use of mechanical apparatus that macerate the live chicks, dislocation of the neck, decapitation, suffocation or exposure to gas mixtures [44]. In the USA, maceration and gas killing are methods that are approved by the American Veterinary Medical Association [55], but the former is a method that is not aesthetically acceptable to many in society. The killing of male chicks has ethical connotations because of people's views on animal life [56].

2.6. Animal handling and the role of the stockman

The handling of animals confines and brings them much closer to humans than they would under natural conditions. This is a stressful period especially for animals that are not used to being handled. Young stock need to come into regular contact with the stockman so that they will not be too frightened when they are handled [57]. Some animals may show evidence of excitement and agitation, while in others, the mental suffering may not be evident. Dairy cattle are used to being closer to people and equipment, due to the regular milking sessions. Any infringement on dairy cattle welfare is likely to be from the poor design of the handling facilities or equipment and from inappropriate actions of stockman. Beef cattle that are reared extensively on pastures with little handling and human contact may suffer mentally during handling. Only properly trained dogs shall be used as an aid for herding animals. Animal handlers should be aware that the presence of dogs can stress and cause fear in animals and should therefore keep dogs under control at all times. The use of dogs in housed systems, collection yards, or other small enclosures where animals cannot freely escape is not recommended.

Stockman need to be well trained, competent, show empathy and have the capacity to detect animal welfare problems early and institute remedial actions in the shortest possible time. Animals in any production system need to be inspected regularly to identify any problems and situations that may compromise welfare. For example, lactating cows should be inspected at least once a day. Some animals may need to be inspected more frequently, for example, neonatal calves, cows in late gestation, newly weaned calves, cattle experiencing environmental stress and those that have undergone painful husbandry procedures or veterinary treatment [23].

A good stockman needs to be acquainted with behavioural changes that reflect poor welfare. The attitude towards animals also matters. Even trained stockman can contribute to poor animal welfare if they have negative attitudes towards animals. Welfare issues that can arise during animal handling relate to injuries such as bruises, damage to the nasal septum and bone fractures. Poorly designed handling facilities can inflict injuries to animals from sharp protrusions, fractures due to trapped legs and from slippery surfaces. Animal handling and restraint should be firm but effective. The following practices and principles help to ensure safe, humane and effective handling and restraint of all animal species on the farm:

- Design facilities as appropriate for each species—solid sides, well lit, non-slip floors and no protrusions that can cause injuries.
- Use only trained and skilled personnel to handle animals.
- Take advantage of animal behaviour by making use of the flight zone and the point of balance to move animals.
- Use an effective restraint method appropriate for each species to prevent injuries.
- Avoid shouting or making noises that excite animals.

- Move animals at their normal walking pace.
- Ensure that handling does not cause stress, pain or injury.
- Use electric prodders when necessary and only if there is space ahead for animals to move.
- Use nose rings with caution as they can damage the nasal septum of cattle.
- Do not pull animals using their appendages such as testicles, tail, horns, ears, legs and the head.
- Twisting the tail to move an animal inflicts unnecessary pain.
- Whips inflict pain and cause injuries on animals. It is advisable to use very light plastic tubing and other plastic material to move animals.

2.7. Assessment of animal welfare

Animal welfare is a science. Therefore, the assessment of the welfare status of animals should be based on objective measures and not emotions. According to Forkman and Lund [58], measures of animal welfare can be broadly categorised into management-based, resource-based and animal-based measures. Management-based measures include management routines such as the use of analgesics at dehorning, treatment with antibiotics, age at weaning or number of inspections of the herd per day. However, these measures can be difficult to measure, and in most cases, they contribute a small part to the overall animal welfare assessment protocol. Resource-based measures include the size of housing pens, provision of perching material and cleanliness of drinking water. Resource-based measures are repeatable, but are risk factors rather than actual measures of animal welfare. Animal-based measures include measures of animal behaviour, disease or injuries. These measures reflect the true experience of an animal more than the other measures. However, they require prior extensive training and at times have to be measured over a long time. The 'Five Freedoms' are an embodiment of what animals need to have a good state of welfare. They are a useful minimum checklist that can be used to assess animal welfare. Most protocols for assessing animal welfare incorporate the five freedoms. The overall goal of animal welfare assessment protocols is to aggregate information that can be used to give an overall impression of the welfare status of animals.

3. Conclusions

Commercial livestock farming is profit orientated, and as a result, it will always be associated with animal welfare infringements because it cannot replicate the natural environment. The objective of animal welfare is to promote the physical and mental health of animals and positive effects that promote well-being. It is now widely recognised that animals are sentient beings that are aware of their surroundings and can remember and suffer painful experiences. It is therefore imperative that their welfare is promoted to prevent suffering. The welfare of farm animals can be measured using the 'five freedoms' and other criteria. The welfare

status of animals can be good, poor and or be in between these two extremes depending on the management conditions to which an animal is exposed. Good welfare can be enhanced primarily by providing good management especially those aspects that facilitate the expression of innate behaviours. Good stockmanship is crucial to the success of animal welfare programmes on livestock farms. Poor animal welfare can manifest as high mortality rates, reduced reproduction, increased disease incidence, body damage, behaviour anomalies, heavy tick and internal parasite burdens. Despite advances in technology and a reasonable increase in awareness of animal welfare, the major animal welfare concerns remain in various livestock production systems. Increasing global demand for food and decreasing land area will always put pressure on the livestock industry to intensify production. The well-being of animals remains under threat.

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Conflict of interest

There are no conflicts of interest associated with this chapter.

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References

- [1] DaSilva ER, Siqueira AM, Martisn JCD, Ferreira WPB, DaSilva N. Identification and in vitro antimicrobial susceptibility of *Staphylococcus* species isolated from goat mastitis in the Northeast of Brazil. *Small Ruminant Research*. 2004;55:45-49

- [2] Oltenacu PA, Broom DM. The impact of genetic selection for increased milk on the welfare of dairy cows. *Animal Welfare*. 2010;**19**:39-49
- [3] Walker M, Díez-León M, Mason M. Animal welfare science: Recent publication trends and future research priorities. *International Journal of Comparative Psychology*. 2014;**27**:80-100
- [4] Hewson CJ. What is animal welfare? Common definitions and their practical consequences. *Canadian Veterinary Journal*. 2003;**44**:496-499
- [5] OIE. Terrestrial Animal Health Code [Internet]. Available from: <http://www.oie.int/index.php?id=169&L=0&htmfile=sommaire.htm> [Accessed: January 09, 2018]
- [6] Broom DM. Animal welfare: Concepts and measurement. *Journal of Animal Science*. 1991;**69**:4167-4175
- [7] Broom D. Sentience and animal welfare: New thoughts and controversies. Response to commentary on broom on animal welfare. *Animal Sentience*. 2016:057
- [8] FAWC. Second Report on Priorities for Research and Development in Farm Animal Welfare. London, UK: Department of Environment, Food and Rural Affairs, Farm Animal Welfare Council (FAWC); 1993
- [9] Compassion in Food Business. Welfare of the Dairy Cow [Internet]. 2013. Available from: <https://www.compassioninfoodbusiness.com/media/5822652/welfare-of-the-dairy-cow.pdf> [Accessed: January 27, 2018]
- [10] Mellor D, Beausoleil N. Extending the “five domains” model for animal welfare assessment to incorporate positive welfare states. *Animal Welfare*. 2015;**24**:241-253. DOI: 10.7120/09627286.24.3.241
- [11] Brooke. What is Animal Welfare? [Internet]. Available from: <https://www.thebrooke.org/our-work/we-work-animals/what-animal-welfare> [Accessed: January 12, 2018]
- [12] Bousfield B, Brown R. Animal welfare. *Veterinary Bulletin-Agriculture, Fisheries and Conservation*. 2010;**1**:1-12
- [13] Held S, Mendl M, Devereux C, Byrne RW. Foraging pigs alter their behavior in response to exploitation. *Animal Behavior*. 2002;**64**:157-166. DOI: 10.1006/anbe.2002.3044
- [14] Held S, Mendl M, Devereux C, Byrne RW. Social tactics of pigs in a competitive foraging task: The “informed forager paradigm”. *Animal Behavior*. 2000;**59**:569-576
- [15] Munksgaard L, Jensen MB, Pedersen LJ, Hansen SW, Matthews L. Quantifying behavioural priorities—Effects of time constraints on behavior of dairy cows, *Bos Taurus*. *Applied Animal Behaviour Science*. 2005;**92**:3-4
- [16] Fraser AF, Broom DM. *Farm Animal Behaviour and Welfare*. 3rd ed. Wallingford, Oxon: CAB International;

- [17] Abeyesinghe SM, Nicol CJ, Hartnell SJ, Wathes CM. Can domestic fowl, *Gallus gallus domesticus* show self-control? *Animal Behavior*. 2005;**70**:1-11. DOI: 10.1016/j.anbehav.2004.10.011
- [18] Zimmerman PH, Koene P, van Hooff JAR. The vocal expression of feeding motivation and frustration in the domestic laying hen, *Gallus gallus domesticus*. *Applied Animal Behaviour Science*. 2000;**69**:265-273
- [19] Regan T. *The Case for Animal Rights: Updated with a New Preface*. Berkeley/Los Angeles: University of California Press; 2004. 360p
- [20] Phillips CJC, Kluss K. Animal welfare and animal rights. In: Scannes CG, Toukhsati SR, editors. *Animals and Human Society*. 1st ed. New York: Elsevier; 2017. pp. 483-497. DOI: 10.1016/B978-0-12-805247-1.00030-7
- [21] Grandin T. The economic benefits of proper animal welfare. In: *Science Reciprocity Fair. Reciprocal Meat Conference Proceedings*; American Meat Science Association; 1995. p. 48
- [22] Rushen JD. Assessing the welfare of dairy cattle. *Journal of Applied Animal Welfare Science*. 2001;**4**:223-234. DOI: 10.1207/S15327604JAWS0403_05
- [23] International Finance Corporation. Good Practice Note. Improving Animal Welfare in Livestock Operations [Internet]. 2014. Available from: <http://www.ifc.org/wps/wcm/connect/67013c8046c48b889c6cbd9916182e35/IFC+Good+Practice+Note+Animal+Welfare+2014.pdf?MOD=AJPERES> [Accessed: January 24, 2018]
- [24] MPI. Code of Welfare: Dairy Cattle [Internet]. 2016. Available from: <http://www.mpi.govt.nz> [Accessed: January 15, 2018]
- [25] IDF. International Dairy Federation guide to good animal welfare in dairy production—2008. *Revue Scientifique et Technique*. 2009;**28**:1165-1172
- [26] FAWC. Opinion on the Welfare of the Dairy Cow. Farm Animal Welfare Council [Internet]. 2009. Available from: <http://www.fawc.org.uk> [Accessed: January 15, 2018]
- [27] von Keyserlingk MAG, Rushen J, de Passillé AM, Weary DM. Invited review: The welfare of dairy cattle—Key concepts and the role of science. *Journal of Dairy Science*. 2009;**92**:4101-4111. DOI: 10.3168/jds.2009-2326
- [28] Sadiq MBD, Ramanoon SZ, Mossadeq WMS, Mansor R, Syed-Hussain SS. Association between lameness and indicators of dairy cow welfare based on locomotion scoring, body and hock condition, leg hygiene and lying behavior. *Animals*. 2017;**7**:79. DOI: 10.3390/ani7110079
- [29] Earley B, McGee M. Managing Weaning [Internet]. Available from: <https://www.teagasc.ie/media/website/animals/beef/Managing-Weaning.pdf> [Accessed: February 13, 2018]

- [30] AVMA. Animal Welfare: What Is It? [Internet]. 2018. Available from: <https://www.avma.org/KB/Resources/Reference/AnimalWelfare/Pages/what-is-animal-welfare.aspx> [Accessed: January 29, 2018]
- [31] Costa JHC, von Keyserlingk MAG, Weary DM. Invited review: Effects of group housing of dairy calves on behaviour, cognition, performance, and health. *Journal of Dairy Science*. 2016;**99**:2453-2467
- [32] Regula GJ, Danuser B, Spycher B, Wechsler B. Health and welfare of dairy cows in different husbandry systems in Switzerland. *Preventive Veterinary Medicine*. 2004;**66**:247-264. DOI: 10.1016/j.prevetmed.2004.09.004
- [33] Taylor RE, Field TG. *Scientific Farm Animal Production*. 10th ed. England: Pearson Education Limited; 2014
- [34] Guatteo R, Levionnois O, Fournier D, Guémené D, Latouche K, Leterrier C, Morméde P, Prunier A, Serviére J, Terlouw C, Le Neindre P. Minimising pain in farm animals: The 3S approach—“Suppress, substitute, soothe”. *Animal*. 2012;**6**:1261-1274. DOI: 10.1017/S1751731112000262
- [35] Meunier-Salaün M, Edwards S, Robert S. Effect of dietary fiber on the behavior and health of the restricted fed sow. *Animal Feed Science and Technology*. 2001;**90**:53-69. DOI: 10.1016/S0377-8401(01)00196-1
- [36] Lawrence AB, Newberry RC, Špinka M. Positive welfare: What does it add to the debate over pig welfare? In: Špinka M, editor. *Advances in Pig Welfare*. 1st ed. New York: Woodhead Publishing; 2017. pp. 415-444. DOI: 10.1016/b978-0-08-101012-9.00014-9 ch15
- [37] Stolba A, Wood-Gush DGGM. The behaviour of pigs in a semi-natural environment. *Animal Production*. 1989;**48**:419-425. DOI: 10.1017/S0003356100040411
- [38] Marchant JN, Broom DM. Effects of dry sow housing conditions on muscle weight and bone strength. *Animal Science*. 1996;**62**:105-113
- [39] Bergeron R, Meunier-Salaun M, Robert S. The welfare of pregnant and lactating sows. In: Faucitano L, Schaefer AL, editors. *Welfare of Pigs from Birth to Slaughter*. Wageningen, The Netherlands: Wageningen Academic Publishers; 2008. pp. 65-95
- [40] Gonyou H, Devillers N, Faucitano L, Friendship R, Pasma T, Widowski TM, Ringnberg N. Code of Practice for the Care and Handling of Pigs: Review of Scientific Research on Priority Issues. National Farm Animal Care Council [Internet]. 2012. Available from: <https://www.nfacc.ca/codes-of-practice/pigs> [Accessed: February 21, 2018]
- [41] Hunter EJ, Jones TA, Guise HJ, Penny RHC, Hoste S. Tail biting in pigs 1: The prevalence at six UK abattoirs and the relationship of tail biting with docking, sex, and other carcass damage. *The Pig Journal*. 1999;**43**:18-32

- [42] Schroder-Pedersen DL, Simonsen HB. Tail biting in pigs. *The Veterinary Journal*. 2001;**162**:196-210. DOI: 10.1053/tvj.2001.0605
- [43] D'Eath RB, Tolkamp BJ, Kyriazakis I, Lawrence AB. Freedom from hunger and preventing obesity: The animal welfare implications of reducing food quantity or quality. *Animal Behaviour*. 2009;**77**:275-288. DOI: 10.1016/j.anbehav.2008.10.028
- [44] Thaxton YV, Christensen KD, Mench JA, Rumley ER, Daugherty C, Feinberg B, Parker M, Siegel P, Scanes CG. *Poultry Science*. 2016;**95**:2198-2207. DOI: 10.3382/ps/pew099
- [45] Olkowski AA. Pathophysiology of heart failure in broiler chickens: Structural, biochemical, and molecular characteristics. *Poultry Science*. 2007;**86**:999-1005. DOI: 10.1093/ps/86.5.999
- [46] EFSA Panel on Animal Health and Welfare (AHAW). Scientific opinion on the influence of genetic parameters on the welfare and the resistance to stress of commercial broilers. *EFSA Journal*. 2010;**8**:1666
- [47] Estevez I. Density allowances for broilers: Where to set the limits? *Poultry Science*; **86**: 1265-1272
- [48] Broom DM, Fraser AF. *Domestic Animal Behaviour and Welfare*. 5th ed. Oxfordshire: CABI; 2015
- [49] CIWF. Compassion in World Food. Welfare Sheet: Broiler Chickens [Internet]. 2013. Available from: <http://www.ciwf.org> [Accessed: January 31, 2018]
- [50] Kettlewell PJ, Mitchell MA. Catching, handling and loading of poultry for road transportation. *World's Poultry Science Journal*; **50**:54-56
- [51] Weeks CA, Nicol CJ. Behavioural needs, priorities and preferences of laying hens. *World's Poultry Science Journal*. 2006;**62**:296-307. DOI: 10.1079/WPS200598
- [52] Council of the European Union. Council Directive 1999/74/EC. *Official Journal of the European Communities*. 1999;**203**:53-57
- [53] Nicol CJ, Bestman M, Gilani A-M, de Haas EN, De Jong IC, Lambton S, Wagenaar JP, Weeks CA, Rodenburg TB. The prevention and control of feather pecking: Application to commercial systems. *World's Poultry Science Journal*. 2013;**69**:775-787. DOI: 10.1017/S0043933913000809
- [54] Lay DC, Fulton RM, Hester PY, Karcher DM, Kjaer JB, Mench JA, Mullens BA, Newberry RC, Nicol CJ, O'Sullivan NP, Porter RE. Hen welfare in different housing systems. *Poultry Science*. 2011;**90**:278-294. DOI: 10.3382/ps.2010-00962
- [55] AVMA. American Veterinary Medical Association. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition [Internet]. Available from <https://www.avma.org/KB/Policies/Documents/euthanasia.pdf> [Accessed: March 21, 2018]

- [56] Bruijnis MRNV, Blok V, Stassen EN, Gremmen HGJ. Moral “lock in” in responsible innovation: The ethical and social aspects of killing day-old chicks and its alternatives. *Journal of Agricultural and Environmental Ethics*. DOI: 10.1007/s10806-015-9566-7
- [57] de Passillé AM, Rushen J. Using automated feeders to wean calves fed large amounts of milk according to their ability to eat solid feed. *Journal of Dairy Science*. 2016;**99**:3578-3583. DOI: 10.3168/jds.2015-10259
- [58] Forkman B, Lund VP. A short introduction to animal welfare assessment. In: DCAW and NordCAW Animal Welfare Conference. DCAW—Danish Centre for Animal Welfare & NordCAW—Nordic Network for Communicating Animal Welfare; 3-4 October 2017; Copenhagen: University of Copenhagen; 2017. pp. 5-6