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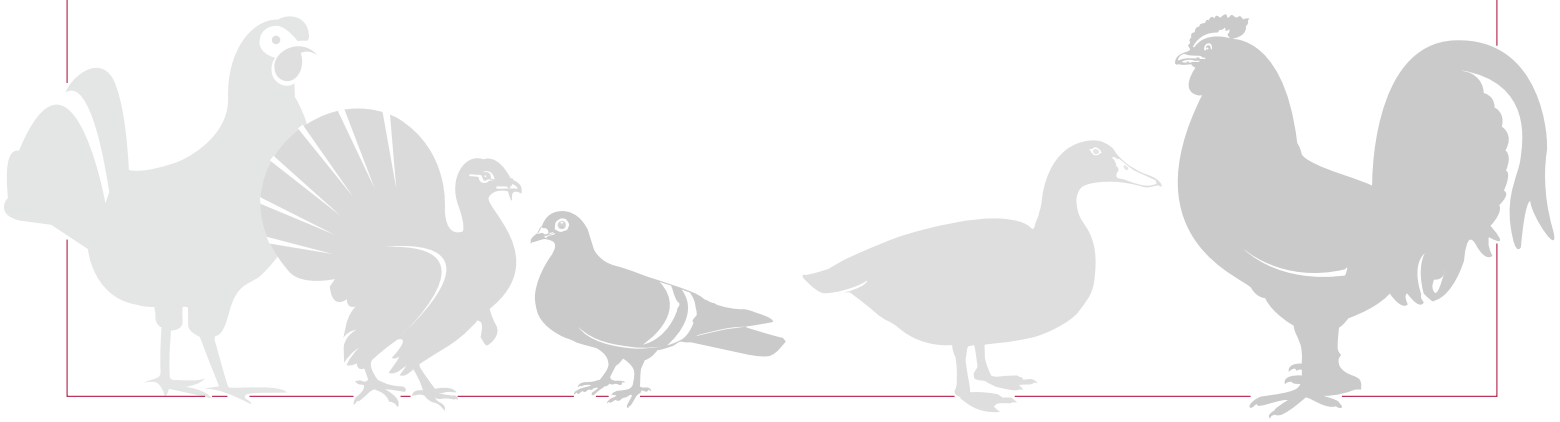

Poultry welfare in developing countries

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WHY IS POULTRY WELFARE IN DEVELOPING COUNTRIES A CONCERN?

The poultry sector is one of the most rapidly growing livestock sectors worldwide: between 1961 and 2001 the number of poultry slaughtered annually increased by 621 percent. Although industrialized countries have much higher average per capita consumption of most poultry products, production in developing countries is increasing rapidly. In 2000, Compassion in World Farming reported that average annual egg production in developing countries had increased by 331 percent since 1980.

Although chickens are very different from people, it is thought that they are capable of suffering from states such as pain or frustration. Ethical consideration therefore needs to be applied to poultry farming, and ways of ensuring good welfare for such large numbers of animals need to be found.

WHAT IS ANIMAL WELFARE?

The *Oxford English Dictionary* associates welfare with "well-being; happiness; and thriving or successful progress in life". In relation to animals, different cultures emphasize different aspects. Thus, people from different backgrounds give different relative importance to animal welfare factors such as: i) health and normal biological functioning; ii) the subjective "feelings" of the animals; and iii) the animals' ability to live a natural life (EFSA, 2005).

The World Organisation for Animal Health (OIE) definition of animal welfare refers to how well an animal is able to cope with the conditions in which it lives (www.oie.int/eng/normes/mcode/en_chapitre_1.7.1.htm). This definition, derived from Broom (1986), has widespread, but not universal, acceptance. Other authors continue to emphasize the importance of animals' feelings and experiences in their definitions of animal welfare (Phillips, 2009).

For the purposes of this review, the concept of animal welfare refers to an animal's overall state of well-being. OIE considers that good animal welfare requires disease prevention and veterinary treatment, appropriate shelter, management, nutrition, humane handling and humane slaughter/killing. In general, many different components of an animal's state must be considered to judge whether its welfare is good or bad. Some of the components that FAO considers important are that the animal should be healthy, comfortable, well nourished, and safe. It is also important that animals are able to express behaviours that are priorities in a captive environment (Weeks and Nicol, 2006) and that they should not suffer from unpleasant mental states such as pain, fear and distress (although these feelings cannot be measured directly). When considering animal welfare as a whole, it is important to take each of these components into consideration.

MEASURING ANIMAL WELFARE

The state of an animal's welfare can range from very good to very bad (Duncan and Fraser, 1997). Sometimes, however, one component of welfare is good but others are not. For example, an animal might be in good health but its ability to move may be restricted by caging or tethering. It is therefore important to be able to measure each component of welfare, and to devise ways of integrating the different measures to reach an overall conclusion.

The Five Freedoms, principles and criteria for good welfare

In the United Kingdom, the welfare of farm animals has been considered a formal discipline since 1965, when the Brambell Committee suggested that farmed animals should have five basic "freedoms" of movement, such as the freedom to stretch and the freedom to turn around. These can be considered the original components of animal welfare. However, they are rather narrow, so to take account of a broader range of animals' physical and behavioural needs, these Five Freedoms were modified in 1979 by the United Kingdom's Farm Animal Welfare Council (FAWC, 1979), which proposed that all farm animals should have:

1. freedom from hunger and thirst;
2. freedom from discomfort;
3. freedom from pain, injury and disease;
4. freedom to express normal behaviour;
5. freedom from fear and distress.

The Five Freedoms have been highly influential, and OIE accepts them as one of the guiding principles governing animal welfare. They are also referenced in most European welfare legislation, referred to by veterinary and animal welfare organizations worldwide, and form the basis for OIE Terrestrial Animal Health Code Article 7.1.1. However, they also have drawbacks. In particular, it is not easy to decide which normal or innate behaviours are important for animals in captive environments. Recently, the European Welfare Quality consortium (www.welfarequality.net/everyone) has expanded and clarified the components of animal welfare, proposing a set of four principles and 12 criteria, as shown Table 1.

Resource-based and animal-based measures

Once the principles and criteria for good welfare have been agreed, ways of measuring each criterion need to be devised. These measures can be used on farms or other livestock enterprises to assess animal welfare. Early assessments of animals on farms were made by observing whether key resources (e.g., nests or clean drinkers) were present; such measures are called resource-based measures. However, the presence of a resource does not mean necessarily mean that it is being used effectively. Recently, there has therefore been a move to make direct observations and measurements of the animals themselves, using animal-based outcome measures. This is important to ensuring the good welfare of all individual animals within a flock or herd.

TABLE 1

Welfare principles and criteria as defined by Welfare Quality

Welfare principles	Welfare criteria
Good feeding	1. Absence of prolonged hunger 2. Absence of prolonged thirst
Good housing	3. Comfort around resting 4. Thermal comfort 5. Ease of movement
Good health	6. Absence of injuries 7. Absence of disease 8. Absence of pain induced by management procedures
Appropriate behaviour	9. Expression of social behaviours 10. Expression of other behaviours 11. Good human-animal relationship 12. Positive emotional state

Much progress has been made in developing valid, repeatable animal-based outcome measures for chickens. The Welfare Quality Project has suggested appropriate measures that could be used to assess each of the 12 welfare criteria for poultry, and the majority of these are animal-based outcome measures. Thus, the absence of hunger can be measured by assessing emaciation on an agreed scale, and thermal comfort can be measured by assessing whether birds are panting or huddling. In drawing an overall conclusion about the welfare of chickens at a specific site, the measures for each criterion can be given different weights, with higher weights given to criteria that are thought to be especially important.

Scientific assessment of welfare

It is important that the measures used on farms to assess animal welfare are backed up by more fundamental scientific research, to ensure that they really do measure factors associated with quality of life. The scientific assessment of poultry welfare usually depends on measuring a range of physiological, behavioural or clinical indicators, and comparing these measurements among chickens that are housed or treated differently in some way. A broad range of indicators can be used to assess stress response and immune function in an attempt to measure whether the animal is coping with its environment or not. However, interpretation of these indicators is sometimes difficult. An alternative scientific approach has therefore been to examine the environmental conditions chosen by chickens. Early studies examined the environmental choices of chickens for food types, laying, foraging and exploratory materials, heat, lighting, and social conditions. The strength and importance of these preferences has recently been assessed by determining how hard chickens will work to obtain these resources or conditions when access becomes more difficult or demands more energy (Nicol, 2010). Important new scientific research is examining how welfare indicators and the environmental choices of chickens interrelate (Nicol *et al.*, 2009). The International Society for Applied Ethology is a scientific body with an interest in how animal behaviour can be used to assess animal welfare (www.applied-ethology.org/index.htm). Many other organizations are interested in the scientific assessment of welfare; their newsletters can be accessed via the FAO website: www.fao.org/ag/againfo/programmes/animal-welfare/en/.

INTERACTIONS BETWEEN WELFARE AND PRODUCTIVITY

It is often thought that good production will itself guarantee good welfare, but the relationship between production and welfare is more complex than this.

In the following two examples, welfare and production are positively associated:

(i) In some backyard, village environments, chickens may be able to express normal behaviour, but their overall welfare may be poor if they are affected by disease, parasitism or malnutrition. Addressing these welfare issues will also result in increased productivity.

(ii) In many cases, acute or chronically stressful events will reduce productivity. For example, moving hens from pens to cages produces a marked short-term decrease in egg production. Similarly, chronic stress can impair immune function and lead to increased disease and mortality, and reduced production.

However, in the next two examples, welfare and production are in conflict:

(i) Intense genetic selection for production traits can have adverse consequences on other aspects of bird health. For example, laying hens selected for high egg production have increased skeletal problems (see information note on "Welfare issues in commercial egg production"), and broiler chickens selected for very high growth rates have problems with leg health and lameness (see information note on "Welfare issues in commercial broiler production").

(ii) Restricting the quantity of feed fed to broiler-breeding flocks/birds is a normal management method because egg production and hatchability are poor if female breeding birds are fed *ad libitum*. However, this means that the birds experience chronic hunger (see Information note "Broilers").

SAFE-GUARDING ANIMAL WELFARE

When production gains can be achieved by improving animal welfare, as in the first two examples above, there should be no need for any other mechanism to safe-guard animal welfare; addressing issues of health or malnutrition will benefit both farmers and chickens. This is why poultry welfare is being integrated into food safety policy, based on scientific evidence that well-treated animals are generally healthier and more productive than badly treated ones (European Commission, 2002). OIE also recognizes the links between welfare and animal health and is introducing guidelines for the transport and slaughter of farmed animals. However, when increased production conflicts with good welfare, other checks and balances are required to ensure that the animals are not suffering or unduly exploited. The mechanisms available to ensure good welfare in these circumstances include the law, codes of practice and voluntary assurance schemes.

POULTRY WELFARE AND THE LAW

The extent to which poultry welfare is protected by the law varies greatly. In 2000, the European Scientific Committee on Animal Health and Animal Welfare investigated international welfare standards and found no generally recognized, specific standards worldwide. Although there appears to be little legislation in the developing world concerning the welfare of farmed animals, many other countries have laws relating to acts of cruelty to individual animals. Significant progress has been made in the last ten

years, particularly in non-European Union (EU) Europe (European Commission, 2002). Most legislation refers to the Five Freedoms (FAWC, 1979), but this may change if the expanded principles and criteria mentioned earlier become widely accepted. Increased legislation often follows increased public awareness of animal welfare issues.

There are two main approaches to introducing welfare legislation (European Commission, 2002). Binding codes are usually included within legislation, and it is a legal requirement to conform. An example of binding legislation in the EU is the Laying Hens Directive (1999). As part of an interim review of the scientific evidence required before adoption of the legislation, the European Food Safety Authority (EFSA, 2005) produced an opinion on the welfare aspects of all housing systems used for laying hens. Following this, the LayWel project, funded via the European Commission's Sixth Framework Programme and national funding from several EU countries, studied the welfare implications of different poultry farming systems. The scientific opinion derived from both these exercises provided the basis for banning conventional cages, summarizing evidence that conventional cages do not allow hens to fulfil behaviour priorities, and present a significant threat to the birds' skeletal health. The EU ban on conventional cages is scheduled to take effect from 1 January 2012. From that date, all cages must contain enrichment (furnishings to assist the birds in performing natural behaviours), such as an area for dust-bathing, and perches. The EU has also introduced a Broiler Directive (2007), which limits the stocking density at which poultry may be kept for meat production. Farmers will be able to keep broiler chickens at higher densities only when high welfare is exhibited and proved. This is likely to be assessed by looking at animal-based outcome measures such as mortality.

CODES OF PRACTICE

Non-binding codes of practice can be used alongside the law. Codes of practice establish recommendations for good practice as followed by competent and conscientious practitioners. Codes of practice can be particularly useful if they set out clearly what farmers *must* do to ensure good welfare (minimum standards), and what they can do further to optimize welfare.

SELF-IMPOSED CODES/ASSURANCE SCHEMES

In many countries, there are voluntary schemes for certifying that farm animals have been kept at specified welfare standards. Self-imposed codes are voluntary, but producers conform as they are likely to offer a marketing advantage. Examples include farm assurance schemes, which are common in Europe. They have been introduced in response to consumer demands that animal products satisfy certain safety, environmental and welfare standards.

HOUSING AND MANAGEMENT OF POULTRY

In developing countries, the majority of poultry are indigenous breeds, kept in small flocks living in a backyard, village environment. Gueye (1998) reports that approximately 80 percent of poultry in Africa can be found in traditional production systems. In these systems, birds are generally free-ranging and often scavenge or are fed household scraps. In this type of poultry production system there is no real distinction between birds reared for meat and those kept as egg layers. Poultry meat is typically obtained from males killed at between 12 and 20 weeks of age, and from egg laying birds that have ceased to be productive.

Many developing countries are now investing heavily in more intensive commercial systems of poultry production to provide meat and eggs for growing urban and peri-urban populations. In these systems, egg laying hens and broiler meat chickens are genetically very different from each other and from the indigenous breeds kept in small family flocks by villagers in rural areas, and are kept and managed differently.

Intensive broiler production systems obtain chicks from commercial hatcheries, and then house them in flocks in floor-based systems until they reach slaughter weight, when they are caught, transported and slaughtered at a specialized abattoir. Intensive egg production systems also obtain chicks from commercial hatcheries, but these chicks are usually kept in large rearing flocks until they reach sexual maturity and start to produce eggs. At point of lay, the pullets are transported to the adult housing system, which contains egg-handling facilities. A great range of adult housing systems exists, including conventional cage, furnished cage, single-tier aviary, multi-tier indoor, and free-range (described in www. laywel.eu). At the end of the commercial laying period, generally at around 18 to 24 months of age, these birds are caught, transported and slaughtered in specialized facilities.

MAJOR WELFARE ISSUES

Poultry welfare is affected by genetics, by the hatching, rearing and adult housing environments, by the methods of transport and slaughter employed, and to a great degree by the attitudes and standards of care of the stockpersons.

Welfare issues in a village environment

In the village environment, birds are mainly indigenous breeds, which are generally better able to cope with the natural environment than those breeds that have undergone extensive genetic selection for production traits. However, disease transmission is high in backyard poultry systems, often resulting in low productivity and high mortality. Newcastle disease is one of the most problematic and widespread diseases in both village and intensive production systems. Vaccines have been developed, but not all farmers have access to them, and vaccinating free-ranging poultry can be a challenge (FAO, 2001).

Another challenge facing small-scale poultry producers in developing countries is the availability of appropriate nutrition. Many smallholder farmers and their families have limited food, and are thus unable to provide feed for their small scavenging chicken flocks. Poultry frequently also lack access to a source of clean and cool water. This is a welfare concern for the poultry and for the people rearing them, as productivity will be low. In hot climates, birds may have difficulty staying cool if natural or artificial shelter is not provided, as all chickens are derived from jungle-living birds and they actively seek shade.

Most of these welfare issues can be addressed by improved veterinary care and nutrition and the provision of simple facilities such as clean drinking-water and shade.

Welfare issues of broilers in commercial production

The major welfare issues for commercially reared broilers are leg

health problems and lameness, metabolic disorders, and hunger in restricted-fed broiler breeder flocks.

Welfare issues of laying hens in commercial production

The major welfare issues for commercially reared laying hens are bone problems such as osteoporosis and the high incidence of resultant bone fracture, behavioural deprivation resulting from housing in cage systems, unequal access to facilities for birds housed in non-cage systems, and injurious pecking and plumage loss, which occurs in all types of housing system.

Welfare issues during transport and slaughter

The major welfare issues arising during transport and slaughter are high levels of stress due to inappropriate handling, and pain and stress if birds are not properly stunned before slaughter.

BENEFITS OF IMPROVING ANIMAL WELFARE

FAO recognizes the importance of animal welfare practices that lead to benefits for both people and their animals, and supports their implementation, recognizing that the welfare of humans and the welfare of animals are closely linked: www.fao.org/ag/againfo/resources/en/pubs_awelf.html

Consumer acceptance

Throughout the world, people are becoming increasingly aware of the importance of farmed animals' welfare (European Commission, 2002). Consumers are interested in the origin of their poultry products, and surveys such as Euro-barometer show that most people believe that the broiler and laying hen industries need to improve the current level of bird welfare:

http://ec.europa.eu/food/animal/welfare/survey/sp_barometer_fa_en.pdf.

Consumers' perception of animal welfare can affect the type of products purchased; 43 percent of consumers say that they consider the welfare and protection of meat animals before they make a purchase.

Access to markets

At present, the World Trade Organization (WTO) operates a free-trade policy and will not allow countries to restrict trade because of differing standards of animal welfare. This is becoming a concern within the EU, however, where there are guidelines relating to animal welfare to which farmers must conform. The EU is pushing for welfare to be included in the WTO multi-lateral trade negotiations. If this happens, imported products will have to meet basic EU standards to enter this market.

Employment

Improvements in animal welfare can create work in countries where employment is difficult to find. It is particularly important that intensification is coupled with increased labour, as one of the best ways of raising animal welfare standards is to improve inspection and handling practices. Intensification without increased labour may result in welfare problems being overlooked. In many developing countries, poultry are raised by women and children. Learning how to raise poultry to optimal welfare standards can help women to improve their productivity, and may help alleviate poverty. Organizations such as the International Network for Family Poultry Development and the Network for Small-holder Poultry Development are helping village women to make their poultry enterprises more productive, efficient and profitable. This has a positive impact on the empowerment of women and provides them with social contact both within and outside the village.

The model farm project set up by the World Society for the Protection of Animals and the Food Animal Initiative also aims to help farmers in developing countries to rear their animals in ways that will provide them with optimal economic outputs. A number of farms have been set up in China, where high-welfare animals are reared to organic standards and receive a premium when sold. The farms provide training for producers and exemplify a viable alternative to intensive farming.

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Welfare issues in commercial egg production

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This information note considers aspects of welfare that have been highlighted as concerns within commercial egg production (Perry, 2004; EFSA, 2005; LayWel, 2006). First some issues affecting chicks and growing pullets are mentioned, before discussing the most significant issues facing adult laying hens.

CHICKS AND PULLETS

Disposal of male chicks

When chicks are hatched for egg production, only females are needed. Male layer strain chicks have no commercial value, which means that 50 percent of the chicks hatched have to be killed. Their disposal raises practical and ethical issues. Methods of disposal vary from region to region and country to country. In all cases, the aim should be to ensure that every male chick is killed humanely and instantaneously.

Chick handling

Whether chicks are to be reared for meat or egg production, it is important that they are handled with care in the hatchery. After being taken from the hatching trays by hand, chicks may either be sexed and sorted manually, or placed on a conveyor from which the males (often with different sex linked feathering rate or feather colour) are removed for slaughter. The female chicks are then placed in disposable chick boxes with perforated ventilation holes, for transport to the rearing houses.

Variation in chick or pullet sizes

The aim of the hatcheries and farms that supply pullets should be to produce birds of even body-weight and size. Variation in size can result in later problems of aggression, poor performance and injurious pecking.

LAYING HENS

Osteoporosis

Osteoporosis in laying hens is a major welfare concern. It is the progressive loss of structural bone throughout the skeleton, which results in weakened bones. Weakened bones can lead to a high number of birds suffering keel, leg and wing fractures, which are likely to be painful. Osteoporosis can also cause birds to become paralysed, which can lead to death. Loss of structural bone in hens begins around sexual maturity and continues throughout the laying period. The process is accelerated in caged systems, which prevent birds from exercising. Fleming *et al*. (2006) found significant improvements in bone strength when birds were housed in aviaries, rather than battery cages. Nutrition also appears to affect bone strength, and the effects of osteoporosis can be minimized by providing sufficient calcium, phosphorus and vitamin D in the diet. Another contributor to the severity of osteoporosis is genotype. Some genetic strains appear to be more susceptible to osteoporosis than others. It has been suggested that it is possible to select genetically against osteoporosis while still maintaining a high egg yield, but this has not been attempted on a commercial scale.

Keel fractures

One consequence of osteoporosis is that it greatly increases the susceptibility of bones to damage and fracture. In laying hens, the bone most likely to sustain a fracture is the keel bone, which can be damaged in two main ways: i) by misjudged landings when birds are perching or nesting in a furnished environment; or ii) when birds are handled during depopulation at the end of lay. The incidence of keel fractures caused by furnishings is higher in non-cage systems than in cage systems. In free-range and single-tier aviary systems (barns), the mean prevalence of bone breakages is 65 percent, 90 percent of which are keel bone breaks (Wilkins *et al*., 2004). These findings are of particular importance in the EU, where conventional cages are being banned in 2012. However, the incidence of new breaks – those caused during depopulation – is higher in conventional cage systems than in other systems. This may be attributed to weaker bones in caged birds, due to lack of exercise. Access to the birds within the cage (i.e., the size of the aperture) and the manner in which the birds are withdrawn from the cage during depopulation are critical factors in determining bone breakages.

Behavioural restriction

In 1999, the EU introduced the Laying Hens Directive, stating that all hens must be housed in an enriched environment from 2012 onwards. This has involved the introduction of furnished cages, which will replace conventional caged systems. Furnished cages will provide birds with a nest, perches and pecking/scratching mats. A recent study comparing the physical and physiological condition of birds in four different housing systems for layers in the United Kingdom concluded that these aspects of bird welfare are better in furnished cages than in any other system (Sherwin, Richards and Nicol, 2010)

The importance of providing nests, perches and pecking areas stems from the natural behaviour of chickens. In the wild, poultry have the ability to build nests, scratch and peck, dust-bath and perch. These are all behaviours that have not been lost through genetic modification of poultry breeds and they are still important for good welfare of modern-day laying hen (Weeks and Nicol, 2006). In conventional cages, it is virtually impossible for hens to perform these behaviours. Hens also need at least 600 cm^2

each to be able to stretch their wings and perform other comfort movements. Furnished cages do not allow birds total behavioural freedom, but they do allow birds to perform their most important behaviours to a degree not possible in conventional cages.

Non-cage systems permit even greater freedom of behaviour for the majority of birds in a flock. In large flocks of hens, however, some birds' access to facilities such as nests and perches is restricted by other birds, and aggression can be common. A small proportion of birds in non-cage systems can be excessively persecuted by their flock-mates. These so-called "pariah" birds have extremely poor welfare.

INJURIOUS PECKING

Injurious pecking in laying hens is a major welfare concern that can spread through flocks, resulting in pain and high mortality. Injurious pecking can occur in all types of layer hen housing. In cage systems persecuted birds are unable to escape, but the problem tends to be confined to particular cages. In non-cage systems, once injurious pecking starts it can spread rapidly throughout the whole flock. Injurious pecking comprises feather pecking, vent pecking and cannibalism.

Feather pecking

Gentle feather pecking occurs when one hen pecks at the feathers of another, without pulling or removing the feathers. Severe feather pecking occurs when feathers are pulled violently or removed. The relationship between these two types of feather pecking is not clear, and they appear to have distinct risk factors. There may be a number of reasons for the onset of feather pecking, including deprivation of natural behaviours such as ground pecking (Rodenburg and Koene, 2004). The inability to perform behaviours can lead to long-term frustration, which may result in arousal, aggression or fear. Any of these emotional states may increase the likelihood that a hen will start feather pecking. There are clear genetic influences on feather pecking (Rodenburg *et al.*, 2008), and epidemiological studies have identified a range of important environmental risk factors. Bald patches on hens, where feathers have been removed, encourage further pecking of exposed body tissue. This has an economic impact on production, as birds lose energy and heat and therefore consume more food. Feather pecking is likely to be very painful for the affected hens, and may lead to cannibalism. The risks of feather pecking can be reduced by feeding mash rather than pelleted diets; providing additional foraging and fibre sources, such as chopped straw and vegetables; and ensuring good litter condition, to encourage birds to peck the litter rather than each other. Reducing light intensity is a short-term measure that does not address the cause of the problem.

Cannibalism

Cannibalism occurs when the flesh or blood of another individual of the same species is consumed. It is a common problem in poultry, particularly laying hens (Newberry, 2004). Cannibalistic behaviour may be learned by hens, and the problem can spread rapidly throughout a flock. Cannibalism can arise as a result of severe feather or vent pecking, which often occurs due to frustration. Producers have attempted to reduce the incidence of feather pecking and cannibalism by beak trimming, which involves removal of up to two-thirds of the upper beak. This process is likely to cause pain, and does not combat the root of the problem. Some producers raise birds at low light intensities so they do not have the visibility to perform cannibalism. This has not been effective however, as the increased light levels needed to inspect birds are associated with cannibalism. Beak trimming has been banned in a number of countries, so an alternative is needed. Providing birds with enrichment, such as litter to peck at, may reduce frustration. It is also important to provide pullets with litter in their rearing environment. Cannibalism is also positively correlated with mineral, protein and energy deficiencies, so providing all nutritional requirements may reduce cannibalism. Selection of genetic strains that are not predisposed to cannibalism should also be encouraged.

Vent pecking

As with feather pecking, vent pecking can lead to cannibalism. Vent pecking is directed at the tissue around the cloaca (see photo).

This may be investigative behaviour to begin with, but once established can lead to birds pecking at internal organs or tissue. The result is often death. It is therefore advantageous to prevent birds from viewing the cloacal areas of other birds, by ensuring that nesting areas are not brightly lit and that there are sensible perch arrangements. It is also important not to bring the flock into lay too early – vent pecking can be triggered when small birds are encouraged to lay large eggs too early.

Emaciation

The metabolic demands of high egg production are great, and by the end of lay many hens show signs of emaciation, poor body condition and chronic stress. This can be minimized by ensuring that a good diet with adequate levels of nutrition is supplied towards the end of the laying period.

AVOIDING WELFARE PROBLEMS IN HENS

Several sources provide advice on avoiding welfare problems in layers. These include national government codes of practice, such

Varying severity of vent damage in laying hens

as the United Kingdom's Department for Environment, Food and Rural Affairs (DEFRA) code www.defra.gov.uk/corporate/consult/broiler-welfare/annex-g.pdf, and assurance schemes guidance, such as the Royal Society for the Prevention of Cruelty to Animals (RSPCA) Freedom Food scheme, which details and specifies high standards of management and provision: www.rspca.org.uk/servlet/Satellite?pagename=RSPCA/RSPCARedirect&pg=welfarestandards&marker=1&articleId=1123153964606.

The following are some important practical tips for avoiding welfare problems:

- Avoid conventional unfurnished cages, as these cannot provide good welfare for laying hens.
- If using a cage system, use furnished cages with at least 600 cm^2 of floor area per bird and a nest area. Manufacturers of furnished cage systems are listed in the LayWel project description of laying systems: www.laywel.eu/web/pdf/deliverable%2023.pdf.
- Produce plans for preventing or coping with emergencies such as equipment breakdown or fire.
- Inspect flocks at least twice a day and check individual birds, even in cage systems where it can be difficult to observe individual birds at the back of a cage. At monthly intervals, catch samples of birds to look more closely for problems such as mite infestations or vent pecking.
- Keep good records of mortality and the causes of mortality. Record spontaneous mortality separately from culling figures.
- Seek veterinary advice if birds show signs of sickness. There are many links between poor welfare and poor health/disease. Improving one can often improve the other.
- If possible, obtain birds from rearing units close to the laying farm, as this will minimize stress during transfer. The new laying flock will settle more easily and early egg production is likely to be improved.
- Do not bring the flock into lay too early. Onset of lay at 17 or 18 weeks is associated with a greater risk of vent pecking than onset of lay at 19 weeks.
- Do not place perches at heights that permit one bird to peck another bird's vent.
- The use of mash rather than pelleted feed allows the hens to spend a longer time feeding, and reduces the risk of injurious pecking.
- The provision of good, dry litter to a depth of at least 10 cm is vital for the good management of hens in non-cage systems.
- For birds in non-cage systems, provide a raised slatted or wire mesh area separate from the litter area. Do not provide high perches, which are associated with "crash-landings" and subsequent bone fractures.
- In non-cage flocks, the risk of injurious pecking can be reduced by ensuring that the litter area is kept dry and friable. Add fresh litter regularly and, if possible, provide hens with additional pecking materials, such as straw or other dry vegetation.
- If the birds have access to an outdoor range area, encourage them to go outside as much as possible, by providing areas of shelter (from sun or rain) on the range. This reduces the risk of injurious pecking in the flock.
- Birds should have at least eight hours of light and at least six hours of dark in every 24-hour period, and light levels should not be less than 10 lux. In non-cage systems, consider providing brighter light over the litter areas, to encourage birds to forage and dust-bath, and lower light levels near the nest boxes and perches, to reduce the risk of vent pecking.

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Welfare issues in commercial broiler production

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This information note considers three aspects of welfare that have been highlighted as concerns within commercial broiler production (Weeks and Butterworth, 2004): leg health, metabolic disorders, and hunger in breeding birds. General issues of health and disease are considered elsewhere (see review on Poultry Health and Disease Control in Developing Countries).

LEG HEALTH

The incidence of leg disorders is a major issue in broiler production and often leads to lameness. The most recent large-scale study in the United Kingdom found that 27.6 percent of the birds assessed close to slaughter age showed poor locomotion, and 3.3 percent were almost unable to walk (Knowles *et al*., 2008). These figures arose even though the participating farms had good culling procedures, with severely lame birds identified and killed humanely to avoid further suffering. A similarly high prevalence of lameness has been found in other studies around the world over the past 15 years. Assuming the worldwide prevalence of leg disorders is similar to that in the United Kingdom this equates to 12.5 billion broilers experiencing leg problems worldwide per year. Although breeding companies are directing far more attention and resources to finding ways of selecting against leg disorders, negative correlations with meat yield can sometimes hinder progress.

There are several causes of lameness in broiler chickens, broadly divided into infectious and developmental causes, although the two are interrelated. One of the main factors contributing to both types of leg problems is genotype. Through intensification of production and genetic selection over the last 50 years, broiler growth rates have increased from 25 g per day to 100 g per day – a 300 percent increase. Owing to the rapid growth of broiler chickens, it is possible for them to reach slaughter weight at less than 40 days of age. The problem is that this rapid growth places stress on the skeleton, resulting in skeletal abnormalities. Rapid growth can result in valgus varus deformation, ruptured tendons, separation of the proximal epiphysis, bending and rotation of the tibia, osteochondrosis, degenerative bone disease and microfractures. It has also been demonstrated experimentally that rapid growth increases the risk of a range of infectious leg conditions including arthritis and tenosynovitis. Generally, the risk of lameness increases rapidly with bird age, up to the point of slaughter. The innervation of chicken legs is similar to that in humans, so leg disorders may be painful to poultry (European Commission, 2000) and some causes of lameness may be associated with more pain than others. When birds are given analgesic (pain-killing) drugs, their walking ability generally improves. In addition, one study showed that lame birds preferentially select food containing an analgesic drug, a feeding pattern not observed in non-lame birds, which suggests that birds might actively seek to control their own pain levels.

Environmental and management factors that increase the risk of chickens developing lameness include diet, lighting regime and antibiotic use (Knowles *et al*., 2008). It is also generally accepted that stocking density has an effect on lameness, although there is conflicting evidence. Dawkins, Donnelly and Jones (2004) report that other environmental and management factors such as air and litter quality within the house may have more of an effect on bird welfare than stocking density. Nonetheless, high stocking density does seem to exacerbate other welfare problems, and the EU Broiler Directive (2007) sets limits on stocking density for farms where leg health problems are apparent.

Lameness is not the only leg problem affecting broiler chickens. Contact dermatitis (pododermatitis) appears to be increasing in prevalence in some countries. Signs of contact dermatitis include the appearance of lesions, ulcers or scabs on the footpads (see photo), hocks or breast. In severe cases, extensive areas of skin may turn black. This results from these parts of the birds' bodies being in prolonged contact with irritant substances derived from faeces, such as ammonia. Lesions can act as a gateway for bacteria, which may spread through the bloodstream and cause joint inflammation.

METABOLIC DISORDERS

There are a number of problems associated with poultry metabolism, and they often have a genetic cause. The major issues result from a very high metabolic rate, efficient feed conversion and rapid growth. Rapid growth places pressure on poultry's internal organs. This can lead to cardiovascular diseases, the most prevalent of which are ascites and sudden death syndrome. Ascites is the accumulation of fluid in the lungs and abdomen caused by

Varying severity of footpad dermatitis in broiler chickens

deficiency of the cardio-pulmonary system in adequately oxygenating the blood pumped through the large muscle mass of the modern-day broiler chicken. This can result in right-side ventricular failure. The condition appears to be more prevalent at high altitudes, although it affects birds worldwide. In 1996, a worldwide survey estimated the incidence of ascites in broilers to be approximately 4.7 percent. Selection based on oximetry or serum levels of cardiac-derived Troponin-T has reduced the incidence of ascites in broiler flocks in recent years, but it is still an important cause of loss, accounting for up to 50 percent of total mortality in commercial flocks of birds reared to 42 days.

HUNGER IN BROILER BREEDERS

When considering the welfare of broilers it is important to consider all stages of production. The welfare of broiler breeders is often compromised by routine feed restriction. To compensate for the negative effect of selection for growth rate on reproductive performance, food is restricted during both the rearing and the laying phases to prevent birds from becoming too fat and heavy, which would compromise egg production and fertility. These birds are almost certainly experiencing extreme hunger, at least during the rearing phase, when they are often given less than half of their voluntary food intake

AVOIDING WELFARE PROBLEMS IN BROILERS

Several sources provide advice on avoiding welfare problems in broilers. These include national government codes of practice, such as the United Kingdom's Department for Environment, Food and Rural Affairs (DEFRA) code www.defra.gov.uk/corporate/consult/broiler-welfare/annex-g.pdf, and assurance schemes guidance, such as the Royal Society for the Prevention of Cruelty to Animals (RSPCA) Freedom Food scheme, which details and specifies high standards of management and provision (www.rspca.org.uk/servlet/Satellite?pagename=RSPCA/RSPCARedirect&pg=welfarestandards&marker=1&articleId=1121442811407).

The following are some important practical tips for avoiding welfare problems:

- Demand good stock from hatcheries, and contact the breeding companies if leg health problems are experienced.
- Produce plans for preventing or coping with emergencies such as equipment breakdown or fire.
- Inspect flocks at least twice a day, and check individual birds. Check that all birds can move freely with gait scores of less than 3 (gait scores are described in Knowles *et al*., 2008).
- Check that there are no signs of breast or leg lesions. Such symptoms are usually associated with wet and dirty litter. If lesions are apparent, take steps to improve litter condition and ventilation.
- Keep basic records detailing the number of birds in the house, maximum and minimum temperatures, etc.
- Keep good records of mortality and the causes of mortality. Record spontaneous mortality separately from culling figures.
- Birds that cannot move sufficiently well to have easy access to feed and water should be culled, as they are unlikely to recover and culling will prevent them from experiencing further suffering.
- Manage the litter, keeping it as dry and friable as possible. Do not allow ammonia levels to rise too high. Consider topping up the litter frequently, to allow birds to rest and dust-bath and to minimize the risk of skin lesions and ulcers.
- Avoid high stocking densities, as these are associated with depressed health and welfare.
- Providing perches at a height of 10 to 30 cm above the floor can improve leg health. Allow a minimum of 2 m of perch length per 1 000 birds.
- Average growth rates of more than 45 g per day from hatch to slaughter may be associated with welfare problems.
- Ensure that birds have a period of darkness in each 24-hour period, to allow them to rest.
- Make sure that wild birds, cats, dogs or rodents cannot enter the chicken house.
- Check for the appearance of panting, which may indicate that the birds are too hot. Good ventilation is essential. In hot climates, consider roof insulation as a way of reducing the impact on birds.
- Ensure that the house is thoroughly cleaned and disinfected between flocks.

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Transport and slaughter of poultry

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DEPOPULATION

In the village environment, birds may be reared in small numbers and slaughtered as and when they are needed for food. In some ways, this system is better for welfare, as it does not require large-scale depopulation and transport. Birds can usually be caught from their night-time enclosures.

Depopulation on a larger-scale usually takes place during the night, when birds are easier to catch and therefore do not become as stressed by the process. Most large producers are responsible for providing both the catching team and the transportation for the birds. Catching teams are required to grasp large numbers of birds quickly and efficiently. Unfortunately, this often involves handling them incorrectly. The preferable method for handling chickens is to catch both legs simultaneously, to avoid hip dislocations and broken bones. However, owing to the speed at which the catching team works, it is usual for only one leg to be caught, which often results in painful leg dislocations. Birds are usually inverted when caught, so that many may be held in each hand simultaneously. This does not provide optimal bird welfare, as birds prefer to be held upright. These processes are likely to cause pain (Weeks, 2007) to the birds, so it is important that they are handled as carefully as possible to minimize the risk of damage.

Techniques are being developed for avoiding excessive handling of birds during depopulation. Automated "broiler harvesters" are large machines that depopulate broiler houses rapidly, by picking up chickens using revolving rubber fingers. Trials have demonstrated that they may halve the risk of catching damage to the legs (Weeks, 2007), but they can only be used in large clear-span houses. Similar good results can be achieved if birds are caught using gentle and correct handling techniques.

Cage systems for laying hens present special problems during depopulation, and injury and damage levels can be high, as birds have to be removed from the cage fronts. In the EU, attempts have been made to improve cage design so that birds can be removed more easily through the whole cage front, rather than through narrow gaps; this has resulted in a reduced incidence of broken bones sustained at the end of lay.

TRANSPORT

In developing countries, there are three main methods for slaughtering birds. The system in which they are reared determines whether and how they will be transported. Backyard village poultry are often slaughtered by their keepers, within the home environment, which does not require transportation. Larger producers however transport birds to either a "wet" market or a commercial abattoir. The range of transportation to each varies among countries and regions. In general, birds that are slaughtered in abattoirs are transported from the farm in large loose-crates or on modulated lorries, similar to those used in the EU. The stocking density is usually very high, as few legal guidelines exist. This poses a problem, particularly in very hot countries, where many birds may die of heat stress. A major welfare issue with this method of transport is the movement of birds from a controlled (relatively stable) environment to a lorry, which may provide birds with little protection from extreme climates.

In many developing countries, there is demand for fresh meat, and animals are often killed at markets in the presence of the consumer. Worldwide, billions of people buy their poultry at "wet" markets, many of which are unlicensed. Birds are often transported under stressful conditions. Small producers may utilize what little transport they have by tying poultry to the back of their bicycles or motorcycles, often in an inverted position, thus causing a high degree of stress.

SLAUGHTER

In large commercial abattoirs, chickens are generally stunned before being slaughtered. A stunning process causes immediate loss of consciousness, which lasts until death. Stunning in poultry is usually performed by passing an electric current across the brain, disrupting normal electrical activity and causing a loss of consciousness (HSA, no date). This enables them to be killed without feeling the pain associated with the slaughter process.

In large abattoirs, poultry arrive on lorries and are often kept in a lairage (holding area) before being killed. In extreme climates, this can be very stressful as birds are densely stocked and unable to cool themselves. Many birds may die before reaching the slaughter line, often through heat stress. Not only is this bad for

Highly stressfull transport of chickens

the welfare of the birds, the economic loss can also be extreme.

Unloading takes place directly from modular or loose crates. Birds are inverted and hung on shackles by their legs. This is likely to cause pain, particularly for large birds, as the shackles are one-size and do not accommodate variations in bird leg size and shape. The shackles carry birds through an electrically charged water-bath stunner. It is essential that the stunner is monitored to ensure that it delivers enough electricity through the brain of each bird. Birds should be observed for the following signs of effective stunning: neck arched and eyes open; no rhythmic breathing; rigidly extended legs; constant rapid body tremors; and wings held close to the body (HSA, no date).

Following stunning, birds may regain consciousness if the brain has not been properly disabled. This makes it essential that birds are bled (by cutting the blood vessels in the neck) within 15 seconds after stunning. In the United Kingdom, it is a legislative requirement that at least one carotid artery is severed during neck-cutting. However, it is recommended that both carotid arteries and both jugular veins are severed, as death then occurs more rapidly.

SLAUGHTER OF VILLAGE POULTRY

In a village environment, poultry that are not transported to be sold at wet markets are likely to be slaughtered on demand within the village. It is likely that only a few birds will be slaughtered at a time, giving the slaughterer plenty of time to ensure that each bird is killed humanely. In wet markets, however, less time may be taken over slaughtering birds, and it is likely that a number are still conscious while being killed. Unlike in commercial abattoirs, stunning is rare at wet markets, although it is a legal requirement in a number of countries. An alternative to the water-bath stunner is a hand-held, low voltage stunner with electrodes that are placed either side of the bird's brain, passing an electric current through it (HSA, no date); however, this has not yet been widely adopted.

The methods of slaughtering poultry that are likely to be used in villages are neck dislocation, decapitation or delivering a concussive blow to the head (leading to loss of brain function). Although none of these methods provide pre-slaughter stunning, they are regularly used for emergency on-farm killing. Each of the three methods has welfare problems associated with it. If performed correctly, a concussive blow to a chicken's head may be the most effective way of killing it. To be effective, however, the blow must be very heavy and accurately directed to the bony part of the head, behind the comb. If delivered to any other part of the head, soft tissue may absorb some of the force of the blow, which may not result in concussion. For a concussive blow to be a reliable method of slaughter, it must be performed accurately and consistently.

Neck dislocation and decapitation must also be performed correctly to be effective methods of slaughter. Of the two, decapitation may be the more reliable, as it involves severing all the arteries supplying blood to the brain (the largest of which are the carotid arteries in the neck) immediately. This gives a very rapid loss of blood pressure, and death follows shortly after (HSA, no date). Neck dislocation involves stretching the neck to dislocate the spinal cord and cause damage to the surrounding blood vessels (HSA, no date). The procedure can be difficult to perform correctly and consistently, and does not always concuss the brain, causing insensibility. It is therefore not recommended as a routine method of slaughter (HSA, no date). As with the commercial slaughter of poultry, bleeding should be carried out immediately after either neck dislocation or producing concussion, to ensure that the birds are killed.

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