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Sustainability and animal welfare with reference to developments in poultry welfare

Introduction

The view that sustainability should be taken into account in relation to human activities is widespread and increasing. Whole industries are under review and the agriculture industry is no exception. A system or procedure is sustainable if it is acceptable now and if its effects will be acceptable in future, in particular in relation to resource availability, consequences of functioning and morality of action (Broom, 2001c). There are several possible reasons why an animal production system, or other system which uses animals, might not be sustainable. However, the earliest reason is often that something impinges upon the general public's values in a way which the members of the public find unacceptable. Frequently considered reasons for unsustainability are that a resource becomes depleted so much that it will become unavailable to the system, or that a product of the system accumulates to a degree which prevents the functioning of the system. Widely known examples are the exhaustion of rare resources or the accumulation of pollutants. Where there is depletion of a resource or accumulation of a product, the level at which this is unacceptable, and hence the point at which the system is unsustainable, is usually considerably lower than that at which the production system itself fails. That which is unacceptable is sometimes the action itself, sometimes an immediate effect and sometimes effects on other systems.

One major reason why animal usage systems may be regarded by the public as unacceptable, and hence become unsustainable without some modification, is that the product adversely affects human health. Another reason is that they have an effect on the welfare of animals which are used in the system. There is a point at which the welfare of the animals is so poor that the majority of the public consider the system to be unacceptable. Hence animal welfare and public attitudes to it must be considered wherever the sustainability of an animal production or other animal use system is evaluated.

No system or procedure is sustainable if a substantial proportion of people find aspects of it now, or of its consequences in the future, morally unacceptable. The people referred to here may be in a local community, in a nation or in the world as a whole. Hence each of the following is unsustainable, not just the first two: a manufacturing process which rapidly and irreversibly uses up all of the world supply of a rare metal; a pharmaceutical synthetic process whose by-product kills all fish in a river; a wild animal pest control programme which causes severe pain or other poor welfare to the animal; an organic farming system in which the incidence of a debilitating disease condition is higher than on conventional farms so that the welfare of the animals is worse overall. Public concern about animal welfare has increased rapidly in recent years (Broom, 1994, Ryan 1997, Ouedraogo and Le Neindre 1999) and, as a result of public awareness of the impact of human actions on the welfare of animals, more practices have become unacceptable.

In most countries, the areas where certain aspects of the poultry industry, as it functions now, might be considered unsustainable are, in order of importance: the welfare of the birds, risks to human health resulting largely from *Campylobacter* and *Salmonella*, and pollution problems. The remainder of this paper concerns animal welfare issues. Human disease resulting from poultry products is not often serious but is a major problem because careful human hygiene is needed to avoid significant *Campylobacter*, or sometimes *Salmonella*, infection. In Sweden, a substantial campaign by government agencies and by the industry has largely eradicated *Salmonella* as a problem. It is likely that the industry in other countries will have to deal with this problem and that increased use of antibiotics will not be acceptable. Pollution of waterways by poultry effluent can be avoided at a certain cost and in most countries the emission of ammonia into the air is not a major issue. Odours from poultry farms may be a local problem.

Developments in views of welfare and related concepts

Scientists who write about welfare and its assessment are generally agreed that welfare refers to animals, including humans, but not to other organisms or inanimate objects. Also, the study of the welfare of individuals is a scientific discipline in which various measurements can be used as indicators and welfare varies over a range (Curtis 1986, Duncan 1987, Broom 1988). Hence welfare can be poorer as well as better. An essential criterion for a useful definition of animal welfare is that it must refer to a characteristic of the individual animal rather than something given to the animal by man. The welfare of an individual may well improve as a result of something given to it but the thing given is not itself welfare. There is also wide-ranging agreement that, when assessing welfare, efforts should be made to assess degrees of suffering or happiness and the extent of any pathology and its consequences. Some authors accentuate feelings largely or exclusively (Duncan 1993, 1996) when referring to welfare whilst others concentrate most on health aspects. Dawkins (1993) and Fraser *et al.*, (1997) emphasise that both must be included. If, at some particular time, an individual has no problems to deal with, that individual is likely to be in a good state including good feelings as indicated by body physiology, brain state and behaviour. Another individual may face problems in life which are such that the individual is unable to cope with them. Coping implies having control of mental and bodily stability and prolonged failure to cope results in failure to grow, failure to reproduce or death. A third individual might face problems but using an array of coping mechanisms, be able to cope but only with difficulty. The second and third individuals are likely to show some direct signs of their potential failure to cope or difficulty in coping and they are also likely to have had bad feelings associated with their situations. Feelings have evolved to help individuals to cope, as have other coping mechanisms (Broom, 1998). My definition of welfare: "the state of the individual as regards its attempts to cope with its environment" includes feelings and health (Broom 1986, 1996, 2001d). 'Environment' may refer to that which is outside an individual or outside a particular response system. Welfare concerns how well the individual fares, or goes through life, and can be assessed scientifically (Broom and Johnson 1993).

Health, like welfare, can be qualified as good or poor and varies over a range. It refers to body systems, including those in the brain, which combat pathogens, tissue damage, or physiological disorder. All of this is encom-

passed within the broader term welfare so health is a part of welfare. Whenever there is disease welfare is poorer than when there is none. It is therefore incorrect to write about "health and welfare" and better to refer to "welfare, including health".

Stress is a term which has often been used in an imprecise and confusing way by scientists. It is of little use if it just means pertaining to the activity of the hypothalamic-pituitary-adrenocortical system or if it means any taxing stimulation. For most people, stress implies the effects of some challenge to the individual which disrupts homeostasis, rather than just activating simple, energetically cheap control mechanisms. A further area of general agreement amongst scientists studying the attempts of individuals to cope with challenge is that there are many coping systems. Hence it is incorrect to speak of "the stress response" if this means that there is only one. There are many different responses which are used by individuals in challenging and potentially adverse situations.

If stress implies some degree of adversity for the individual, the key question is how much adversity? The definition of stress which I find most useful is: "stress is an environmental effect on an individual which overtaxes its control systems and results in adverse consequences, eventually reduced fitness". The environmental variable which has the effect on the individual can be called a stressor. Using this definition, stress may or may not involve the activation of the HPA axis but stress is never good for an individual. Stimulation, some of which may be initially unpleasant, is necessary for the development of many aspects of systems for coping with challenge and individuals which are prevented from having adequately varied experience may prove unable to cope with certain problems. However, such ultimately beneficial stimulatory effects are not stress. Stress always involves poor welfare. However, welfare can also be poor where the individual is having difficulty in coping, for example during pain or depression, but where there is no likelihood of fitness reduction.

In order to understand the needs of animals, the range of functional systems e.g. controlling body temperature, nutritional state etc., must be understood. A need is a requirement, which is part of the basic biology of an animal, to obtain a particular resource or respond to a particular environmental or bodily stimulus. The need is in the brain and there are needs to carry out actions as well as those for particular resources. Needs can be identified by studies of motivation and by assessing the welfare of deprived individuals (Hughes and Duncan 1988; Toates and Jensen 1991).

Unsatisfied needs are often, but not always, associated with bad feelings whilst satisfied needs may be associated with good feelings. When needs are not satisfied, welfare will be poorer than when they are satisfied.

Hens need to:

* obtain adequate nutrients and water;
* grow and maintain themselves in such a way that their bodies can function properly;
* avoid damaging environmental conditions, injury or disease; and
* be able to minimise the occurrence of pain, fear and frustration (Broom, 1992).

In order to achieve these ends, hens carry out a variety of activities, respond to certain stimuli and maintain certain physiological states.

Hence they have other needs such as to:

* show certain foraging and investigatory movements;
* have sufficient exercise;
* show preening and dust-bathing behaviour;
* explore and respond to signs of potential danger;
* interact socially with other hens; and
* search for, or create by building, a suitable nest-site.

Important results from research on poultry welfare in relation to housing

Within the European Union food retailers have been pressurised by public opinion to set up standards for egg and poultry meat production. These standards have resulted in substantial changes in farm practice (Broom 1999). In relation to egg production, farmers have been helped towards uniformity in certain aspects of systems by the Directive (1999/74/EC) *Laying down minimum standards for the production of laying hens.* This legislation (Broom 2001b), which will phase out the use of battery cages, was based on information from a report from the E.U. Scientific Veterinary Committee. A further report on broiler welfare is likely to lead to future legislation. Some of the welfare research data are summarised here. The details of the publications can be found in the E.U. reports or in Broom (2001a).

Stocking density

If hens need to carry out a range of normal movements how much space is required for these? Measurements of the space occupied by a hen when carrying out such movements have been made. An average hen uses 1044 cm^2 for preening, 1096 cm^2 for turning and 1420 cm^2 for wing-flapping. If there are five hens in a cage, these will not show all of the different movements simultaneously and some hens might be relatively inactive whilst one bird uses more space. If hens crowded together occupy 325 cm^2 each, four hens crowded plus one wing flapping would need 2720 cm^2, more than the 2250 cm^2 cage for five hens allowed 450 cm^2 each. Similarly, four hens standing but not crowded and one preening occupy 3074 cm^2, two hens standing, two turning and one wing stretching occupy 4050 cm^2 so the stocking density severely inhibits normal movements. Wing-flapping is not possible with commonly used cage heights of 50 cm or less.

If hens are allowed more space than 450 cm^2 per bird the amount of disturbed behaviour shown is decreased. Hens will work for a larger space allowance of up to 1125 cm^2 per bird and they continue to space themselves out in cages of 1410 cm^2 per bird but in much larger space allowances of 5630 cm^2 per hen, they cluster. The effects of space allowance on the extent of injurious behaviour do not have linear relationship in battery cages but depend upon the complexity of the environment. In order to provide opportunities to escape and to hide from birds which tend to feather-peck or cause tissue damage by pecking, more space allowance than that normally provided in a battery cage is needed. Such escape possibilities are important in order to minimise injuries caused by other birds. As long as they are available, injurious behaviour can be low at various space allowances.

The space requirements of broilers in normal housing conditions, are sufficient to allow normal movements, exploration and social interactions. At least enough space to exercise, maintain leg condition and have access to resources is needed. The problem arises in the latter stages of growth when birds are crowded together. Increasing stocking density above 25 kgm^{-2} increases mortality, reduces locomotion, reduces litter quality, increases leg disorders and dermatitis, reduces calm behaviour and nesting and makes the finding of sick and injured birds more difficult.

Weak bones and exercise

The diet of hens is adequate for bone development, with calcium and vitamin D being key factors, but the bones of hens from battery cages break easily. In a series of studies, 25-40% of end-of-lay hens from battery cages were

found to have at least one broken bone following handling prior to stunning and 98% of carcasses had a broken bone. The numbers of broken bones from percheries and aviaries were much lower although hens from poorly designed or over-crowded percheries sometimes broke bones in the living conditions. The strength of the bones in wings and legs were reduced if there was insufficient opportunity for exercise. Birds which lived in cages in which they could not flap their wings had wing bones which were only half as strong as those of birds in a perchery which could and did flap (Knowles and Broom, 1990; Nørgaard-Nielsen ,1990).

Needs for pecking and dust bathing

Chickens strongly prefer litter floors to wire floors. The opportunity to peck at objects on the floor, scratch on the floor and dust bathe in a suitable substratum reduces the likelihood that injurious behaviour will be shown by hens and broiler breeders. Studies of the development and motivational basis of feather-pecking behaviour indicates links with deprivation of ground-pecking and dust-bathing opportunities.

Needs for nest boxes

An appropriate nest box is used by almost all hens if it is readily accessible and behaviour is clearly disturbed if none is available. The abnormal behaviour most frequently observed when no suitable nest site is present is stereotyped pacing. This stereotypy is a sign of long-term, intense frustration.

Needs for perches

Perches are preferred resting places for all but the youngest chickens. The design should be right and early experience of perches facilitates effective use. The presence of perches can increase leg strength. Where cloaca-pecking is a possibility, the perch should not be sited at such a height that the heads of some birds are level with the vents of others. This has been an important reason for the failure of some "getaway" cages because of injurious pecking. Young broilers use platforms and straw bales more than perches but appropriate perching facilities could improve welfare in general and leg strength in particular.

Problems of low light levels

If hens, broilers or broiler breeders are kept in low light levels they are not able to show normal exploratory behaviour. At the lowest levels eye development is impaired and clear welfare problems are indicated at light levels lower than 20 lux.

Beak-trimming

Mutilations which involve tissue damage are painful at the time of the operation and can sometimes cause neuromas which result in lasting pain. Beak-trimming also seriously impairs sensory input and pecking behaviour. The effect on welfare of beak-trimming is substantial but is much greater if neuromas are present.

Problems of leg disorders and ascites

The major causes of poor welfare in modern strains of broilers are leg disorders and ascites. The clinical conditions which impair walking include femoral head necrosis, dyschondroplasia, valgus-varus deformity, rickets and, in older birds, degenerative disorders. These conditions have become much commoner as growth rates have increased. The conditions must be painful as walking ability of birds with moderate lameness was improved after administration of the analgesic and anti-inflammatory drug carprofen.

Ascites is another pathological condition associated with fast growth in broiler chickens. It is also known as pulmonary hypertension syndrome and results in fluid from the blood leaking into abdominal cavities. It affects 5% of young broilers and 15-20% of the larger birds and whilst it can kill, it certainly weakens the birds and results in carcass condemnation. The main cause of ascites is failure of heart function associated with lack of oxygen supply to tissues. It is extremely rare in old strains of broilers and results from failure of the cardiovascular and pulmonary systems to grow fast enough to keep pace with the demands from the muscles and gut.

Problems resulting from selection by breeding companies

Farm animals have been selected for breeding on the basis of a range of criteria but by far the most important has been efficiency of production per animal. Fast growth, good feed conversion efficiency and high egg production have been selected for and this has had various consequences.

Broiler chickens have been selected, and their nutrition and management have been designed, so that they grow to market weight quickly and convert food to muscle efficiently. Thirty years ago chickens reached market weight at 12 weeks of age. Now the weight is often reached in 35 days and the age has been reduced by one day per year. The change in the bird has been that muscle and gut grow very fast but problems can arise because the bones and cardiovascular system do not grow as fast.

As a consequence, the birds may suffer from leg problems even when the diet is ideal. Some broiler chickens have leg damage and leg pain especially in the last week before slaughter, one consequence being that their ability to walk is impaired. In one study 90% of broiler chickens had some walking ability impairment in the last week before slaughter and 26% had a severe impairment. In another using a broiler strain used in many countries 30% of birds on commercial farms had severe walking difficulties by market age. It is widely known that birds with weak legs sit on litter and when the litter quality is not good many chickens, as a consequence, have contact dermatitis visible on carcasses as breast or hock burn. A comparison of 1957 and 1991 strains of broilers showed that growth rates and, hence, leg problems have an origin which is much more a consequence of genetics than of food quality.

The poor welfare which occurs in broiler chickens as they near the age of slaughter affects a very large number of individuals and may well be the most serious animal welfare problem in the world today. However, the problems can be solved. Birds can be bred for stronger legs but some slowing of growth, by genetic selection or management, is essential for a real solution. Leg problems can be reduced if food intake is limited for a period during growth. Some problems are exacerbated by high stocking density so this should be limited to a maximum of 25 kg m^{-2}.

For broiler breeders, the major welfare problem is probably hunger. Selection for fast growth means that the breeding birds would eat too much if fed *ad libitum*. However, the level of feeding normally used means that broiler breeders are hungry for most of their lives.

The selection of hens has taken insufficient account of the need to minimise injurious pecking and other welfare problems. Successful genetic lines in future will have to be those for which good welfare, as well as egg-production, has been a major factor in selection procedures.

Conclusions

Animal welfare is a factor in the sustainability of systems and procedures. Welfare includes feelings and health and studies of stress and welfare help us to understand needs. There are very serious problems for hens in battery cages which result in poor welfare. In order to solve these, the basic needs of hens, including those to show certain behaviours must be met. This is not possible unless the space available and design allows the provision of: a nesting place, a perch, possibilities for dust-bathing and

investigatory pecking, and room for walking and wing-flapping. No small cage can provide this. Design of hen accommodation and genetic selection of birds should be such that injurious pecking is minimised.

Broiler chickens must be genetically selected for stronger legs and slower growth. Stocking density must be limited and methods of enriching the environment in adequately illuminated conditions should be used.

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ANZCCART Workshops on the welfare of transgenic animals

ANZCCART will be holding workshops on this very topical subject in Sydney and Melbourne on 28 and 30 November, 2001.

The Sydney workshop will be held at the University of New South Wales and the Melbourne workshop at the Parkville Campus of Monash University. Each will commence at 9.30 am and finish at 3.30 pm and will cover the following topics:

* ethical issues;
* welfare issues;
* how to measure welfare of transgenic animals; and
* legislative issues.

Speakers will include scientists and representatives of animal rights groups. All are welcome.

Notes will be produced for participants and will also be posted on ANZCCART's website.

For further information, including the program and registration, contact ANZCCART's website –

www.adelaide.edu.au /ANZCCART/

or email ANZCCART at-

anzccart@adelaide.edu.au