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Future Food Animal Production Efficiency and Acceptability

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Introduction

What is the impact of food animal production in the world? What role does it play in human activity, who benefits from it, who pays costs associated with it and how should it proceed in the future? The majority of this account concerns the relationships between efforts to improve animal production efficiency and acceptability of aspects of the systems which have been developed. However, some initial questions about what is moral and what is sustainable will be considered first.

Morality and sustainability

Most human action involves some degree of benefiting others, tolerating others, accepting benefit from others, or cooperating with others and relatively little of it involves competing with or harming other individuals. Cooperative behaviour and morality evolved because, in a society which is long-lasting, it is advantageous to look ahead to future situations and to consider what relationships with other individuals will be. Arguments for the evolution of moral systems in human societies, and in the societies of other species, are presented by Broom (2003). Although, in some difficult situations, people may think in a more short-term way, when decisions are made about whether a system for exploiting resources should be used, a central question is whether or not the system is sustainable. 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 2001b,2002).

There are several possible reasons why a system, for example an animal usage system, might not be sustainable. It could be because it involves so much depletion of a resource that this will become unavailable to the system. It could be because a product of the system accumulates to a degree which prevents the functioning of the system. However, in each of these cases, and in the case of some other aspects of systems, the earliest effect which renders the system unsustainable is one which impinges upon the general public's values in a way which the members of the public find unacceptable. 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. Unacceptability is often due to effects on other systems.

A system could be unsustainable because of one of the various harms which result (Table 1). There might be harm to the perpetrator, or to other humans, or to the environment of present or future humans. There might also be harms to other animals.

Table 1 - Reasons for lack of sustainability of a system:

- | | |
|-------------------------|--|
| 1. resource depletion | - to level which is unacceptable.
- to level which prevents system function. |
| 2. product accumulation | - to level which people detect and find unacceptable.
- to level which affects other system in an unacceptable way.
- to level which affects the system itself, perhaps blocking its function. |
| 3. other effect | - to level which is unacceptable. |

In all of the above, the consequences of acts or of system functioning could be unacceptable because of immediate or later:

- | | | | |
|-----|--|---|-------------------------------|
| [a] | harm to the perpetrator | : | resource loss or poor welfare |
| [b] | harm to other humans | : | resource loss |
| [c] | harm to other humans | : | poor welfare |
| [d] | harm to other animals | : | poor welfare |
| [e] | harm to environment including that of other animals. | | |
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No system or procedure is sustainable if a substantial proportion of people find morally unacceptable either aspects of it now, or their estimate now of its consequences in the future. 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 examples in Table 2 is unsustainable.

Table 2 – Unsustainability – examples of unacceptable harms

1. harm to perpetrator: resource loss or poor welfare
 - [a] system for energy production uses more energy than it produces.
 - [b] machinery for process made of poor quality materials so injury to working person likely.
 - [c] people spreading insecticide on fields likely to be poisoned.

2. harm to others humans : resource loss
 - [a] factory/agricultural system outflow into lake or river – fishing industry lost.
 - [b] heavy metals from industry – reduces farm production.
 - [c] radiation from energy production system – reduces farm production.

3. harm to other humans : poor welfare
 - [a] dioxin released from factory – people become sick, some die.

[b] cheap cattle protein fed to other cattle – bovine spongiform encephalopathy in cattle and new variant Creutzfeldt Jacob's disease in consumers of the meat.

[c] work which is too demanding – some workers become depressed or psychotic.

4. harm to other, non-human, animals : poor welfare

[a] traditional entertainment for people e.g. bullfight, dog-fight, cock-fight, bear-baiting, throw donkey off church tower.

[b] use leg-hold trap for pests or fur-bearing animals.

[c] veal production from calves kept in small crates and fed only milk.

5. harm to environment including that of other animals.

[a] use of CFCs in refrigerators – ozone layer damage.

[b] use chlorinated hydrocarbon insecticides – birds etc. which are insectivores or top predators killed or unable to reproduce.

[c] produce too much carbon dioxide and other greenhouse gases – global warming.

Benefits of animal production and efficiency changes

Farmed animals provide a significant proportion of human nutrition. Although plants are a much more important source of food, the contribution of animal products to protein and other components of human diet is very important. The energetic inefficiency of much animal production means that if demand for food continues to rise, the proportion which is derived from plant production is likely to increase. However, some areas of the world's surface will continue to be most efficiently exploited by grazing animals and, via animals we shall be able to utilise and convert otherwise unusable crop components. Farmed fish will become steadily more important sources of protein as all of the world's wild fish stocks are over-exploited and lost to man.

Improved efficiency in plant and animal agriculture, resulting from genetic selection and other scientific developments, was in my view one of the two most important successes in the twentieth century, the other being improved communication amongst people. Food availability increased enormously and food became much cheaper. In animal production, meat, eggs and milk became accessible in greater quantities to people in many parts of the

world. The dramatic increase in efficiency of animal production had some costs, many of which were not considered to be important by those encouraging the drive towards greater efficiency.

Despite great progress in some aspects of animal production, there remain many areas where its potential is under-exploited. Some plant production systems can be combined with animal production in a way which is socially and economically desirable. One example of this is to combine various forms of forestry and tree fruit production with sheep production. Another example is to keep cows for dairy production and young cattle in oil palm plantations. Such plantations usually allow substantial production of pasture plants which can provide food for the cattle. An example of under-exploitation in many tropical countries is the grazing of cattle on pastures which could be much more productive if sodium and other fertilisers were added to them. In some cases, just to ensure that manure is returned to them would be very beneficial in providing sufficient nutrients for grazing cattle. In general, changes like those described above are sustainable.

One major reason why animal production systems may be regarded by the public as unacceptable and hence become unsustainable without some modification, is that the product adversely affects human health, a second reason is their effect on the welfare of animals which are used in the production system, whilst a third is an effect on the environment.

Animal production and human health

Although the general effect of the provision of nutrients to inadequately nourished people is to improve their health, human diseases can be carried by food of animal origin. In most countries, food hygiene laws and practices have led to a decrease in the frequency of occurrence of food poisoning and food-related diseases. Some problems remain and new problems may arise. Greater local concentrations of animals can result in a greater chance that a particular pathogen will be present on an animal holding and widespread use of prophylactic drugs can increase the chances that new, more virulent strains of pathogens will

arise. Animal transport can disseminate pathogens which could infect humans or other animals. Some new strains of pathogens, such as *E. coli* 0157:H7 can be passed from farm animals to humans but it is possible that the strain would have arisen even if the intensification of animal agriculture had not increased. The outbreak of bovine spongiform encephalopathy, on the other hand, would probably never have been serious, or never have occurred at all, if animal protein had not been fed to cattle causing a very rare cattle disease to become a major epidemic with consequences for human health. Intensive housing conditions also make it more likely that poultry meat will carry *Campylobacter* which can lead to diarrhoea in humans who do not take good hygiene precautions.

Animal production and animal welfare

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 system is evaluated.

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.

The welfare of an animal is its state as regards its attempts to cope with its environment (Broom, 1986). Hence welfare is a characteristic of an individual animal and includes extent of success in coping with all aspects of its environment, failure to cope which may lead to disease, injury and death, and extent of difficulty in coping. 'Environment' refers here 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). The mechanisms for trying to cope include behaviour, physiological systems, immunological systems, a range of feelings such as pain, fear and various forms of pleasure, etc. Health is that part of welfare which concerns coping with pathogens and pathology. Welfare varies on a scale from very good to very poor and can be assessed scientifically, an adequate range of measures being needed (Broom 1991, 1998, Fraser and

Broom 1990, Broom and Johnson 1993). Animal welfare science has developed rapidly in recent years. Health also varies from good to poor. Good health involves absence of pathological effects whilst good welfare involves absence of indications of poor welfare, including those of pathology and disease, and indications of contentment, pleasure and happiness.

Animal welfare refers 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.

Most work in which the welfare of animals has been quantitatively assessed have been studies of the effects of housing systems, experimental procedures, handling, transport or commercial procedures on the animals. The animals are normally on farms or otherwise captive for human use. The range of measures used are also useful for studies of the effects of chemical pollution, radiation etc. on wild or captive animals. Hence there are close parallels between the work of ecologists studying impact of adverse environments on wild animals and animal welfare scientists studying the impact of adverse environments on domestic animals. Once welfare measures have been taken, the scientist can describe the welfare of the individual on a scale which ranges from very good to very poor welfare.

The term welfare can only be applied to living animals, not to plants, or inanimate objects or dead animals. There are substantial differences between welfare which becomes worse rapidly and remains poor for a long period before death and welfare which is only slightly affected until just before death. Such calculations are important when methods of killing pests or other animals are being valued (Broom 1999). Some traps for mammals, some poisons, poor quality shooting and chasing animals with dogs until they are exhausted all have very severe effects on the welfare of those animals. On the other hand, good traps, rapidly acting poisons, and instantaneous killing by shooting cause little or no poor welfare.

The scientific assessment of animal welfare provides information which legislators, for example those in the European Union, use when formulating new Directives and Regulations. This information is also used by commercial companies such as supermarket

companies and restaurant chains who are pressurised by their customers to obtain their products using systems which do not result in poor health for consumers, poor welfare for animals, adverse impacts on the global environment, or damage to populations of rare animals or plants. Members of the general public have recently come to realise that they can force commercial companies to behave in a moral way by refusing to buy from the company if they sell anything which is produced using immoral methods, e.g. those which require child labour, which harm animals or which damage the future world environment. Those who are concerned about such issues can have an effect on what happens by trying to influence laws and international agreements such as those of the World Trade Organisation.

There is 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).

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.

Table 3 - Indicators of animal welfare

Physiological indicators of pleasure
Behavioural indicators of pleasure
Extent to which strongly preferred behaviours can be shown
Variety of normal behaviours shown or suppressed
Extent to which normal physiological processes and anatomical development are possible
Extent of behavioural aversion shown
Physiological attempts to cope
Immunosuppression
Disease prevalence
Behavioural attempts to cope
Behaviour pathology
Self narcotisation
Body damage prevalence
Reduced ability to grow or breed

Reduced life expectancy

(after Broom 1999b)

Examples of poor welfare which occurs more frequently because of increased individual production efficiency include leg problems and ascites in broiler chickens, lameness, mastitis and reproduction disorders in very high producing dairy cows and physiological problems resulting from large muscle blocks in pigs. .

Animal production and the environment.

Pollution resulting from farm animal manure production and other animal products can have wide-ranging effects on the environment. However, this subject will not be covered in detail here.

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