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The scientific basis for action on animal welfare and other aspects of sustainability

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Summary

There is increasing public demand in all countries for sustainable plant and animal production systems. A system or procedure is sustainable if it is acceptable now and if its expected future effects are acceptable, in particular in relation to resource availability, consequences of functioning and morality of action. When purchasing food, many people now consider efficiency of usage of world food resources, human welfare, animal welfare, biodiversity and conservation, genetic modification, fair trade and continuity of rural communities. The quality of the product is more and more frequently judged to be poor if the production method is unacceptable. In order to use resources efficiently, every person should eat more plant material than animal material and should not waste food. Where the killing of animals is a concern, there should be consideration of the many animals killed in the course of plant production, probably more than in production of some herbivorous animals. Animal production should focus on herbivorous animals that eat foods that humans cannot eat. Much of the earth can be used for herbivore production but is unsuitable for producing plants that humans can eat. Animal welfare is a major factor in the sustainability of food production systems and in food quality. The most important animal welfare problems all concern farmed animals: broiler chicken welfare, dairy cow welfare, laying hen welfare, pig welfare, and the welfare of farmed fish. There is much scientific evidence about animal welfare and several other aspects of sustainability. New semi-intensive silvopastoral systems are being developed in tropical and sub-tropical countries in which pasture is combined with shrubs and trees with protein-rich edible leaves. Plant and animal production are greater than in pasture-only systems, biodiversity is much increased, animal disease is reduced, and animal welfare improved.

Sustainability

A key question about any production system, including those where it is human food that is being produced, is whether or not it is sustainable. The meaning of sustainability is now much wider than it was in early writings on the subject because the ethics of the production method are now included and a system can be unsustainable because of negative impacts on human welfare, on animal welfare, or on the environment. A definition of sustainability is: a system or procedure is sustainable if it is acceptable now and if its expected future effects are acceptable, in particular in relation to resource availability, consequences of functioning and morality of action (Broom 2014, modified slightly after Broom 2001, 2010).

The concept of the quality of goods that people buy has also been changing. Whilst quality still includes immediately observable aspects and the consequences of consumption, for many people it now includes the ethics of the production method. Consumers now require transparency in commercial and government activities and take account of the ethics of food production when they evaluate product quality (Broom 2010, 2017).

What makes a food production system unsustainable and results in product quality being judged as poor? The impacts of each of these aspects of production can now be measured in an objective scientific way.

(a) Adverse effects on human welfare, including human health
Food products are not just evaluated on taste and price. If they cause people to become sick, the quality is considered poor. Some foods are regarded as being better for the health of the consumers because of the nutrients present in them. A major effect on animal production in recent years of attempts to provide a healthy diet has been the dramatic increase in the production of farmed fish, in part because they contain poly-unsaturated fats (Wall et al 2010). Another human and animal health impact is that in all aspects of farming, the use of antibiotics and other antimicrobials will have to decrease, in most countries via new legislation. The development of antimicrobial resistance (AMR) means that many of these drugs are no longer effective, partly because of misuse of antibiotics in human medicine but partly because of widespread rather than just therapeutic use in livestock farming (Ungemach et al 2006). It is estimated that 65% of antimicrobial usage by weight is for farm animals (EU data from ECDC/EFSA/EMEA/SCENIHR 2009). Because the animals are a mean of 2.4 times the weight of a human, calculations using the EU data are

that the number of treatments with antimicrobials is 44% for farm animals. For the antimicrobials assessed by WHO as the most important for humans, the figures are 36% by weight and 19% by treatments. Every human patient and every farmer in the world should respond to this dangerous situation. There is still use of antimicrobials in farming that substantially increases the risk that resistance will develop. As with human use, the risk is much greater in some countries than in others, especially in those where the antimicrobial can be obtained by users without prescription by a medical doctor or veterinarian and where prescribers are easily persuaded to prescribe when they should not. The use of antimicrobials as growth promoters, a practice that is becoming illegal in more and more countries, is a particularly damaging practice.

(b) Poor welfare of animals

Many consumers will not buy animal products if there is close confinement of animals, individual rearing of social animals such as pigs and cattle, and other systems for housing and managing animals that do not meet the needs of the animals. An increasing result of this is the number of people who decide to become vegetarian or vegan. Other people just decide not to buy particular animal products. Hence some widely-used animal housing systems are unsustainable (Broom 2017). Animal welfare is a key aspect of sustainability and product quality.

(c) Unacceptable genetic modification

The use of genetically modified plants is not accepted by some consumers and few people accept the use of genetically modified or cloned animals. All cloning of farm animals is associated with poor welfare of animals and this is the reason why it is not permitted in the European Union (Broom 2014, in press). The public's antipathy to genetic modification and cloning is partly dislike of modifying what is natural. Another aspect is that modified organisms may have allergenic proteins and many of the public do not believe that proper checks on such possibilities are in place (Lassen et al 2002). Animals which are genetically modified may have welfare problems so there should be checks, using a wide range of welfare indicators, before they are used in any way (Broom 2008, 2014).

(d) Harmful environmental effects

Agricultural methods that result in low biodiversity are a consequence of widespread herbicide and pesticide use and are perceived to be the norm by many farmers and some of the general public. However, such a change is far from inevitable and there are agricultural systems that lead to biodiversity on farmland being much increased. Livestock production can also result in pollution, locally and on a world-wide scale, e.g. via greenhouse gas production. Greenhouse gas production can be reduced by modified feeding and land management systems. Maintaining resources, such as soil with good structure, and retaining water that might be lost from the soil are important objectives, as are minimising usage of carbon-based energy and imported fertilisers. Soil is often damaged by tillage and greenhouse gases emitted (Pagliai et al 2004). There has been over-exploitation of all open water fish and of whales and widespread extinction of species is occurring very rapidly now. In some cases this occurs because of a specific use, e.g. feathers, ivory or rhino horn, but whole habitats are disappearing because of human activity. A livestock farming component that has led to a dramatic environmental effect is the widespread death of vultures in India caused by the use of the veterinary drug diclofenac (Green et al 2004). The population declined to only 3% of its former level but is starting to recover following legislation. In temperate and tropical countries a dramatic example is that in the last 20 years we have seen the greatest decline in farmland birds, butterflies, bees and wild plants ever recorded. This is principally because of the use of herbicides but also because of pesticide use. These examples raise the question of what we want in our environment. Do we need vultures in India or farmland birds and butterflies in the U.K. or U.S.A.?

(e) Inefficient usage of world food resources

At present, there is often very inefficient usage of food and energy resources. Much human food used in homes, sold in restaurants and sold in shops is wasted. Some food for farmed animals is wasted. Almost all of this waste could be prevented. In addition, much food that humans could eat is fed to animals that are then eaten by people. This is a much less efficient process than for the humans to eat the food directly. What can be done in animal production to exploit existing resources better (Herrero et al 2010)? The most important animals for food production are those that eat food that humans cannot eat. Hence herbivores eating forage plants, not cereals, are

much more important than pigs or poultry which compete with humans for food (Broom et al 2013). Similarly, herbivorous fish are more important than those fish that eat other fish. Land used for agriculture is sometimes degraded because of poor management, for example repeated tillage and use of the same crops, so is not exploited efficiently. Too much energy from fossil fuels is used in cultivation and transport of feed and products, as well as in production of fertilisers and other materials and equipment.

(f) Not “Fair trade” – producers in poor countries do not receive a fair reward

Consumers in many countries have now discovered that producers of food in poor countries are often not properly rewarded for their work. Most profits from the sale of some basic products bought by many people have been found to go to large companies. This is considered morally wrong by most consumers and, as a consequence of publicity about unfairness to poor producers, products like coffee, cocoa and fruit are among those that are independently checked and have a Fair Trade label (Nicholls and Opal 2005). Hence the producers receive a larger part of the money paid by shoppers.

(g) Not preserving rural communities

Small-scale rural farmers are often out-competed by large-scale production, with the result that local communities disappear. The general public often find this unacceptable so schemes are introduced by governments to safeguard such communities. Consumers may also buy locally-produced products, regarding this as a part of product quality. In the European Union, subsidies to preserve rural communities have prevented rural people migrating to towns and hence large cities becoming ever larger (Gray 2000, Broom 2010).

Welfare and health

The term welfare is used for all animals but not for plants or inanimate objects. The welfare of an individual is its state as regards its attempts to cope with its environment (Broom 1986) so welfare varies over a range from very good to very poor and can be measured scientifically. This state includes all coping systems, including behavioural and physiological body regulation, the immune system and many other systems that are largely controlled by the brain. Those systems that cope with pathology contribute to health which is

an important part of welfare. Positive and negative feelings are adaptive mechanisms that are central aspects of welfare. Animals with the level of awareness and cognitive ability necessary to have feelings are said to be sentient (Broom 2014).

The concept of health and the concept of welfare are exactly the same for humans and non-humans. This point is emphasised in the “one health” and “one welfare” discussions (García-Pinillos et al 2016). Many measurements are the same for humans and non-humans. Welfare measures, such as those of behaviour, physiology, immune system function, clinical condition and body damage, are described by Blokhuis et al (2010), Broom (2013, 2014) and Broom and Fraser (2015). Emergency adrenal responses are the same in a frightened person or sheep, or a fish taken out of water. All can result in immunosuppression. One response to pain in people is the grimace response in which the eyes are partly closed, the mouth is moved and the cheek muscles are clenched. The same response to pain is shown by sheep, goats, horses, mice and rats so grimace scales have been developed for assessing pain in these species.

As a result of much study of animal welfare science, we now have information about the needs of the main farm animal species so consideration of these needs is the first step in evaluating systems for keeping and managing animals. For animal welfare scientists and legislators, this approach has largely superseded the less precise five freedoms approach. The most important animal welfare problems all concern farmed animals: broiler chicken welfare, dairy cow welfare, laying hen welfare, pig welfare, and the welfare of farmed fish. There are many scientific publications on the welfare of all of these animals in the various possible production systems (Fraser 2008, Broom and Fraser 2015, Broom 2017). The first step when there is a requirement for laws or codes of practice concerning the use of animals is to have a report produced by unbiased scientists. After an objective scientific report has been produced, its conclusions and recommendations can be discussed with stakeholders (i.e. those with a financial interest in the area) and other interested parties. Legislators can then decide on laws and both NGOs and companies that produce or sell food can decide on codes of practice. In relation to animal welfare in the European Union, the EFSA Panel on Animal Health and Welfare produces the scientific reports and makes it available on the internet. The welfare of hundreds of millions of animals has improved as a result of EU policies and legislation.

Food production systems for the future

What is the future for the production of food and other goods in the world? Consumers in more and more countries have concerns about healthy food, biodiversity and animal welfare. There is an ever-increasing number of people with the view that we must provide for the needs of the animals that we keep and that we must use world resources more efficiently. In order to do this we should consume more plants and fewer animals. If grain is produced, it is more efficient for people to consume the grain directly than for it to be fed to animals, with much loss of energy in the process, and then to consume the animals. Where meat is consumed, it should come mainly from animals eating food that humans cannot eat. Hence we should concentrate on producing herbivorous mammals, birds, fish, etc. As a consequence, ruminants, that get their nutrients from leaves, are much more important than pigs or poultry that compete with humans for cereals and soya.

A question which arises as a consequence of such arguments is “should we stop animal production and just produce plants?” If the basis upon which this will be decided is to do with the efficient utilization of world food resources, the answer is no. We should reduce animal production. However, approximately 45% of land in the world is good for producing food for herbivores but not for producing plants as human food. If we stopped production of animals for human consumption, this land would produce almost no food for people. The remainder of the land would have to be farmed more intensively and there would probably be major food shortages. Of the food that is produced for human consumption, as much as 30% is wasted. In order to use that which would otherwise be wasted, some could be fed to other animals. For example, after it is treated to prevent the spread of disease, much could be fed to pigs (zu Ermgassen et al 2016). A further factor is that most of the world is sea and there is potential for it to be better used for producing marine plants and animals for human food.

A further question to consider is “is it morally right to consume animals?” The answer to this question depends upon which moral issues are considered the most important. For some people, the main view is that it is objectionable to consume animals or animal products. I see this as principally an aesthetic question but some

others do not. People for whom this is the paramount issue, will not eat animals.

A second moral argument is that "it is wrong to consume animals because we should not kill animals". However, this argument does not logically lead to vegetarianism because large numbers of animals are killed in plant production. Some are small soil animals. Others are mammals, birds and insects that we call pests. Other animals die or are prevented from living at all in order that crop production methods can be used. Per unit of human food, some animal production methods allow far more animals to survive than some plant production methods.

A third position is that we have an obligation to use animal production methods only where animal welfare is good. Where animal welfare is viewed as a part of sustainability, this position can be rewritten as all food production systems should be sustainable. Returning to the initial questions, it is clear that, if we stop or reduce animal production methods that misuse world resources, more food can be produced. We should concentrate on farming herbivorous mammals, birds, fish and perhaps insects or molluscs that can be fed grass, leaves and other plant products which humans cannot digest efficiently.

Sustainable animal and forage plant systems

For many years we have been talking about grazing systems. The key plants have all been pasture plants. Trees and shrubs have been mainly considered as competitors for the pasture plants. Yet plant production from a mixture of herbs, shrubs and trees is much greater than from a single layer pasture system.

Some shrubs and trees provide good food for ruminants and other animals, including herbivorous fish. Shrubs such as *Leucaena* have been used as forage for ruminants for many years. However, most animal production is still from pasture only.

Work in Colombia, Mexico and Brazil on semi-intensive, three-level, rotational, silvopastoral systems has now reached a point where revolution is starting. This is because semi-intensive silvopastoral systems with grasses, leucaena *Leucaena leucocephala* or other protein-rich shrubs and trees, often with edible leaves, produce more forage and more animal product than monoculture pasture-only systems (Murgueitio et al 2008). In addition, the welfare of the animals is better, including less disease; biodiversity is much greater;

worker satisfaction is high; soil quality, including water-holding capacity, is much increased; there is less water run-off; conserved water use is six times less than feed-lot systems; there is 30% less greenhouse gas production per kg meat; there is better carbon sequestration; and the land area needed for beef production is 42% of that for feed-lots (Broom et al 2013).

Especially during dry periods when herbs and shrubs are less productive, the leaves of trees like ramón (Maya nut) *Brosimum alicastrum* can be cut and fed to livestock. Shrubs and trees that are too high for animals to reach can be cut and fed to ruminants or fish. This development can be taken up in many parts of the world now but, for the future, another step is to collect and eat the insects that feed on tree leaves. This means planting forests for farming.

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