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Animal welfare complementing or conflicting with other sustainability issues

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Abstract

Systems for the production of food, or other products for human use, should be sustainable. This means that the system should be acceptable now and its expected future effects should be acceptable, in particular in relation to resource availability, consequences of functioning and morality of action. However, there are many components of sustainability. People who consider only one aspect may not advocate the best solution. If the focus is entirely on: animal welfare, preservation of rare wildlife species, maximising local biodiversity or minimising greenhouse gas, production may cause other harms. When an agricultural or other product is considered, life cycle analysis of the product takes account of every contributory factor. Every externality of the system should be evaluated and the value of each balanced.

Some actions that improve animal welfare may also have positive environmental effects and each aspect can be measured. If straw from cereal production is burned, carbon dioxide is released but if it is used as bedding or for manipulation welfare is improved and the greenhouse gas effect is reduced. Taking wild animals to keep as pets leads to poor welfare and wild populations are reduced. Stray dogs have a negative impact on the populations and welfare of some wild animals and dog welfare is often poor because of disease and malnutrition so humanely killing the dogs can prevent poor welfare and benefit conservation. The land-sparing argument, encouraging intensive animal production so more land is available for nature reserves, would favour feedlots for beef production but the welfare of the cattle in feedlots is often poor and water usage is high. However, semi-intensive silvopastoral systems are also very efficient. The presence of shrubs and trees greatly increases biodiversity, reduces greenhouse gas production per unit of production, reduces conserved water usage and improves welfare.

Conserving land for hunting wild animals increases biodiversity but the hunting usually causes poor welfare. Where endangered species cannot adapt well to captive conditions, captive breeding might preserve the species but the welfare of the animals is poor. When a system is being evaluated, each of the many components of sustainability should be measured precisely: welfare, biodiversity, worker satisfaction, water use, greenhouse gas production and harmful accumulation of

pollutants like nitrogen and phosphorus. Decision-making may involve developing units for comparison of each positive and negative consequence or considering any negative that is so great that no counter-balancing would ever be acceptable to the public.

1. Sustainability

A key question about any human activity, and especially about any production system, is whether or not it is sustainable? Systems were initially called unsustainable when a resource became depleted so much that it became unavailable to the system, or when a product of the system accumulated to a degree that prevented the functioning of the system (Tivy and O'Hare, 1982). Now, the meaning of the term is much wider and should take account of the needs of the present and of the future ((Stavins et al, 2003). For example, a system can be unsustainable because of negative impacts on human health, animal welfare, or the environment. 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 after Broom 2001). Using this definition, if the general public find any effect of a system unacceptable, that system is unsustainable. Members of the public in all parts of the world, particularly in developed countries, are now insisting on transparency in commercial and governmental activities and are using their purchasing power to change methods of producing various products (Bennett et al 2002, Broom, 2017a). Hence there are many components of sustainability. Some of the factors that may make a food production system unsustainable, and result in product quality being judged as poor, are listed in Table 1 and discussed elsewhere (Broom 2010, 2017b).

The public consider some factors to be more important than others and the perceived order of importance varies over time. At present, whilst climate change is an urgent issue, in my view the greatest human problem in the world is the rapid development of antibiotic resistance so that more and more bacterial diseases, of people and the animals that we use, are becoming untreatable. This is largely because of misuse of antibiotics in human medicine, but is partly because of widespread rather than just therapeutic use in livestock farming (Ungemach et al. 2006). In all aspects of farming, antibiotic and other antimicrobial use must decrease. In most countries this will have to be achieved via education of the public and by legislation. It is also likely that the inefficient use of world resources (Herrero et al 2010) will increase in importance in the near future.

Table 1

Some of the factors that may make a food production system unsustainable.

<p>Adverse effects on human welfare, including human health</p> <p>Poor welfare of animals</p> <p>Unacceptable genetic modification</p> <p>Harmful environmental effects</p>	<p>biodiversity reduction</p> <p>inadequate conservation</p> <p>water or land pollution</p> <p>atmosphere and climate change</p>
<p>Inefficient usage of world food resources: land, water, etc</p> <p>Not "fair trade" – producers in poor countries do not receive a fair reward</p> <p>The cost at point of sale cannot be borne by consumers</p> <p>Worrier effects: persons who can and wish to operate the system not found</p> <p>Not preserving rural human communities</p>	

All actions whose aim is to make systems more sustainable should take account of every aspect of sustainability and not just one aspect. If the focus of an action were to be entirely on animal welfare, some other harm might be done. Similarly, focus entirely on preservation of rare wildlife species, maximising local biodiversity, or minimising greenhouse gas production may harm welfare or lead to inefficient use of land or water resources.

2. Life cycle analysis and evaluation of externalities

What are all of the effects of a system such as that shown in Fig 1? Terms used in such evaluations include life cycle assessment or analysis and externalities of systems. When an agricultural or other product is considered, life cycle assessment takes account of the impact, on a specified variable, of every stage in the operation of a system from the inception of resource gathering and land use to the final stage of breakdown of the product and any side products. The concept of product life-cycle analysis is used in business (Day, 1981) to systematically consider all of the consequences of production, especially those that might have negative effects for the business and including factors affecting sustainability. In order to do life cycle analysis, it is essential to consider where the product goes after sale, including its ultimate

disposal. An example of life cycle analysis applied to biological systems is research examining all water and nutrient usage during microalgae-based biodiesel production (Yang et al., 2010). Clambrone (2018) describes "How to best design or change a product or set of processes to minimize the impact on the environment over the life cycle of the product or process." For life-cycle analysis, a single variable is considered and expressed using the same units. Many life cycle analyses focus on energy use and do not adequately consider other impacts. Where food production is concerned, efforts are usually not made to take account of competing between human food and the same food fed to livestock, as discussed below. In some assessments, monetary cost might be a useful variable to measure because the welfare of housed pigs can have a cost in that consumers who do not accept the poor welfare of pigs refuse to buy the product or would pay more for a better quality product where welfare was better.

A similar approach is applied to systems where the production method or intended product has other effects, or externalities, in the world. Many economic policies take little account of externalities, indeed the name suggests that they are not really a part of the system. Every externality of the system should be evaluated and the value of each balanced. For example, Delucchi (2000) considered the environmental externalities of motor vehicle use in the USA. The following

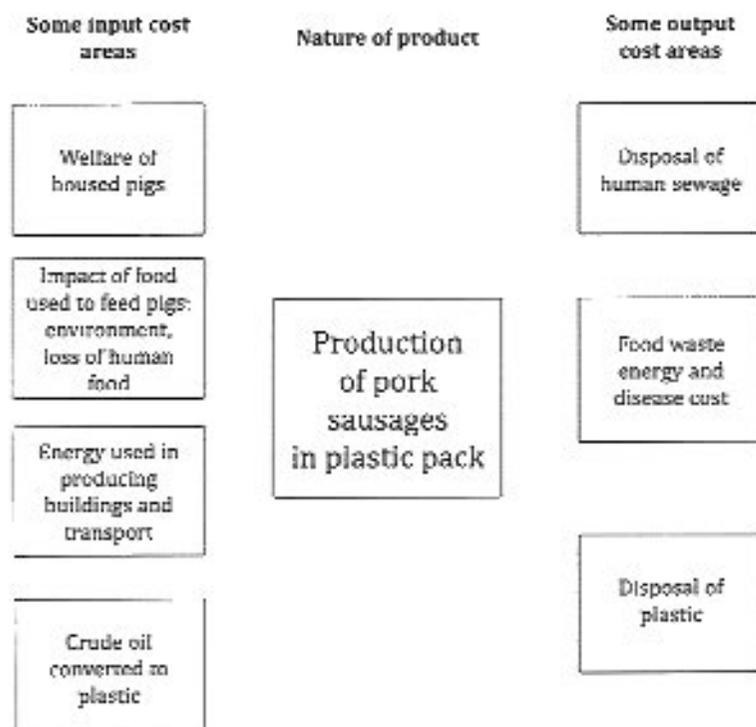


Fig. 1. Some of the factors that could be considered in order to understand the whole of systems involved in producing a human food product. For each life cycle analysis, a measure of how a variable is affected from the beginning of production to the end of disposal of the product is used: e.g. measures of total land use, all greenhouse gas production, or monetary cost of purchasing resources or preventing damage. The impacts of the process, other than the beneficial impact of the human food, can be referred to as externalities.

examples are of actions that have effects on animal welfare and on other aspects of sustainability

3. Improving animal welfare and improving the environment

If straw from cereal production is burned, the greenhouse gas carbon dioxide is released into the atmosphere with negative consequences for climate change. Crop burning in Asia has been estimated to give off 379 teragrammes (million tonnes) of carbon dioxide per year. This is 34% of all CO₂ from burning solids in Asia (Gadde et al. 2009). If the straw is used as bedding or for manipulation and consumption by pigs, the welfare of the animals is improved. The straw and manure can be composted or incorporated directly into soil. If this is done, some carbon dioxide and some methane are produced but the total greenhouse gas impact is less. The presence of straw reduces the greenhouse gas emissions of manure during composting (Wang et al. 2014), composting of straw produces less CO₂ than burning because carbon is incorporated into stable compounds (Lim et al. 2016) and the total greenhouse gas output of composting municipal waste was 0.27 t carbon eq./t waste⁻¹ as compared with 0.4 for landfill and 0.58 for incineration (Lee et al. 2007). Hence use for pigs followed by composting would improve welfare and environment.

If wild animals, including birds, mammals, reptiles and fish, are brought into captivity and kept as pets, for most species their welfare is very poor. The EPSA report (EPSA, 2006) on wild birds brought into captivity showed that the survival of small wild birds during: catching, holding in the area of origin, local transport, international transport, holding in the destination country, transport prior to arrival at the place of sale and sale in a shop was 10%. Of all birds initially caught in the wild, 90% died before being sold in a shop. The survival of valuable birds like large parrots was 20–30%. Much of the mortality was due to stress-induced disease. There are similar data for reptiles as a very high proportion die before sale and welfare is poor before that (Warwick et al. 1995). The practice of catching wild birds, reptiles and other animals has led to the extinction of some species and to major population reduction in others. The catching of wild animals in order that they can be sold in shops is bad for welfare and bad for conservation. The result of the EPSA report was that the import and sale of wild caught birds was banned in the European Union (Commission Regulation (EC) No 318/2007, implemented by Regulation 139/2013), mainly for animal welfare reasons. In the United States, the same ban was introduced, mainly for conservation reasons (Wild Bird Conservation Act 1992).

A third example of an action that is good for welfare and for conserving is the removal of stray or feral dogs from natural environments. Stray dogs may have a large negative impact on the populations and welfare of some wild animals, and their welfare is often poor because of disease and malnutrition, so reducing the populations can prevent poor welfare and benefit conservation. Montecino-Latorre and San Martín (2018) provided evidence for negative impacts of packs of free-ranging dogs as they were found to be the main cause of animal losses in small-scale farms in Chile. Packs of feral dogs are the main predators of wild camelids in Chile and for domestic and wild animals, death or injury from dog attack would often cause very poor welfare to the animal attacked (Bonzale et al. 2016). There is debate about the best policy in such circumstances. Some people strongly resist plans to kill feral dogs or housed dogs that kill livestock, wildlife or other pets. Neutering a high proportion of such dogs can reduce but not solve welfare and conservation problems. Whilst people are not responsible for the actions of wild animals, unless these are caused by human action, they are wholly responsible for the actions of owned dogs or their offspring. In most circumstances, humanely killing the dog or dogs is the best solution.

4. Attempts to improve welfare or the environment whose consequences depend on the method used

Since close confinement of livestock and very low space allowance per individual result in poor welfare, efforts are often made to keep the animals in more extensive conditions so that their needs are more likely to be met. Extensive systems for the production of farm animals result in better welfare of the animals and, whilst some systems lead to habitat degradation and soil loss, others do not damage the environment. However, if all livestock that are currently kept intensively were kept using the most extensive systems, much more land would be needed and there would be a very great reduction in the amount of natural habitat. Better welfare would lead to much environmental damage. Indeed, in a study of wheat, rice, dairy and beef production systems, relating yield per unit area of land to externalities such as greenhouse gas output and the extent of nitrogen and phosphorus pollution per unit of production, the more efficient the yield per area of land the lower were the greenhouse gases and pollution (Balaloud et al. 2018). The way focused here is to switch from the most intensive animal production systems to more extensive systems that provide for the needs of the animals but do so in a way that uses all resources more efficiently. A key problem is that systems that might appear efficient, such as feedlot systems for beef production, are associated with poor welfare of animals and high levels of local pollution and water usage (Broom 2019). Grain and soya fed to livestock such as beef cattle could be used directly by humans and this would lead to a very great reduction in land use, pollution and greenhouse gas production. Other very efficient and profitable systems, such as three-level semi-intensive silvopastoral production of beef or milk, are good for biodiversity and animal welfare, and reduce greenhouse gas and pollution per unit of production (Murquieite et al. 2008, Brown et al. 2013).

The protection of cows as holy animals free to roam in India is intended to result in good welfare for the animals as well as some milk production. For many Hindus, the reverence for cows extends to not killing them (Adcock, 2010). A few cows kept in India today have very good welfare. In the whole country, when there was a small population of people and of cows, the welfare of the cows was generally good. However, with the increase in the numbers of people, there has also been an increase in the numbers of cows and road vehicles. This has led to the majority of cows, at least in or near cities, having insufficient food. Some cows starve to death and many cows are involved in road accidents. Many of these cows are not cared for and can be seen in Indian communities searching through human refuse and eating plastic bags. The refuse may have in it pathogens that can lead to infections in cows and disease transmission to humans and to other cows. The plastic bags can block the gut and lead to early death by starvation. The impact of the cows is negative for some habitats and leads to pollution. What should be done in Hindu countries with old animals that have stopped producing milk? If they can't be sold, owners have no money to replace old cows and can't continue to produce milk. If older animals are allowed to be killed by people whose religion permits it, the money obtained from this enables Hindu farmers to get new young cows and to continue to produce milk. If they cannot sell the cows that no longer produce much milk, they either have to spend money feeding them or they leave them to feed for themselves. Very large numbers of cows are left in this way. Some cows are kept in gaushalas, a form of shelter, but these are far from sufficient to solve the problem. As a result at present, because cows starve, are diseased or are injured, there is extreme cruelty to many cows in India. There is also illegal trade in which animals are sent out of the country, often in very bad conditions, indeed India is the world's second largest beef exporter (<https://beeflive.com/story/world-beef-exports-ranking-countries-0-106903>). I believe that none of the bad treatment of cows is acceptable, either to Hindus or to other people in India. An intention to protect cows results, in today's

changed circumstances, in negative effects on cow welfare and on the environment. Part of the solution to this problem is to allow the humane killing of cows.

5. Actions that are positive for the environment but negative for welfare

The conservation of land in order that people can hunt wild animals has resulted in much natural vegetation being preserved in the United Kingdom and in many other countries. When landowners preserve land for shooting birds or mammals, hunting with dogs, or fishing their action generally increases biodiversity but the hunting or fishing almost always causes poor welfare. Bateson and Bewley (1997) studied red deer shot or hunted by dogs. They found that whilst accurate shooting had little adverse effect on deer welfare, hunting with dogs had much adverse effect. Whilst inaccurate shooting causes prolonged poor welfare, deer that were stalked and shot accurately died very quickly. They had a plasma cortisol concentration of less than 3 nmol per litre whilst the plasma cortisol concentration of hunted deer was 197 nmol per litre, the highest ever recorded for the species. The concentration of lactate dehydrogenase isoenzyme 5, another indicator of poor welfare, was nine times higher in the hunted deer.

Captive breeding of endangered animals can sometimes result in the extinction of rare species being prevented (Kleinman, 1989). However, the mortality rate of captive animals released from zoo conditions, whenever it has been measured, has been very high until methodology improvement in recent years (Bunnell et al., 1996; Bowker, 2008). Recent methods for helping captive bred animals to adapt to the wild have led to some success in survival rates after return to the wild (Sutherland et al., 2018). A key factor for most species is to minimise human contact or to avoid it completely. Hence zoos can hardly ever exhibit to the public animals that they wish to be part of a programme to augment wild populations. The impact of zoo conditions on many species, and in particular on animals taken from the wild or not well-adapted to captive conditions, is that their welfare is poor (Broom, 2002). Policy on captive breeding should therefore take account of the welfare of the animals as well as their potential for supplementing endangered wild populations. Whilst some wild animals such as European bison can breed in zoos, other animals such as rhinoceros do not breed well in zoos and should not be kept in them. Captive breeding for introduction to the wild should be done in semi-wild but protected conditions and not in zoos.

Many of those who buy organic products do so because of concern about the environment. Organic standards vary but some prescribe all use of chemicals in food production and include in this a ban on the use of therapeutic drugs for animals kept on farms. The health of farm animals is a very important part of their welfare so failure to use the optimal method for treating disease can lead to very poor welfare. Indeed, failure to treat diseased animals is against the law in many countries, for example as part of the duty of care in the German and U.K. animal welfare Acts. Attempts to treat farm animals using herbal medicines can be successful but would be morally unacceptable unless there was good evidence of a high probability of success. A few homeopathic veterinary medicines have some useful effect, often because of the increased human contact involved, but many have been demonstrated, in carefully controlled experiments, to have no beneficial effect at all (De Veelder et al., 2008; Helroen et al., 2004; Holmes et al., 2005). To use an ineffective or unproven veterinary medicine when an effective medicine could be used constitutes cruelty to animals. No organic standard should ban or postpone the sustainable use of therapeutic drugs. If an organic standard advocates the use of herbal or homeopathic drugs first, and use of the best drugs only after these fail to reduce disease, the animal will suffer during any time when an ineffective medicine is used. Hence such a standard is not sustainable and to follow it may be illegal.

6. Actions that are positive for welfare but negative for the environment

As mentioned above, if intensively farmed animals were all kept extensively there would be a large increase in demand for currently unfarmed land. Similarly, the use of bedding is good for animal welfare but could be bad for the environment if bedding and faeces are not disposed of optimally. However, in each of such situations, an option that is good for both the environment and welfare is available.

Domestic cats which are allowed to roam freely outside their owners' houses are sometimes used to control rodent pests in specific situations. However, the majority of roaming cats are free to do so because their owners want to improve their welfare. Some cats are at serious risk of road traffic accidents (Reichler 2003, 2004, 2005), so there are negative aspects of welfare associated with roaming, but the effect of roaming on most cats is positive. The effects of some cats on wild mammals, birds, reptiles and amphibians is close to zero, as the cats are well-fed and do not hunt, but most cats attack and kill wild animals and some kill or torture large numbers (Fitzgerald and Turner, 2000; Woods et al., 2003; Lass et al., 2013). Some pet cats kill and bring back to their homes up to 100 birds and other prey per day and many people know the screaming of birds being tortured by a cat. In every country, to allow widespread killing of prey, other than rodent pests, by cats is not justifiable, so cats that roam should always be fitted with a bell and they should be kept indoors if they continue to kill. Cat welfare is better if the cat can go out wearing a bell than if kept indoors. A balance is needed between the welfare of the cat and the welfare and conservation of wild species (Broom, 2015; Broom and Fraser, 2015, Ch 38).

7. How should we take account of all of the components of sustainability?

In order to consider adequately the various components of sustainability, good quality scientific information about each of them (see Table 1) is needed. Once information has been obtained, there are two approaches to decision-making. One approach is to compare the extent of each positive and negative consequence. In order to do this it is desirable to express each in the same units. For example, scores for: the welfare of the animals, greenhouse gas production, water-usage and river pollution might be needed. Whilst there are several sustainability assessment tools, there is a need for improvement to cover all factors and indicators. A system could be devised and discussed by experts in each of the areas. The scoring would be different in different areas of the world. For example, water usage might have much more importance in some areas than in others. Scoring would also change over time as views of the positive or negative values of the consequences of some of the factors change.

The second approach also necessitates obtaining accurate information but not necessarily about all factors. If any factor is considered to be negative to an extent that is so great that no counter-balancing would ever be acceptable to the public the system is unacceptable and should be banned. To quote some welfare-related examples, use of some procedures on laboratory animals is never permitted because the welfare of the animals is too poor. The keeping of certain species of zoo animals for public viewing, or in a conservation breeding project, is not acceptable if there are high levels of stereotypy or self mutilation. The keeping of all but domestic animals in circuses is unacceptable to most people on welfare grounds. A different example is that, if one wild animal is killing another on a nature reserve, inhumane methods for killing the first (Broom, 1990) are scarcely ever acceptable.

8. Conclusions

When a system is being evaluated, each of the many components of sustainability should be measured, precisely: welfare of humans and of

