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Cow welfare and herd size: towards a sustainable dairy industry

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Abstract

There is increasing realisation amongst the public that dairy cow welfare is not good because of certain management practices and genetic selection for high milk yield. If the industry does not act rapidly, consumers will refuse to buy milk unless good cow welfare can be guaranteed by the use of welfare outcome measures. Management in such a way that welfare outcome criteria can be met is usually more difficult in larger herds. Several other aspects of sustainability can be affected by herd size in a positive or negative way. The negative aspects have to be avoided so increasing herd size would have to be undertaken with many extra measures in place and hence greater costs than might be immediately apparent.

Keywords: welfare, dairy cows, herd size, sustainability, product quality, welfare outcome indicators

1. Sustainability

Are current dairy farming systems sustainable and what is the effect of the trend towards increasing herd size on sustainability? A system or procedure is sustainable if it is acceptable now and if its effects will be acceptable in the future, in particular in relation to resource availability, consequences of functioning and morality of action (Broom 2001, 2010). Examples of reasons why a system could be

unsustainable are inappropriate resource usage or harms to people, the environment, or other animals.

In relation to animal production, consumers drive legislation and retail company codes of practice (Bennett 1994; Bennett and others 2002) and media reports of activities or events that the public find unacceptable, may result in consumers in many countries refusing to buy animal and other products from the companies or countries involved (Broom 2001, 2009). The purchaser's idea of quality of goods has changed in the last 10-20 years. Quality referred formerly to immediately observable aspects, i.e. for an animal food product, its visual qualities and taste. These aspects of quality are still important, and expectations about taste are tending to become more refined, but other factors are now becoming incorporated into what constitutes good quality. Factors currently considered by purchasers include: (i) the welfare of the animals used in production, (ii) any impact on the environment, including conservation of wildlife, (iii) ensuring a fair payment for producers, especially in poor countries, (iv) the preservation of rural communities so that the people there are not forced to live in towns and (v) the carbon footprint of each product as factors leading to global warming are now high on the agenda of many discriminating consumers.

The future contribution of ruminants to human food supply is likely to be great because they can consume biologically widespread materials, in particular leaves that cannot be digested by humans. This value of ruminants is likely to outweigh any disadvantage associated with production of greenhouse gasses by ruminants. However, it is not likely to be sustainable in future for food suitable for humans, such as grain, to be fed to dairy cows or other ruminants. It is too great a waste of world resources.

A major harm that results from agriculture is that it normally reduces biodiversity as compared with the original natural vegetation. Where wild or semi-wild areas are cleared for animal production, substantial harm can be done to populations of animals and plants. Hence, some animal production is not considered acceptable

and products are not bought because these harms have been done, as occurred when a global fast-food chain was perceived to have been responsible for Amazon forest clearance. In order to improve biodiversity and animal welfare where animals currently consume pasture plants, one solution is to keep the animals in areas where they can browse on bushes and trees as well as grazing (Murgueitio and others 2009).

2. Dairy cow welfare

The scientific study of animal welfare has developed rapidly in recent years and welfare can be objectively assessed using a wide variety of measures (Broom and Fraser 2007; Fraser 2008). Since welfare varies from very good to very poor, we need indicators of the positive as well as the negative. Adaptive responses that are part of coping mechanisms include measurable changes in brain, behaviour, body physiology, immune system function and tissue regeneration. Some of these involve feelings. Coping with pathogens and pathological conditions is necessary if welfare is to be good so health is an important part of the broader concept of welfare, not something separate (Dawkins 1980; Webster 1994; Broom 2006; Broom and Fraser 2007). The major welfare problems in dairy cows are associated with pathologies. These are: leg and foot disorders; mastitis; and reproductive disorders. Dairy cows also have some problems because their needs in relation to social behaviour and feeding are not met. Cows thrive in stable groups with space to interact, or to avoid interactions, and their welfare is less good when there is increased competition. The number of agonistic interactions per hour in a herd was found by Miller and Wood-Gush (1991) to be 1.1 at pasture but 9.5 at much greater density indoors. When space allowance per cow is decreased, competition goes up (Fregonesi and Leaver 2002; Fregonesi and others 2007; Krawczel and others 2012).

Until 15-20 years ago the welfare of the dairy cow was not often perceived to be poor, and it was only in calf rearing that dairy production systems were regularly criticised. However, the dairy industry has been changing. Evidence of poor welfare in cows has accumulated and this has influenced public opinion in several countries.

It is important to the dairy industry that welfare problems should be addressed before there is any widespread public condemnation of breeding and management practices.

In many countries, milk yield per cow has more than doubled in the last 40 years and many cows now produce more than 20,000 kg of milk per lactation. Data from National Milk Records in the UK show an increase in average yields of dairy cows of about 200 kg/year from 1996 to 2002 and 50% of the progress in milk yield is attributed to genetics.

The increase in production in dairy cattle should be viewed with concern for several reasons. Firstly, the increase in milk yield has been accompanied by declining fertility, increasing leg and metabolic problems and declining longevity. Secondly. there are negative genetic correlations between milk yield and both fertility and production diseases, indicating that genetic deterioration in fertility and health is largely a consequence of selection for increased milk yield. Thirdly, high disease incidence, reduced fertility, negative energy balance to the point of starvation, decreased longevity and modification of normal behaviour are indicative of substantial decline in cow welfare (Oltenacu and Broom 2010).

For over 10 years, several breeding organisations in Europe and North America have included fertility and mastitis in their breeding objectives. Recently, several Nordic Countries added lameness to their Total Merit Index. A multi-trait selection programme in which health, fertility and other welfare traits are included in the breeding objective is needed in all countries. It is not the case that selecting for welfare traits is uneconomical. Calculation of the Profitable Lifetime Index in the UK suggests that expansion of this to include mastitis resistance and fertility could increase economic response to selection by up to 80%, compared with selection for milk production alone. The effectiveness of a selection programme to improve welfare is enhanced if selection acts directly on causes of poor welfare, not only on consequences. Selection tools to improve welfare in dairy cows are important for industry economics as good welfare in dairy cows is now regarded by the public as part of sustainable systems and good product quality.

3. Effects of herd size on welfare and other aspects of sustainability

3.1 What is a herd?

Farmers usually refer to a group of animals that they keep together as a herd. However, whilst a herd formed by the animals themselves will be composed of animals that know one another and may temporarily associate with and separate from other herds, the group on the farm often results from mixing animals that are strangers to one another. Biologically, the term herd should be limited to a stable social group of individuals that move around together. This can exist on a dairy farm and cows remember one another well enough to have stable social relationships when individuals, such as dry cows, leave the herd and return to it.

The term herd is used here, according to the general farming usage, to mean a group of cows that are kept in a group, with some movement of animals in and out during a year. The owners or managers of this herd may have other herds on the same farm, or on different farms but these are not called one herd. The owner of 2000 cows could keep them as one herd, or could keep them as 20 herds of 100. In the latter case, herd size is considered to be 100. The complication here is that those managing several herds may be more likely to move cows between herds than those who manage only one herd.

In the United Kingdom, the mean size of dairy cow herds increased from 83 in 2002 to 123 in 2011 (DairyCo 2012). What are the consequences of such changes and of much larger increases in the size of some herds? Since welfare is a key aspect of sustainability, effects on welfare will be considered first.

3.2 Evidence for effects of herd size on cow welfare

When cubicles were introduced in dairy herds, herd size increased. The incidence of leg and foot disorders also increased but this is more likely to be a consequence of the system than of the herd size. Wherever a relationship between a variable, such

as herd size, and a consequence, the possibility that a third factor change may have led to the consequence has to be considered. It may be that the increase in herd size has increased the risk of a problem but that there are other ways to minimise this risk. Alternatively, avoidance of the adverse effects may be difficult when herd size increases. EFSA (2009) pointed out that when herd size is increased, a possible consequence is that there may be insufficient grazing, or other food for the animals. Unless farm design is changed, for example to a radial field system, cows will have to walk further to obtain sufficient grass. Bowell and others (2003) reported that the body condition of dairy cows declined as herd size increased. With competent planning this problem can be avoided. However, another change in feeding that tends to occur when dairy cow herd size is increased is that concentrate feeding increases and reliance on pasture or cut forage decreases. Increase of concentrate intake tends to increase the risk of lameness and other welfare problems, as does decrease in pasture plant consumption. Cows have a clear preference for pasture and inability to graze means poorer welfare. Adaptation to indoor living occurs but at a cost to the animals. However, it is possible to provide a very good diet to cows in large herds.

The major animal welfare problems for dairy cows, leg and foot disorders, mastitis and reproductive disorders, are associated with high milk yield. Those who manage cows in large herds are more likely to use the genetic strains of cows that predispose to such problems and are more likely to use feeding and management methods that maximise milk yield. If they do this herd size will be positively correlated with extent of poor welfare. However, a large herd could be managed so that yield per cow is low and cost of feeding, using pasture, is low. The best way to prevent poor welfare in cows is for legislators, retailers' codes of practice and individual farmers to use maximum levels of welfare outcome indicators for each herd. The welfare outcome indicators are described by EFSA (2012). An example is to record the number of dairy cows that are lame and use a criterion as a maximum acceptable. At present, dairy cow welfare is one of the worst problems in farming so a substantial change is needed from the present situation. There would be a great improvement in welfare, and a good chance of public acceptance of the products, if the criterion for all dairy

production, large or small herds, were to be set at a maximum incidence of 10% of cows in a herd lame in any year.

In a study of Danish dairy herds, Thomsen and others (2006) found that cow mortality rate increased with herd size with an odds ratio of 1.05 for herds larger than 50 cows. The reason for this may be that some clinical disease conditions become commoner, and hence welfare becomes worse, as herd size increases (Simensen and others 2010). Probably as a consequence of greater exposure to wet slurry in large herds, the prevalence of digital dermatitis is greater in larger herds (Frankena and others 1993). Increased exposure of dairy cows to faeces can also result in greater pathogen dose so clinical disease is more likely. Some organisms that are not normally pathogenic may cause clinical disease if contacted in sufficient quantity, as has been described in some large herds for *Histophilus somni.* On the other hand, as EFSA (2009) pointed out, larger herds would normally have veterinarians present more often than small herds so the potential for recognition of problem animals in the herd should be greater. Also, staff training affects disease recognition and could be better in large herds. It is not known whether or not either of these is true in practice. Another increase in disease risk in larger herds is that if a very infectious pathogen such as foot and mouth virus gets to a herd, more animals will be infected in a large herd than in a small herd.

Facilities for calving could be good in large herds but where farmers increase herd size, they may not improve calving facilities at the same time (EFSA 2009). In addition, with larger herds the number of cows calving on peak calving days will be greater. This can result in more cows calving in groups. Cows prefer to isolate themselves from other cows when calving and group calving can result in calves not receiving colostrum because of mis-mothering or other calves taking it (Edwards 1983; Broom and Fraser 2007). Assistance at difficult calvings may also be reduced.

Many of those who increase herd size have reduction in staff costs as an objective. As a consequence of staff reduction, less attention may be paid to each cow. Waiblinger and Menke (1999) reported less frequency of contact and less intensity of contact between staff and cows as herd size increased. In larger herds there is

also a greater likelihood of personnel change, a greater number of persons carrying out milking and a greater variety of problem solving methods to which the cows in the herd are exposed (Menke and others 1999, Waiblinger and others 2001). Since cows are disturbed by the advent of new stockpeople and a greater turnover of staff tends to be associated with lower average care, the welfare can be worse in the larger herds as a consequence. If each cow has less contact with humans, they show more fear of people, their welfare is worse, they are more disturbed by activities such as hoof-trimming and these activities are more difficult for staff (Rushen and others 1999; Waiblinger and others 2003). Again, these problems are soluble but the risk of poor welfare is higher with larger herds.

As herd size increases there are usually more occasions when re-grouping of animals occurs (Jóhannesson and Sørensen 2000; Phillips 2002; Boe and Faerevik 2003). Re-grouping causes problems to cows and especially to heifers (Wechsler and Lea 2007, von Keyserlingk and others 2008). Whilst large groups of calves can be stable (Faerevik and others 2007), fewer positive interactions occur in larger groups of cows than in smaller groups (De Rosa and others 2009). More agonistic interactions occur in larger groups of cows than in smaller groups (Kondo and others 1989) and introduction of animals to one another for the first time, or after long periods of separation, has a range of negative effects on welfare and production (McLennan 2013). Welfare and production in dairy cows is improved if they live in stable social groups with few introductions (Takeda and others 2003; Simensen and others 2010)

3.3 Effects of herd size on the health of human consumers

Whilst the nutrient quality of dairy products is not likely to be affected by herd size, the risk of disease in consumers may be affected to a small degree. Bovine spongiform encephalopathy arose because of feeding animal protein to cattle and, although similar acts are now unlikely, those who have the biggest herds might be the most likely to attempt to save money in ways that affect human health. If animals in large herds are stressed by social problems, they may be more likely to secrete pathogens and this could have effects on *Salmonella* or other pathogens in

dairy products. If there were greater use of antibiotics in large herds, the probability of antibiotic resistance could increase.

A management consequence of large herd size is a greater likelihood that silage will be used to feed the cows. This can increase the risk of *Listeria* in milk.

3.4 Effects of herd size on use of world resources

Some of those with large dairy herds will reduce use of fresh or cut pasture or other leafy material as food for the cows. If grain or other food usable by humans is used for dairy cows, the system is less likely to be sustainable in the long run.

3.5 Effects of herd size on the environment

Biodiversity in areas used for dairy production is often low but could be increased by use of a wider variety of plants, including shrubs and trees, as food for the animals. Large herd size does not necessarily restrict such developments but if the animals are kept inside buildings, they cannot directly harvest the plants so new developments are less likely to occur.

The high level of manure produced by large herds, or by farms with a number of herds, opens up possibilities for individual farmers to have their own biodigesters and to thus reduce carbon wastage and greenhouse gas production. Water pollution can also be managed better by those with more cattle. On the other hand, if no extra effort were made to reduce pollution, larger herds would lead to more pollution than smaller herds.

3.6 Effects of herd size on preservation of rural areas

Poor farmers in remote areas are less likely to have large herds than richer farmers. Although there is no fundamental reason why large herds should not be located in remote areas, and hence help to preserve the communities, it would seem more

likely that large herds would be located in places where communications of all kinds are good. Hence a move to large dairy farms might remove work from some rural areas.

3.7 Effects of herd size on human communities where they are located

High levels of manure production without use of digesters etc. would lead to increased odour nuisance for those living nearby but this can be avoided. Increased farm size, such as that associated with a 10,000 cow farm, would result in a great increase in road traffic in the area and this may not be possible or acceptable to the local community.

3.8 Effects of large herds on use of GM plants and animals

Public concern about genetically modified (GM) organisms is substantial, if not based entirely on the available evidence. Large herds might lead to greater pressure for use of GM plants to use in feed, as has occurred in the U.S.A., and for use of GM cattle. Whilst neither is a necessary consequence of herd size, the public antipathy to GM may affect acceptability of large herds.

4. Conclusions

There is increasing realisation amongst the public that dairy cow welfare is not good because of genetic selection for high milk yield and certain management practices. If the industry does not act rapidly, consumers will refuse to buy milk unless good cow welfare can be guaranteed by the use of welfare outcome measures. For example, a criterion might be that not more than 10% of cows should be lame in any year.

There are advantages of large herd size as well as disadvantages for cow welfare. However, an increase in herd size, increases the risk of poor welfare once there are

more than 50 cows in the herd. Hence management in such a way that welfare outcome criteria can be met is more difficult in larger herds. Several other aspects of sustainability can be affected by herd size in a positive or negative way. All decisions in relation to this subject should be taken considering carefully what will be acceptable in 10 or 20 years from now. Current dairy farming is under challenge and needs to change rapidly. Increasing herd size would have to be undertaken with many extra measures in place that might well make it more expensive than the use of current herd size.

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