

The Making of Sustainability in Farm Animal Breeding and Reproduction

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Abstract

The paper examines sustainability within the context of farm animal breeding and reproduction. Sustainability can benefit breeders in two ways: (i) it invites breeders to take a comprehensive look at potentially conflicting breeding-related concerns, and to face any difficult trade-offs; and (ii) presenting the concerns within a framework (i.e. of sustainability) that is endorsed by society as a whole enables the breeder to make room for communication to, and dialogue with, a broader audience than the rather narrow group of people directly involved in farm animal breeding. The paper presents key concepts and factors involved in sustainability and discusses the results of an attempt within a thematic network, SEFABAR, to adapt and apply sustainability to farm animal breeding and reproduction. Defining and adapting sustainability to breeding conditions and farm animal circumstances is more than a technical/scientific task. It is necessary to address underlying value questions, to clarify priorities and to involve stakeholders in dialogue. Fundamental, ethical breeding dilemmas which emerge when the notion of sustainability is considered have no easy solutions but can be addressed through a series of steps that are developed and discussed in the paper, and in particular by taking into account four key characteristics of sustainability.

Keywords animal breeding, communication, criteria, ethics, sustainability, values

1. Why do we need sustainability?

Why should animal breeders and animal breeding scientists discuss 'sustainability'? The concept is notoriously difficult to clarify and has a distinct air of political correctness.

On the other hand, the concept seems (for good or bad) to be part and parcel of present-day discussions regarding the future of agricultural production. The notion of sustainability, for all its ambiguity, has an essential component relating to the management of renewable resources. And clearly the genomes of farm animals are a renewable resource of great importance to mankind.

Over time farm animal breeders have incorporated an ever-wider range of concerns in devising breeding goals. Farm animal breeding was at first preoccupied with the exterior of animals — and with prizes at animal shows. Later the focus turned to productivity. Not too long ago concerns about product quality came to play a more significant role in the mind of farm animal breeders, and quite recently functional traits affecting the health and welfare of future farm

animals have become more important. Now the preservation of genetic resources for future use is being taken into consideration.

How does 'sustainability' add anything new to this? In at least two ways the notion may make a difference. First, the idea of sustainability invites the breeders to take a comprehensive look at various potentially conflicting breeding concerns, and to face any connected, difficult trade-offs that have to be made. Second, by presenting breeding concerns within a framework (of sustainability) that is endorsed by society as a whole, the breeder makes room for communication to, and dialogue with, a broader audience than the rather narrow group of people directly involved in farm animal breeding.

Once the need for a concept like sustainability has been recognised, breeders and other stakeholders may seek a ready-made definition of sustainability that they can put to use. However, the expectation that such a definition will be readily found is for various reasons unrealistic:

- *Sustainability is not a single, easily measurable or tangible notion.* It should rather be looked upon as a more or less structured set of ideas, a notion which acts as an umbrella for different visions and beliefs held collectively by society or by individual groups.
- *Translation or adaptation of the general concept is needed.* A specific interpretation of sustainability, when singled out, will not say anything about how to proceed with farm animals, or within breeding and reproduction of farm animals. However, successful adaptations of the general notion are known from natural resource management.
- *Prioritisation is necessary.* Even if the general notion can be adapted within farm animal breeding and reproduction, and perhaps specified for distinct species groups, not all things 'good' will necessarily be achievable. Conflicting concerns need to be identified. Moreover, there is no single, 'true' account of (say) the conditions under which a 'sufficient' number of animal welfare goals will be met, or what would be a 'satisfactory' consideration of the environment in pig breeding. Internally, within the breeding communities, a discussion of which concerns and aspirations are most important needs to take place first.
- *Communication of motivation is needed.* The fact that a more operational concept of sustainability within the context of farm animal breeding and reproduction has emerged (if and when it has) is not a matter for breeders alone. It also concerns the wider agricultural community as well society as a whole. From the commercial perspective of 'value added' to the product, there is, finally, a need to communicate the idea, the adaptation and the prioritisation.

Thus to embrace sustainability we need to make the concept of sustainability more clear. We need to examine the philosophical background and the value implications to get a basic grasp of the notion. To define it in the specific context of farm animal breeding and reproduction, we need to look at how sustainability concerns can be translated into more tangible breeding goals, and to develop suggestions as to how sustainability could be of actual benefit to the breeding industry and animal breeding scientists.

This paper examines key concepts and factors involved in making sustainability applicable within the context of farm animal breeding and reproduction. Notably, it presents and discusses results of an attempt within an EU-funded thematic network to make farm animal breeding and reproduction more sustainable. This

network, SEFABAR (Sustainable European Farm Animal Breeding And Reproduction), running from 2001-2003 involved participants from industry, animal science, social sciences, ethics and special interest groups (Liinamo and Neeteson, 2001).

Given the nature of the subject, the paper does not pretend to give ready-made solutions. It aims instead to provide an introduction to sustainability which, besides offering a better grasp of the concept, will facilitate the application and adaptation of sustainability to farm animal breeding and reproduction. To reinforce this understanding, part of the process the breeders of the network went through — acquiring skills in dealing with sustainability in connection with four species groups: ‘ruminants’, ‘pigs’, ‘poultry’ and ‘aquaculture’ — is described. With the professional assistance of an ethics partner (the authors of this paper, and in the first period Stine B. Christiansen) the breeders were required to (i) suggest their own definitions and interpretations of sustainable farm animal breeding and reproduction, (ii) characterise key concerns and priorities, (iii) identify resulting dilemmas, and (iv) suggest ways toward a meaningful operationalisation through the elaboration of so-called sustainable breeding scenarios.

2. The evolution of the idea of sustainability

It is often stated that there are thousands of definitions of sustainability, but in point of fact there are thousands different *wordings* of what sustainability is. And often, these wordings and their implications are not much discussed. This leaves the user of sustainability, including the animal breeder, bewildered. To get better bearings here, it is instructive to look at the development of the idea of sustainability. This idea has evolved over hundreds of years, and has come to encompass an increasingly wide set of concerns.

Sustainability is a characteristic of states or processes which can, with the right kind of management, be maintained. In this very basic form the idea is to maintain renewable resources for harvest and consumption in perpetuity.

This idea was implemented in a more than 350-year old principle of *sustained yield*, described systematically for the first time in connection with German forest and mining activities. Sustained yield was the regular periodic output that a forest could produce continuously at a given intensity of management without impairing the land's productivity.

This use of the general idea of sustainability focused on the *continuous procurement* of goods from natural resources and connected demands for the *wise use* of resources for the sake of present and future generations. During the next 200 years, the concept of sustained yield was in different interpretations something of a lodestar in forestry especially, but also in fisheries and other types of primary industry concerned with maintaining a regular output from a natural resource.

Much later, and in its contemporary format, the idea of sustainability then developed to cover more than a concern with how to maintain consumable resources such as fish, firewood or fodder. At the 1972 Stockholm conference on the human environment, and even more so at the 1980 ‘World Conservation Strategy’, released by the World Conservation Union (IUCN), the focus of the idea of sustainability was expanded beyond issues concerned with immediate human livelihood to cover the *preservation* of species and ecosystems. Nature preservation became a major issue as so-called key habitats and keystone

species came to be threatened, or near extinction, at an alarming rate (exploitation and other economic developments, especially in developing countries, being the primary causes). Thus sustainability was no longer merely about preserving natural resources but about preserving biodiversity at large.

In 1987, the well-publicised report of the World Commission on Environment and Development (WCED) 'Our Common Future' shifted the focus to *distribution*. Given that some sort of wise use of resources was possible — what would be a fair distribution of natural resources between generations? Thus, the notion of sustainability now combined the idea of wise use of resources and other natural goods with the idea of a fair distribution over time. In the WCED report, a famous general definition of sustainable development appears: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987: 8).

The work of the Brundtland commission and the IUCN was elaborated at the 1992 Earth Summit. This produced the 'Rio Declaration on Environment and Development', in which it was stated that ongoing development could not take place without environmental protection, including preservation of natural biodiversity — these were recognised in the Declaration as something worth protecting in itself. Another notable outcome of the summit was 'Agenda 21' — a blueprint of how to make development economically, environmentally and socially sustainable. Following this, issues having to do with *intra-generational distribution* (such as fair distribution between rich and poor countries, and third world development) were included in the notion of sustainability with the goal of "...establishing a new and equitable partnership..."

Over the past decade, with the notion of sustainability enjoying very broad support from decision makers and all sectors of production and management, more and more issues have been *considered* — covering many matters, from a good working environment to profit for the farmer and animal welfare. These issues were seen as important and of value in different disciplines. They were included under the umbrella idea of maintaining and making wise use of resources as well as preserving natural values (see Figure 1).

Figure 1. Diagram of selected aspects of sustainability, as the concept has developed over the past 350 years

	Key concept	Key aspect
Time ↓	Sustainability/ Sustained yield	<i>Procurement</i> of goods <i>Wise use</i> of resources
	Sustainability/ Sustainable development	<i>Preservation</i> of species and ecosystems <i>Distribution</i> between generations, between rich and poor <i>Consideration</i> of biodiversity, animal welfare, working environment, food safety, farmer profitability, ...

With the push to employ production systems respecting the ecological basis of development to protect the interests of future generations, sustainability had in effect been turned into something of a buzz word. However, this marked the beginning of a process of 'conceptual erosion' (Dubgaard et al., 1999).

In the process of such erosion, features and objectives considered to be of positive value – almost inevitably good – are added to a notion, thereby making it seemingly applicable to a lot of issues, disciplines and sectors. In this way, the notion of sustainability came to have broad reconciliatory appeal. Initially, this may appear attractive. However, concepts become harder and harder to deploy as they incorporate more features. (Not surprisingly, the notion of sustainability has been used by many in the belief that it supports their specific values.)

The now prevailing idea of sustainability seems to offer much. It is indeed difficult *not* to be in favour of a development which: (i) allows industry to prosper, (ii) gives a sustained yield of high quality products, (iii) protects the natural environment, (iv) caters for the needs of future generations, (v) makes provisions for the needs of poor people, and (vi) takes care of animal welfare, and so on. However, the problem now becomes one of balancing several potentially conflicting ideals – assuming of course that these ideals can be satisfactorily identified.

Sustainability is at once a fine idea and hopeless concept. It is good because it reminds us of the fate of future persons, it is hopeless because it begs for operational content. (Bromley, 1998: 239)

Once it is recognised that the concept of sustainability can be of no practical use in its broad, yet somewhat vague sense, there are two ways to proceed. Either the concept is surrendered entirely to decision makers and politicians who want to appear to be progressive, or it is 'braced up' so that sustainability becomes an operational ideal once more (Dubgaard et al., 1999). This second option has been taken within natural resource economics. It has been a success. Much greater awareness has been created about the role of underlying ethical assumptions about such matters as distributive justice and the value of nature. However, as the focus is sharpened, and as included sub-concepts are clarified, sustainability has inevitably lost its role as an instantly recognisable denominator for all things 'good'.

Although some sort of broad, general concept of sustainability concerned with conservation and wise use of resources is needed, the real work consists in adapting that notion to the specific conditions, agendas and priorities of (say) agriculture and animal husbandry – looking at issues such as animal welfare and food safety. Having gained an initial understanding of the general concept of sustainability and its evolutionary process, we can ask how sustainability should be defined when it comes specifically to farm animal breeding and reproduction.

3. Defining sustainability in the context of farm animal breeding and reproduction

Clearly within agriculture in general, and livestock production in particular, there is great interest in trying to apply a general notion of sustainability to more specific practical issues. And lately, within the context of farm animal breeding and reproduction, the notion of sustainability has also been specifically

addressed. However, to what extent can breeding and reproduction draw on the lessons of agriculture and livestock production?

Sustainable agricultural production systems, including animal husbandry, are the subject of a growing numbers of papers (to cite just a few, Alrøe and Kristensen, 2000; Broom, 2001; Francis, 1997; Heitschmidt et al., 1996; Hermans and Vereijken, 1994; Hindar, 1992; Svennevig and Reinertsen, 1999; Pearse and Drew, 1998; Pimental et al., 1989; Thompson and Nardone, 1999; Viatte, 2001; Wit et al., 1995).

In these, and other papers, sustainable systems are in general defined as those that balance what the current generation and future generations want, and in terms of what is biologically and physically achievable in the long run (Vavra, 1996). More specifically, it has been stated that to be sustainable, animal production has to meet a number of ecological, ethical and economic requirements: or, phrased in another way, sustainable livestock production means production that is ecologically sustainable in terms of the environment and biodiversity, and ethically and economically sustainable (Torp-Donner and Juga, 1997).

Commonly listed elements connected with the term 'sustainable agriculture' include: resource efficiency, profitability, productivity, environmental soundness and social viability (Francis, 1997). Olesen et al. (2000) present the new idea in the term 'sustainability' as the tenet that environmental concerns, genetic diversity, ethical considerations and social aspects should be accounted for in addition to short- and long-term economic value.

In these definitions thorough consideration of the specific problems relating to farm animal breeding and reproduction, including the balancing of concerns, is missing. This is an important omission in the context of farm animal breeding and reproduction.

A systematic review of the literature on sustainable farm animal breeding and reproduction within Western Europe and the United States addressing either sustainability or sustainability relevant issues (such as animal health, productivity, genetic diversity) was performed in the networking period (Gaworski et al., 2002). It confirmed that there is a wealth of literature on the *components* or concerns of sustainability — such as animal welfare or functional traits — and that this literature contained more or less explicit discussion on sustainability (e.g. Christensen, 1998; Broom, 1998).

However, very few papers indeed focus explicitly on farm animal breeding and reproduction in conjunction with *sustainability* (e.g. Amer et al., 1998; Brenøe and Torp-Donner, 1999; Hodges, 1991; Martyniuk and Planchenault, 1998; Olesen et al., 2000; Olesen et al., 1998; Stear et al., 2001; Torp-Donner and Juga, 1997). Even less has been written on sustainability in relation to the breeding and reproduction of specific species (e.g. Kanis, 1993; Leenstra and Ehlhardt, 1994; Olesen and Bentsen, 1999).

While some papers try to combine probable characteristics of future agricultural systems and potential animal breeding strategies (e.g. Olesen et al., 2000), the majority of these papers do not consider the concept of sustainability in a way that allows breeders and other stakeholders in breeding and reproduction to pursue sustainability in practice. Thus there is a need to define sustainability from scratch within the breeding and reproduction sector.

In the attempt made by SEFABAR, working parties consisting of breeders working with different species groups (ruminants, pigs, poultry and fish) tried to construct their own definitions of sustainability. It will be instructive to consider

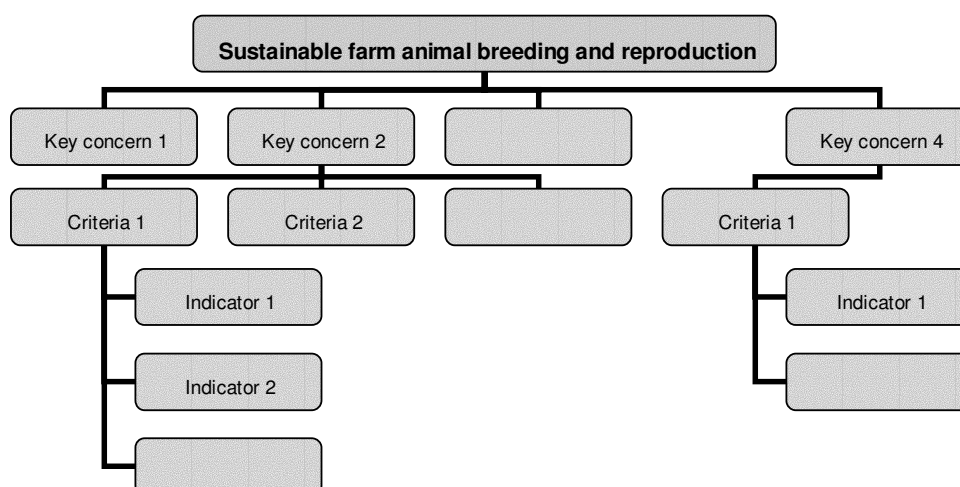
some of these first attempts. An example of a very general definition was “genetics for future use” (Liinamo and Neeteson-van-Nieuwhoven, 2002a: 24). This may be applied to any breeding activity, as clearly the breeding of an animal species will be for near, medium or long-term future use, not the breeds presently in use. This kind of definition holds no information about what is actually entailed in breeding and reproduction becoming more sustainable. A more comprehensive, yet not very elucidating, definition which also came up in the early stages of the work of another working party was: “Produce animals that fit better into the environment for the production of good quality products for present and future generations in an acceptable manner” (Liinamo and Neeteson-van-Nieuwhoven, 2002a: 15). This definition begs the question of what is actually meant by “fitting better into the environment etc.” more efficient use of resources, or livestock better adapted to certain conditions? It also raises the question, what are the criteria of acceptability, and *who* will actually decide what is acceptable?

At the end of the networking period, the working parties agreed upon a common definition across the species groups represented: “Sustainability in animal breeding and reproduction means the extent to which animal breeding and reproduction, as managed by professional organisations, contribute to maintenance and good care of animal genetic resources for future generations.” This definition was broken down into more concrete requirements.

In the process, it generally turned out that the working parties gave well-presented descriptions of their work areas, identified and discussed trends, and considered specific problems relating to future breeding and reproduction practices. The working parties came up with definitions, but at first the underlying discussion of why the specific wording was chosen was lacking. In further work, the participants realised that there are several layers (so to speak) in a definition that instead of trying to encompass everything in a comprehensive, one-off definition, they could address concerns separately.

The workshops held during the networking period revealed some confusion with regard to terms such as ‘definition’, ‘principles’, ‘concerns’, ‘criteria’ and ‘indicators’. These terms needed to be clarified before it was possible to proceed (see Figure 2).

Figure 2. Schematic diagram of the components of an operational sustainability definition within farm animal breeding and reproduction.



Generally, the basic definition of sustainable farm animal breeding and reproduction is broken down into key concerns, which are then collapsed into more detailed criteria and indicators. A concern might be a single area, such as 'animal welfare' or 'production efficiency'. Criteria, in contrast, must be expressed in the form of the relevant concern or a special tenet of it, coupled with a direction (e.g. to *maintain* productivity, to *decrease* use of resources, or to *enhance* animal welfare) or presented as a statement detailing a desirable state, process, value or quality regarding the concern in question (e.g. "there is a specific policy in place with the following six points to consider on animal welfare in place in breeding of dairy cattle "). Indicators are measurable, or at least verifiable, sub-statements about specific genetically determined traits used to determine the truth-value of the criterion at stake: is it fulfilled or not, and to what extent?

Typically, on the basis of experience from other sectors, such as agriculture and forestry, a basic definition is broken into 4-6 concerns (sometimes called principles), which then contain 2-4 criteria each. Each criterion is assessed through 2-4 indicators, depending on the level of complexity of the criterion. If, for example, we start with one definition, and 4 concerns, we end up with between 8 and 16 criteria, and 32-72 indicators.

Specific demands can now be set up for the criteria and indicators (C&I). Are they closely and unambiguously related to the overall concern in question? Are they easy to detect, record and interpret? Does the indicator continue to give you useful and meaningful information over a wide range of situations?

The *important* thing, however, to learn from this procedure is not so much the choice of the exact wording (which might, mistakenly, be conceived of as a 'magical' stand-alone sentence) but the outcome of engaging in a process whereby underlying goals and objectives are thought about and assessed. Meaningful use of sustainability requires the stakeholder in question (in this case the breeding industry) to engage in a *sustained* attempt to define sustainability in a clear manner. As a second step, the stakeholders must point out their concerns and the implications of these for the reaching of desirable breeding goals.

4. Identifying sustainability concerns and translating these into breeding goals

Needless to say, a multitude of ethical concerns can appear to be of relevance to modern farm animal breeding and reproduction (Gamborg and Sand e, 2003; Sand e et al., 1999). The issue, however, is this. What do the breeders and other stakeholders *in fact* consider to be the relevant concerns about sustainability, and how should potentially conflicting concerns be handled?

The most pressing concerns about modern farm animal breeding and reproduction include animal welfare, health, animal integrity, biodiversity, environmental protection, consumer safety, food quality, and competitiveness. The SEFABAR species groups were required to single out what they considered the most important concerns in relation to their species. However, because these broad concepts, such as animal welfare (Broom, 1988; 1991; Jensen and Sand e, 1997; Appleby and Sand e, 2002) and food quality, mean different things to different people, clarification and definition of these terms was also needed.

Most working parties identified categories of concern such as economics, environment, quality and diversity. 'Quality' was often loosely defined so as to relate to improving product quality, as well as the health and welfare of animals and food safety for consumers. 'Diversity' covered the maintenance of biodiversity, the improvement of adaptability to diverse environments and greater product diversification. The 'environment' included the minimisation of pollution, and the improvement of efficiency of feed resource and land utilisation. 'Economics' had to do with improving production efficiency and economic viability, over both the short and longer term (Liinamo and Neeteson-van-Nieuwenhoven, 2002).

Handling of the concerns listed differed between the species groups. However, common elements were found. Maintenance of genetic diversity was prioritised by the ruminant and pig groups. Minimisation of environmental impact and prudent use of (feed) resources were listed in connection with ruminants, poultry and fish in aquaculture, where breeding is a relatively new business, interbreeding of domesticated stocks with wild conspecifics was considered a negative environmental impact. Concern for animal welfare and animal health were listed by the ruminant, pig and poultry species groups, but maintenance of animal integrity (i.e. maintenance of normal physiological function) was a specific concern about fish. Production concerns, such as breeding animals which are robust and efficient in different conditions or of an acceptable price, were listed for ruminants, pigs, poultry and fish. Finally, concerns relating to the demand for food safety and product quality, and relatedly consumer acceptability, were highlighted for ruminants, poultry and fish (Liinamo and Neeteson, 2001).

In the beginning, the breeders were able to translate their stated concerns into more specific criteria in only a few cases. Such translation (see Figure 1) of broad areas of concern into more specific criteria is necessary if some sort of follow-up monitoring of how the breeding and reproduction business is doing in relation to these concerns is to occur.

Moreover, initially the breeders did not consider how the different concerns might come into conflict with each other. To state merely that breeders of broilers should have as prime concerns animal welfare, environment, quality and efficiency is to give no information about what it actually requires of changes in the breeding practices, and to what extent (say) efficiency is to be promoted at the cost of animal welfare. These specifications and trade-offs will depend on value assumptions, i.e. the breeder's beliefs about the relative importance of breeding goals.

After the first year of the network and the outcome (in definitions and lists of concerns) a 'checklist' was produced by the ethics partner as an aid to the proper handling of concerns and the preparation of definitions of sustainability in relation to breeding goals. The list contained five basic questions which needed to be asked during, and after, the process of relating sustainability to specific farm animal breeding and reproduction issues. These basic questions are broken down into ten more concrete items that should always be considered when working with sustainability (Table 1).

The first three questions in Table 1 concern the notion of sustainability. What is the vision? What type of definition is being used? What concerns are included? Just as important, we ask what concerns are excluded and whether there is an explicit motivation or discussion of these particular choices. As mentioned above, many of the working parties initially had difficulty in making a well-discussed definition and in seeing the point of elaborating their own definitions.

Table 1. Checklist for adapting sustainability to farm animal breeding practices (Gamborg & Sandøe, 2002a)

What concept of sustainability is used?	<p>1. Ideal or vision of sustainability</p> <p>2. The kind of definition used</p>						
What is deliberately included/not included?	<p>3. List of included concerns – and why they exist</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; vertical-align: top;"> Productivity Food/product quality Animal health Wise use of resources </td> <td style="width: 3%; text-align: center; vertical-align: middle;"> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </td> <td style="width: 33%; vertical-align: top;"> Production/cost efficiency Consumer safety Animal welfare Environmental protection </td> <td style="width: 3%; text-align: center; vertical-align: middle;"> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </td> <td style="width: 28%; vertical-align: top;"> Competitiveness Animal integrity Biodiversity Other </td> <td style="width: 3%; text-align: center; vertical-align: middle;"> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </td> </tr> </table> <p>4. List of concerns which have <i>not</i> been included – and why</p> <p>5. Statement of concerns which are the key concerns</p>	Productivity Food/product quality Animal health Wise use of resources	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Production/cost efficiency Consumer safety Animal welfare Environmental protection	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Competitiveness Animal integrity Biodiversity Other	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
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How are the concerns connected with breeding goals?	<p>6. Clear breeding and reproduction policy in relation to each of the key concerns</p> <p>7. Qualitative or quantitative criteria available between potentially conflicting concerns/criteria</p>						
What are the motives and underlying assumptions?	<p>8. Overview of priorities between potentially conflicting concerns/criteria</p> <p>9. Motivation of stated priorities available</p>						
How is this communicated to the rest of society?	<p>10. Definitions, breeding goals, selected concerns, identified criteria, ensuing priorities, and policies explained</p> <p>(a) within the agricultural community</p> <p>(b) to the rest of society/other stakeholders</p>						

However, the working parties realised that without a clear definition, and without a clear statement of included and excluded concerns, it would be difficult to take sustainability any further. In particular it would be hard to formulate directional criteria and to elaborate breeding goals – the topic of the third question. Here the concerns are translated into more practically useful and operational breeding

and reproduction policies. They become criteria for individual breeding characteristics or traits which can be qualitatively or quantitatively assessed. The breeders in the network did ultimately link concerns and criteria with operationally clear breeding goals.

5. Engaging in dialogue with stakeholders on values and priorities

Moreover by carefully *stating* what is included and what is deliberately not included as a concern, we can use sustainability to convey the values which are the basis of priorities and goals to stakeholders. Stakeholders can then more easily see if they share the values expressed by a particular breeding goal, and breeders can adjust their set of concerns, if possible and desirable, to be in better accord with other stakeholders.

The last two questions in Table 1 relate to the translation of the vision of sustainability that is specified by the included and excluded concerns. An important task at this stage is to make clear the relative priority of different concerns. Each of the concerns has to be assessed against the others to see if there are potential conflicts between them. For example, productivity vs. concern for animal welfare, or wise use of resources vs. competitiveness or, as stated by one working party: “Short-term economic demands must be balanced against long-term sustainable value. A potential problem is the conflict between the requirement of genetic diversity to maximise genetic variability and the automatic effect of selection to increase the frequency of desired alleles, which reduces variability “ (Liinamo and Neeteson-van-Nieuwhoven, 2002a; 16).

It should be mentioned that the SEFABAR network also involved members with one specific value to pursue. One such was the specialist interest group on animal welfare, who had the job of combing through the breeders’ work and offering suggestions for ways in which animal welfare could in their view be more aptly and adequately addressed. This group and the breeders certainly did not agree on all aspects of animal welfare but the network gave room for dialogue between industry, scientists and a special interest group, which enabled everyone to go into the arguments a bit more deeply instead of engaging in mud-slinging and painful, unproductive confrontation.

In essence, conflicts of concern can be solved in two complementary ways: by (i) technological accomplishments or (ii) increased transparency. The technological accomplishments or changes in breeding practice can make compromise possible. Thus productivity or rather profitability might be maintained without reductions in animal welfare. As stated by one of the working parties, “Pig breeding programmes can be designed such that no reduction in health (e.g. piglet vitality) and welfare (leg weakness) due to selection on increased production and reproduction will occur.” (Liinamo and Neeteson-van-Nieuwhoven, 2002a; 29).

Transparency, on the other hand, results in the assignment of different relative priorities to the various concerns. So, it might be stated that animal integrity is not a *key* concern, or that animal integrity is not as highly prioritised as consumer safety. In this vein, one of the working parties stated that “Product quality is a *key issue* of sustainable production. The primary goal of any production is to supply products meeting objective as well as subjective demands of the consumers. Sustainable breeding must be directed toward this goal” (our emphasis). Such clear statements will allow stakeholders to react accordingly.

The last, but not the least important, part of the process of adapting sustainability to farm animal breeding and reproduction (see Table 1) concerns *dialogue*. The dialogue in question will be about not just results but also the motivations behind them, and it will involve stakeholders within the agricultural community as well as other societal groups, since public perception of agriculture, and animal breeding and husbandry, is in general becoming increasingly influential in decisions about directions for the industry (Christensen, 1998a). In this genuine dialogue – not just a one-way statement – openness about ethical dilemmas and set of values, and transparency about ensuing priorities and choices, all play an important role. This role, which may be more or less emphasised, ultimately depends on the way sustainability is to be used in farm animal breeding and reproduction.

6. Using sustainability in practice in farm animal breeding and reproduction

Once sustainability has been defined and (to some extent) clarified in relation to individual species groups, the following question arises: how is sustainability to be used in farm animal breeding and reproduction? Will the breeder seek to promote it simply to appease stakeholders such as consumers and civil society, or does it represent an essential tool which enables better management of breeding and reproduction? The appropriate way to introduce and exploit sustainability depends very much on whether it is to be used (as we might put it) as a *communication tool* or a *managerial instrument* (see Table 2).

Table 2. Requirements for sustainability when used either as a managerial instrument or as a communication tool (Gamborg & Sandøe, 2002a).

Characteristic/ Requirement of sustainability	Managerial instrument	Communication tool
Use	Policies and breeding goals	Stakeholder communication
Perspective	Mainly breeders	Mostly rest of society
Agenda	Well-defined	Broad
Breeding objectives	Clear	Multi-purpose, vague
Sustainability concerns	Few and clear Non-conflicting	Many Conflicting
Key issues	Usability Controllability	Accountability Credibility

If sustainability is employed mainly as a managerial instrument, it can be directly used within breeding industry in the formulation of policies and provide a framework for elaborating breeding goals. Here, the selection and control of

aspects that are to be considered and included is one of the main issues. In relation to sustainability, the issue of selection is clear and well-defined. The relatively few aspects that breeders regard as relevant tend to be of a non-conflicting nature.

If, on the other hand, sustainability is used as a tool for communication with stakeholders and society in general, it can be used as a way of flagging, or directing attention to, specific issues. These might be known to be of concern to (say) consumer organisations. The breeding industry can thus make sustainability a way of showing society as a whole, and other stakeholders in particular, that it is aware of these issues by including them in an ever-growing concept of sustainability. At the same time it can draw attention to the fact that it will pay special attention to these concerns.

Two of the key issues, when we use sustainability entirely for communication purposes, will be credibility and accountability towards stakeholders rather than usability and controllability. In contrast with the situation in managerial use of sustainability, the range of things to consider under the sustainability banner here is broad. The concerns arising, which different parts of society perceive as important, are more likely to be in conflict with each other. It follows that breeding goals based directly on sustainability in this sense have to serve many different purposes and run the risk of becoming slightly vague.

In the long run, however, it is crucial that there is a connection between what breeders *do* and what they *say they want to do*. Therefore it is important at the same time to approach sustainability from the two perspectives: to look at sustainability as a managerial tool *and* a communication tool. One perspective requires a specification of the breeder's own goals, and the other requires discussion of these goals in the light of a broader agenda set by society.

For these reasons, the development of well-discussed definitions of sustainability within farm animal species groups is necessary as is the identification of relevant concerns from various perspectives, and the tracing of the relationship of these to tangible breeding goals and workable traits. Here scenarios come into play.

7. Building scenarios for sustainable farm animal breeding and reproduction

The next step in communicating sustainability, and also a synthesising goal of the thematic network, is building scenarios for sustainable farm animal breeding and reproduction. Scenarios are, among other things, used to predict future events and to look at the consequences of possible changes in technologies and economic conditions. Scenarios can be powerful decision-making and planning tools, as well as a means of enhancing dialogue with stakeholders. However, there is considerable conceptual ambiguity involved in the construction of sustainable farm animal breeding and reproduction scenarios. To capitalise on the full value of the tools, great awareness of what is entailed in the construction of a scenario, together with conceptual clarification, is required (see Gamborg and Sand e, 2002b).

There is not just one type of sustainable farm animal breeding and reproduction scenario. Instead a combination of two types of scenario has to be used here: a technical/socio-economic scenario and a value-based scenario (see Gamborg and Sand e, 2002b for details of these types). The strength of *technical/socio-economic* scenarios is that they will serve to improve our understanding of what

is likely to be possible. The strength of *value based* scenarios is that they will play out the technical and/or socio-economic possibilities in the light of different values and resulting priorities.¹

When constructing these scenarios – whether the technical/socio-economic scenario or the value-based scenario – it is important to: (i) make the specific objectives of the scenario clear, (ii) state what the scenario's main use should be, and (iii) present the assumptions and values in a clear and transparent way, i.e. consider and explicitly convey what is meant by 'sustainable', by 'animal welfare', 'biodiversity' or whatever other concerns are included.

8. Work ahead on sustainability in farm animal breeding and reproduction

Sustainability can be much more than a marketing ploy or an empty rallying cry of interest groups. If pursued sensibly, it can be a powerful management instrument and open up discussion with stakeholders of future breeding. However, this requires all parties to be aware of their own priorities and the values on which these priorities are based. Meaningful discussion among stakeholders in animal breeding will of course require stakeholders to state their values in a transparent manner. And obviously, an open-minded attitude to other stakeholders' views will be very important in any dialogue that takes place. In short, work ahead on sustainability in the context of farm animal breeding and reproduction needs to take into account that:

(1) *There is no single correct concept of sustainability.* It is a question, not of reaching a true, well-defined goal, but of becoming 'more or less sustainable'. Specific methods to follow up on this involve comparing, analysing and developing actual definitions and goals of sustainability – as elaborated by the working parties and from literature available. Moreover, they involve a grasp and the correct use of relevant terminology (e.g. 'principles', 'definition', 'criteria' and 'indicators').

(2) *A distinction must be made between 'factual' discussion and the making of value judgements.* To distinguish these two varieties of speech it is necessary to identify value judgements inherent in the working parties' understandings (including definitions and criteria) of sustainable farm animal breeding. It is also necessary to be aware of the trade-offs entailed by the sustainability criteria so that one can appreciate the ethical dilemmas involved in working towards more sustainable farm animal breeding and reproduction.

(3) *Dilemmas are inherent in sustainability, so key concerns will always need to be balanced.* This balancing of concerns is at the core of sustainability discussions. Sustainability does not signify a single set of pre-fixed values and concerns. However, it can be seen as representing a willingness to set an ethical agenda. Key ethical aspects associated with the value judgements need to be brought out. The specific methods involved are to identify and analyse key ethical aspects of farm animal breeding goal setting, planning and practice. Such aspects may include animal welfare, animal integrity, animal health, biodiversity, environmental protection, consumer safety, food quality, and competitiveness.

¹ A paper by the authors presently planned for publication will go into more detail on how to work with scenarios in the context of farm animal breeding and reproduction and also explain in detail the different phases of scenario construction.

(4) *In order to achieve more sustainable practices, there is also a need for clearer prioritisation, increased transparency and improved stakeholder dialogue.* One of the most important aims when farm animal breeding and reproduction industry and academia try to work towards more sustainable breeding and reproduction practices is to be able to explain goals and give good reasons for actions undertaken to all stakeholders. Key issues to consider are the need for: (a) clear prioritisation of goals, (b) transparency with regard to prioritisation and (c) stakeholder dialogue.

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