



Breeding for productivity and breeding for welfare: what is the relationship?

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When FCRN's [Tara Garnett](#), [Marian Dawkins](#), Professor in Animal Behaviour, [Jude Capper](#), US based livestock sustainability consultant, and [Elin Rööös](#), Swedish LCA researcher, met just before Christmas to discuss animal production efficiencies in relation to animal welfare, an important question that emerged was: **Can breeding for productivity and animal welfare be aligned?**

To explore this question in more detail, Tara and Elin met over Skype with two Swedish experts in animal breeding, [Professor Lotta Rydhmer](#) and researcher [Anna Wallenbeck](#). Lotta is Professor in animal breeding at the Department of Animal Breeding and Genetics, Swedish University of Agricultural Sciences (SLU). Her work focuses on animal breeding and genetics for sustainable production, and most of her work focuses on pigs. Lotta is also involved in the SLU's interdisciplinary research platform '[Future Agriculture](#) – Livestock, Crops and Land Use' and in a multidisciplinary project, '[Mistra Biotech](#)' which investigates the role of biotechnology in sustainable and competitive agriculture and food systems.

Anna specialises in applied research related to animal welfare and in developing breeding and genetic material for alternative, mainly organic, production systems - systems that are common in Sweden. Anna is involved in several interdisciplinary research projects in this area and much of her work is focused on collaboration with the society and stakeholders, e.g. through a commission at SLU's Centre for Organic Food and Farming, [EPOK](#).

1. The context for a discussion on animal breeding, animal welfare and productivity

Knowing more about the productivity-welfare relationship is critical to building our understanding of what more sustainable systems of livestock production and consumption look like, irrespective of whether we believe that we 'need' to produce more meat or milk. Since some of the comments on [our last paper](#) seemed to suggest that our approach was inherently productionist, we preface this paper with some initial comments.

Productivity - outputs relative to inputs - is often equated not just with financial efficiency but also with environmental efficiency. For a given output of milk or meat, fewer, but more productive animals incur lower costs, generate fewer greenhouse gas emissions and have lower land and water requirements than if a greater number of animals were needed to yield the same amount of edible output. Breeding has had an important role to play in increasing animal productivity, in combination with the use of carefully formulated feeds and confined housing. Thus, it is argued that breeding animals to be more productive is also a pro-environmental strategy.

At the same time, there have been strong criticisms of this approach. First, it is argued that productivity and efficiency as concepts are too limited to serve as proxies for environmental sustainability. Breeding efforts geared at achieving high levels of productivity may not lead to 'resilient' breeds that can withstand environmental shocks or consume diverse feed. And to achieve their genetic potential, these breeds of animals need to be fed on grain and protein crops that could be consumed directly by humans, thereby creating resource competition and potentially undermining food security. It is also pointed out that the drive to achieve even higher levels of production is fundamentally misguided; to address our interlinked environmental and health challenges we need to address our dietary patterns: specifically we need to curb rather than increase our consumption of animal foods. Finally it is argued that the whole notion of 'productivity' when applied to sentient animals is ethically unacceptable. Some hold that the use of animals for human gain is wrong per se. Others

accept that animal farming is a reality but argue that the welfare of those animals is paramount.

In our view there while these are very legitimate criticisms, there is value in considering the relationship between productivity and welfare for several reasons.

First, although productivity, environmental 'efficiency' and environmental sustainability are absolutely not coterminous, there is a complex relationship there that needs to be investigated further rather than ignored. Understanding the relationship between breeding for increased welfare and breeding for productivity provides a useful starting point for investigating the more difficult relationships among welfare, productivity and environmental sustainability in its more encompassing sense.

Second, while a robust and growing body of evidence shows that consumers in high-consuming developed countries, as well as affluent high-consuming individuals in developing countries need to reduce their consumption of animal products, even with concerted policy action to curb the growth in animal production, some animal source foods will always be eaten and some livestock farming will always take place. And so the need to reduce the impacts of those production systems remains – the relationship between animal breeding, productivity and sustainability will continue to be pertinent and require investigation.

Third, the question is worth exploring in itself. The current reality is that in commercial animal production animals are reared for consumption and for profit. Increased productivity has been a driving goal for commercial breeders and producers for many years - this is true not just of animal production but of food production in general. Consumers, it seems, demand cheap food. However when it comes to livestock production, productivity gains have come at the expense of welfare. It is important to investigate whether there is an inherent biological trade-off between these goals or whether it is a consequence of current political and market conditions. Put another way, if one were to turn priorities on their head and focus on improving animal welfare through breeding, could productivity ever be a useful 'byproduct' of this goal?

2. The discussion

To restate the key question for discussion here: **Can breeding for productivity and animal welfare be aligned?**

Both Lotta and Anna agreed that the short answer to this question was 'yes' – but that a longer explanation and a series of qualifications and caveats were definitely needed.

They began by explaining that while there is no inherent biological conflict between breeding for productivity and breeding for improved health, there are various issues to consider, and obstacles in the way of these co-objectives becoming mainstream.

The first of these is time and money. The second is the current policy and commercial context. And the third relates to issues of coordination and knowledge sharing. Finally we discussed the important point that good welfare arises from a match between the animal and its environment – an animal may or may not be suited to the environment in which it is reared. This raises ethical questions about how far one should adapt the animals to suit the environment and about how we think about good welfare.

2.a. Time and money

Breeding is expensive and time consuming. To observe traits and to select the best candidates so as to achieve robust and consistent genetic changes, it is necessary to have a large cohort of animals. These costs and the need for scale mean, among other things, that less attention has been paid to breeding for various objectives, including for traits related to good welfare, in alternative free-range and organic systems, since these systems tend to be less prevalent and smaller in scale. As a result, alternative farms often have to use conventional breeds, who may not be suited to (for example) outdoor conditions, or who may not have the leg strength needed to cope with more active lives or moving on uneven surfaces. [Studies](#) comparing leg problems in organic and conventional pig systems in Sweden show greater problems in organic systems when the same breed is used because animals bred to live in confined conditions are not well adapted to the more physically active lifestyles they encounter in organic systems. This immediately raises problems because it can lead to the simplistic conclusion that welfare is poorer in free-range conditions – rather than the more accurate observation that there is a mismatch between the animal and its environment.

To reiterate the point above, while breeding for both increased welfare and productivity is possible, it can take longer to achieve progress in each trait. There are some favourable genetic correlations between goal traits, for example between growth rate and feed efficiency. This may be positive for the environment, since selection for increased growth rate also results in decreased feed consumption. Genetic correlations between production traits and health traits are, however, often unfavourable. Milk yield and mastitis is an example. Although healthy cows produce more milk, the genetic relationship is unfavourable: cows with the genetic ability to produce a lot of milk are more prone to mastitis. By including mastitis together with milk yield in the breeding programme progress is achieved in both traits, but the progress in milk yield is slower than it would have been if mastitis was not included. In a global marketplace where time equals money, the slower nature of breeding for win-wins presents a problem.

This is of course to adopt a very narrow definition of what makes economic sense: it focuses on short term market goals (in this case cheaper milk for the consumers), rather than longer term societal goods. To give an example, the rising problem of [antimicrobial resistance](#), to which livestock-related antibiotics use contributes, is likely to cause major global health problems and associated economic costs. The market continues to favour short term productivity gains over the more structural economic savings to be obtained from breeding for animals that are more resistant to diseases – which in turn would positively affect their welfare. Piglet production is another example. In the short term, breeding for larger litters (more piglets born) increases profits even though it leads to increased piglet mortality, since the cost of letting a sow give birth to one or two additional piglets is low. Even if most of these extra piglets die soon after birth it is still worth the effort (economically speaking) as some of them survive.

Of course no one wants dead piglets. High piglet mortality rates are depressing for farmers and could, in the long run, decrease the consumers' acceptance of pig production. But while a better option would be to place less weight on litter size and more on piglet survival in the breeding goal, that would raise the cost of pork and today most consumers choose to buy the cheapest pork. So who should pay for increased animal welfare and higher ethical standards?



2.b. Policy and markets

While national and international guidelines and codes on animal welfare exist (for example the [Five Freedoms](#) developed in the UK, or the OIE's [Code](#)), there are few Codes in existence that focus on *breeding* for good welfare; the voluntary [Code EFABAR](#) is an exception.

Breeding goals are overwhelmingly shaped by the market, and the market currently favours productivity. Producers tend to balance the welfare and financial costs of leg health, mastitis and other negative animal health traits against profit-related objectives that include productivity and product quality. Until recently there have been few market incentives to breed animals that are more 'robust,' that is, that tend to suffer from fewer health problems. This said, the situation has been slowly changing since the 1970s, with the Nordic countries taking a lead in this regard. For example in dairy selection there is now increasingly an emphasis on breeding not just for yield but for functional traits such as reproductive capacity, lower susceptibility to mastitis and for leg strength. Anna pointed out that the Swedish dairy breeding program was almost laughed at in the 1980s when most breeding regimes were focused very narrowly on increasing milk yields. Today about 50% of the selection pressure is on functional traits in many dairy cow breeding programs.

Nonetheless, while there may now be greater understanding that poor health, an important aspect of welfare, can undermine productivity and profitability, and that there is a need for a different strategy, less attention is paid to other aspects of welfare. For example, less attention is given to behavioural traits, such as aggression in pigs. Essentially this is because there are few obvious financial incentives to do so: while pigs fight, they seldom kill one another. And when it comes to tail biting - a behaviour that clearly causes suffering and undermines welfare - it is simply cheaper to dock their tails than to breed animals that are less prone to this behaviour (we discuss the role of the environment in behaviour below). On a more positive note, characteristics of reduced feather pecking are partly included in poultry breeding programs.

Policy makers could, by intervening in the market, help shift breeding objectives in ways that lead to better outcomes for welfare. For example, if antibiotics were significantly more expensive then that would incentivise breeding goals geared at disease resistance. Tail docking is no longer allowed under the EU's animal welfare law, but it is still the standard

routine in most EU countries. If tail docking were to result in expensive fines, the motivation for including (reduced) tail biting in the breeding goal would increase. On the other hand, some policies introduced for, say, environmental reasons, would need to be carefully designed so as to achieve better welfare. For instance, the introduction of a carbon tax might be bad for welfare if it led to a drive for greater productivity at the expense of welfare. On the other hand, if introduced in tandem with very clear standards and expectations around good welfare outcomes, then there would be pressure to achieve both at the same time.

2.c. Data and logistics

It is not only short term economic signals that hinder welfare-oriented breeding objectives; there are also some very practical problems. When breeding for multiple traits, including traits important for welfare, a great deal of information is needed - not just data on yields, but also as to the incidence of diseases, fertility rates, behavioural traits and so forth - information that can only be collected by farmers or veterinarians. There needs to be an infrastructure in place to collect these data and make them useful and available to the breeding organisation. Ultimately, there is a need for data to be integrated and shared between the artificial insemination company (who sells the semen), the breeding organisation and between farmers and veterinarians who see what is happening as regards behaviour and health. Thus data pooling, collection and coordination are key. But this is often expensive and time consuming. Another problem is that it is more difficult to record behavioural and health data on an individual level in species such as chicken and fish than in large animals such as cows. While in one sense it is quicker to achieve genetic progress in poultry because of their shorter generation interval, since these individual health and behaviour parameters are seldom registered, breeding needs to be carried out in groups, which takes longer.

2.d. Breeding and the environment

A huge amount of work has been undertaken in recent years in seeking to define what good welfare is, and how it can be [measured](#). While it is generally agreed that there are multiple aspects to good welfare, people place different emphases on these various aspects. While there is widespread unanimity that good animal health is necessary, the idea that animals should be able to have access to a 'natural environment' is more contested by some, particularly those who favour cost-effective confined systems of animal production. Besides, what is a 'natural environment' for a domesticated species?

As noted above, there has been some progress in linking productivity with some aspects of welfare but this progress has been slow and the focus has been very much on dimensions of welfare - good health - that either directly or indirectly have a natural affiliation with productivity and profitability. Healthier animals don't get sick and die, and they reproduce better. Far less attention has been paid to breeding for 'happier' animals.

This in part is because understanding what good, as opposed to poor welfare is, and how to breed for traits that advance it, is much harder to do. While huge advances have been made in developing metrics to assess welfare status, it is still much easier to identify poor welfare and therefore to select for behavioural traits that avoid poor welfare outcomes, than it is to identify good welfare. For example, we know that if pigs perform tail-biting then their welfare is poor. But does it follow that pigs are happy when there is no tail-biting? Research on good welfare is still young and there is still a lack of accurate measures that could be used in breeding activities.

Of course this raises at least two very important questions. First, what do we mean by 'happy' animals? Second, in seeking to achieve 'happy' animals, what ethical balance should be struck between adapting the animal, through breeding, to suit its environment, and adapting the environment to suit the animal?

As to the second question - changing animals genetically by breeding versus changing the environment in which they live - ultimately the whole history of animal domestication is about the former. We have bred animals to produce the products we want them to produce and to conform to the environmental context - the production system - in which we have placed them.

Arguably calm and social animals that don't mind living in crowded and confined conditions have good welfare; but most people are uncomfortable about where, morally, this approach might lead. The difficulty is that everyone will draw a line somewhere but where that line is drawn will differ from person to person. For example, most of us would say that it is not acceptable to breed an animal that likes being poked at by an electric prod, or chickens that like to be in an environment where they cannot turn around. But would it be acceptable to breed pigs for less explorative behaviour so that they stay calm in a barren pen? Looked at another way, should we breed pigs that do not tail-bite, or should we give them straw and materials to move around in, since tail-biting tends to be a response to an arid environment? The former may be cheaper or easier to manage than the latter - but many, particularly animal welfare advocates, argue that the latter is better. Most farmers and animal scientists would say that we shall strive for both genetic and environmental improvements, simultaneously. However, currently it is too cheap and simple to dock tails, so that neither of the two is considered.

And even if we manage to breed animals that do not show any unwanted behaviour in confined and barren environments, we will probably never be able to know how they are experiencing their situation. Currently these ethical considerations are put in the hands of the breeding companies who may have ethical boards to handle these questions - but ultimately the decisions taken are heavily based on market demand.

3. Summary

In summary, we identified from this discussion that breeding goals that include both productivity and animal health aren't necessarily incompatible, but a question of prioritization and time. Breeding efforts that place a greater emphasis on health are hindered by the lack of economic incentives and also by practical obstacles. Things are slowly progressing in the right direction, but it is difficult to see how large improvements can be achieved quickly without policy involvement. Less progress has been made in breeding for other aspects of good welfare, such as behavioural traits, since there are few commercial incentives to do so and policy has not taken a lead. The issue is complicated by differences in perspectives on how we define animal welfare, and the fact that good welfare is a consequence not just of breeding but the environment - and the suitability of one to the other. An added difficulty is that there are multiple stakeholders who have influence over the breeding agenda; policy makers, breeders, farmers, retailers, and the public who buys and eats meat - but there is no single body with oversight of it all. The consequence is lack of coordination and of a clear 'vision' for where we want to go. Finally, and as highlighted in our introduction, this discussion paper has focused just on animal welfare and its relationship with animal breeding; but this relationship needs to be situated in a much bigger analysis of the complex relationships among productivity, environmental sustainability and the multiple genetic and environmental influences on good welfare.

4. Research questions

Finally, Lotta and Anna raised a number of questions that merit further research including:

- How can political governance be used to influence breeding goals considering that the livestock industry competes on a common, free global market?
- What are consumers' attitudes as regards animal welfare and how are these attitudes reflected in their willingness to pay for high animal welfare standards?
- Which kind of measures are necessary to ensure efficient control of and increased compliance with the EU's animal welfare law in all member states, in order to guarantee the welfare levels democratically agreed upon and to provide an even playing ground for all EU livestock producers?
- Which traits are especially important in specific production environments? How are animals best matched with their environment?
- How can breeding goals be designed to consider the whole production system, with emphasis on production, environmental load and animal welfare over a longer period of time and in relation to system inputs?
- How can the development of alternative infrastructure and diversity in companies and organisations working with animal breeding be strengthened?