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RESEARCH ARTICLE

Perceptions of Ethical Challenges within the LowInputBreeds Project

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Abstract This paper reports and analyzes the perceptions of researchers involved in the EU project LowInputBreed on the ethical challenges facing low input livestock production and how these challenges relate to the ambitions of the research project. The study is based on observations of two workshops; one at the beginning of the project and one at the end. The focus is on identifying common themes across the four species groups involved. The main findings of the study are that from a biological perspective a variety of ways to better meet the needs of low input production exist. However, these solutions share some of the problems regarding animal welfare that also characterizes intensive production systems. The question thus becomes whether these solutions will meet the consumer concerns that lies behind the choice of paying a premium for local, low input products or whether the quality of these products will disappear in the eyes of the consumers.

Keywords Animal breeding · Low input livestock production · Animal welfare · Environmental impact · Ethics

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Introduction

This paper uses the EU project LowInputBreeds as an opportunity to illuminate the ethical challenges in low input livestock production through the perceptions of the participating researchers and stakeholders.[1] If breeds are not well adapted to outdoor conditions, it may have consequences for productivity as well as for 'product quality' including the welfare of the animals. Part of the background for the project was indeed a concern that if low input systems do not live up to their higher standards for animal welfare compared to conventional production, there is a risk that they will lose credibility in the eyes of the general public. The focus of this paper is, therefore, to analyze what challenges face low input production and the potential for solutions.

The LowInputBreeding project aimed to develop breeding and management strategies designed specifically for the needs of low input livestock production. The project covered four species: dairy cows, sheep, pigs and laying hens. The underlying motivation behind the project was:

> Until recently, very little R&D has focused on breeding livestock breeds/genotypes specifically for organic and/or 'low input' (e.g. free range, pasture fed) livestock production systems. As a result, the majority of such systems currently use either **(a)** breeds/genotypes/hybrids developed for 'high input' production or **(b)** older traditional breeds. However, it is increasingly recognised that breeding priorities differ between high and 'low input' systems.
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> The LowInputBreeds project will therefore focus on developing **(a) 'robustness'** (e.g. resistance to biotic and abiotic stress factors, survival of young animals, longevity, fertility), **(b) 'product quality'** traits (including ethical qualities related to **animal welfare** and **environmental impact** related traits) that have a higher priority in organic/'low input' compared to 'high input' conventional systems.
>
> (LowInputBreeds, 2009a, p. 13; bold in the original)

This paper seeks to map the ethical concerns that the participants in the workshops found relevant, not to present an exhaustive view of the ethical challenges to low input breed production as seen from a thorough ethical analysis. Thus, the issues e.g. of whether it is at all ethically justifiable to weigh the welfare of the animals against production efficiency in relation to e.g. growth or whether the perceived naturalness (whatever "naturalness" means to various stakeholders) of different production systems are relevant when assessing the welfare of the animals are not touched upon in any systematic way, although both – albeit rarely – showed up in the discussions.

Definitions and Method

What is the defining characteristic of 'low input' production? If we look at the LowInputBreeds project, the dairy cow and sheep systems are based, at least partly, on

[1] More specifically, it reports and analyzes the outcome of two workshops. The first workshop took place during a larger symposium, the First LowInputBreeds Symposium on ethical issues relating to low input livestock production in Wageningen on 15th–16th March 2011, which was co-organized by LowInputBreeds and the European Consortium for Organic Animal Breeding (ECO-AB). The second workshop was part of the final Fourth LowInputBreeds Symposium in Newcastle on 15th–16th April 2014.

grassland grazing. This is not the case for pigs and laying hens, where the feed is usually provided. However, for the sake of the animals, they are allowed freedom of movement and are kept outdoors most of the time, or at least given access to outdoor areas. Thus an overall unifying aspect of low input production is allowing the animals access to outdoor environments. This freedom of movement is considered essential for the production and is also considered important by the general public (e.g. Lassen, Sandøe, & Forkman, 2006).

Within the overall category of 'low input' production, there is a distinction between organic and non-organic. Organic production within the EU is defined by a set of requirements for certification, which are based on a set of explicit fundamental values (IFOAM, 2017). Non-organic 'low input' production also covers a wide range of pasture feeding or free range systems, which may or may not be governed by explicit value systems or requirements.

During the first LowInputBreeds symposium held in Wageningen in 2011, workshops were organized for each species group in parallel. The objective was to allow the participants to present their perceptions of ethical issues for the species in question and present their research aims regarding this species. Finally, the combined relevance of these was discussed by invited external commentators and stakeholders. The authors of this article served as moderators for the four groups.

Firstly, we report the proceedings from these workshops. For each species group, the report is divided into three sections. First, the LowInputBreeds presenter is reported, then the comments from the invited commenter, and finally the group discussion.

These reports are based on the moderators' observations and various sources such as written introduction PowerPoint presentations. Leenstra, Jensen, Butler, Baker, Willer, and Maurer (2012) contains written introductions by presenters and commentators, moderators' immediate reports and links to PowerPoint presentations. In this context, the reporting concentrates on the perception and discussion of ethical issues. We conclude the first part by summing up some common themes across species groups.

This summary served as the starting point for the workshop of the final symposium held in Newcastle in 2014. Here, each group was asked to present how they perceive "striking the balance between breeding for productivity and functional traits of importance for the animal's adaptation to their specific environment" (Jensen, 2014). K. K. Jensen was the moderator for the workshop, while M. Gjerris was the commentator.

In the second part of the paper, we report these perceptions and the discussions they gave rise to during the workshop. The reporting is based on the observations of Jensen and Gjerris. Sources for this can be found in Jensen and Gjerris (2014). LowInputBreeds (2014) contains summaries of the presentations. In the final section, we analyze common themes across species groups and attempt to draw a general conclusion.

Report of Species Specific Workshops from the First Symposium (2011)

Dairy Cows

The presentation on ethical issues and breeding goals for dairy cows by H. Simianer (University of Göttingen) focused on the problem of meeting future demand for animal products. If the expected demand for animal products is to be met, animal production will have to increase by

2–3% per year. Given constant input resources, this increase can only come from increased efficiency in using input resources.

Simianer estimated that up to 2007, more than 50% of the increase in productivity stemmed from breeding. He also estimated that with traditional breeding tools a maximum increase of 1% per would be possible. However, genomic selection has the potential to further increase this to the needed 2–3%.

In recent years, there has been increasing interest in functional traits, but they have been difficult to realize because they have low heritability and are unfavorably correlated with production traits. Genomic selection, however, offers the possibility of different trade-offs in the genetic progress between production traits and functional traits, which means it should also be of interest for low input production. Simianer ended by claiming that technologies associated with genomic selection are socially acceptable and in routine use.

The invited commentators from the European Consortium for Organic Animal Breeding (W. Nauta and A. Spengler Neff) stressed the difference between conventional and organic breeding. The first work within the context of uniform and stable systems with housing, feeding and treatments that are independent from the geographical location. Thus animals can be bred on a large scale to maximize production levels. The latter is dependent on local resources and environments and animals that are adapted to specific local environments are needed. Many examples show that animals from conventional production do not fit well into organic/low input systems.

Functional traits and health traits are becoming more important in all breeding programmes. However, the different environments make it difficult to breed animals for organic farming at a large scale, e.g. low input systems demand flexible, self-sustaining animals capable of adapting to the feed available. Dairy cows which do not exhibit great changes in body condition during lactation are healthier, especially in roughage-based feeding systems. They often serve a dual purpose and do not use much body fat to produce milk, which would be a risk to their health, but use energy from their muscles instead. Other interesting traits for low input systems are roughage intake or roughage conversion ability.

The commentators suggested that, ideally, breeding should be on-farm. They rejected technologies such as embryo transfer (ET) and sperm sexing as they considered them to be incompatible with organic values, but they did not outright reject genomic selection in itself. However, a number of issues made them skeptical overall: there is a threat to the local infrastructure of organic farming and its transparency, and a threat of losing sight of the importance of the different environments and, thus, an indirect threat to biodiversity and animal health.

In the discussion most of the claims of the commentators were met with opposition. It was remarked that genetics *is* important and that data for genomic selection are available from many different environments and that it is possible to select bulls on the basis of genomics, and finally that genomic selection tends to reduce the rate of inbreeding and even increases biodiversity.

Concerning resource efficiency, the discussion basically focused on how broadly this notion should be defined. One side considered efficiency a matter of feed conversion. The invited commentators, on the other hand, stressed that low input animal production could be efficient in grasslands where no other use is possible, but also that organic milk production *is* efficient and not that different from conventional. Further, it was pointed out that, with regards to comparing efficiency, all costs associated with the use of concentrates should be included, and further that prices on concentrates tend to increase.

Sheep

The presentation by S. Sotirako from The National Agricultural Research Foundation (Greece) stressed the importance of animal welfare and developed an elaborate scoring system for evaluating animal welfare based on an interpretation of the classic definition of *the five freedoms* (FAWC, 2009). As the presentation did not play an important role in the discussion (see below), we have decided here to analyze the discussion in greater depth as it was intense.

The invited commentator, J. Conington from SAC Consulting (Scotland), pointed out some main areas for discussion regarding the mismatch between genotype & environment. Ensuring the right breeds is critical for animal welfare, while the introduction of inappropriate breeds or crosses without corresponding modifications to the environment should be avoided. For instance, the offspring of more prolific breeds in extensive environments will have lower birth weight and, hence, potentially higher levels of mortality. Moreover, larger numbers of sheep looked after by one shepherd inevitably means less individual attention per sheep. Using breeds that require little human intervention to lamb unaided is critical to both animal welfare and flock efficiency. Breeding for disease resistance seems a sustainable way forward, particularly for low-input sheep systems where the animals are only gathered once or twice during the lambs' lifetime.

The discussion revealed that what was seen as increased animal welfare from one perspective (e.g. breeding for heat resistance or intensification of production systems) was considered to involve a reduction in the species-specific behavior of the animals and, thus, decreasing welfare from another. The LowInputBreed researchers readily accepted that notions such as integrity or naturalness play a role both for consumers and producers, but found it hard to incorporate this into the research aims of the project.

Moreover, the discussion established that the basic challenge to sheep production is economic. Several other goals were also seen as important (animal welfare, maintaining local breeds, low environmental impact, etc.), but all participants stressed that these could only been addressed to the extent that they were consistent with the overarching economic concerns.

The participants identified a number of areas within the production systems where improvements could be made that would either increase production efficiency or add extra value to the end product, which would also lead to improved animal welfare and a lower environmental impact:

1) Parasites: Breed animals that are resistant to parasites (in this case specifically gastrointestinal nematodes) and mastitis combined with different strategies for feed and grazing areas to avoid disease. The combination of breeding and controlling feed and environmental factors was seen as the most efficient.
2) Heat: Either breed animals that are more tolerant to heat or change production systems to incorporate the cooling of the animals. Indoor housing was considered to facilitate the goals of reducing heat stress and parasites, although it creates other problems for the animals, especially a reduction in the opportunities for the animal to perform its species-specific behavior.
3) Species-specific behavior: The appropriate time to wean lambs was one of the parameters that were intensely discussed. For some, early weaning (7 days as in France) was the most efficient production method, while it was also considered to ensure the welfare of the animals, whereas others thought that later weaning (40 days as in Greece) made economic

sense as it led to improved animal health, while it also allowed the animals to experience the maternal bond between ewe and lamb.

4) Animal integrity: Some found that opportunities for species-specific behavior are important even if depriving animals does not cause negative experiences.
5) Production efficiency: This was considered an acceptable goal to the extent that breeding initiatives could ensure increased production efficiency (perhaps in combination with other measures such as changes in diet or environment) without damaging the value of the product as a result of lower consumer evaluation.
6) Product quality: One way of increasing the value of the product is through increasing the quality. Parameters such as taste and tenderness were mentioned. Again, this was seen as something that could be achieved through breeding or the environment (diet, pastures, production system etc.). A general problem with using breeding strategies or changing environmental or dietary factors often mentioned was the risk of diminishing differences between the various local breeds and local products. This could cause problems with regards to the genetic diversity of the sheep population, but also consumers' expectations regarding being able to buy a distinct local product.
7) Environmental impact: In general, the participants agreed that sheep production is an environmentally friendly way of producing meat. The main reasons for this is the extensive nature of the production systems that are often adapted to the local environment and the utilization of marginal agricultural land. Advantages could perhaps be gained through breeding animals with more efficient digestion to reduce CO_2-emissions. These advantages could also be sought through changes in feed. There was general agreement that regional differences would play a large role regarding which strategies would be acceptable to producers and consumers. What was labeled "sensible intensification" through breeding and management changes was, in general, believed to be more acceptable in Southern Europe than in Northern Europe.

Pigs

The presentation by S. Edwards (Newcastle University) was based on the 'Ethical Matrix' (Mepham, Kaiser, Thorstensen, Tomkins, & Kate Millar, 2006). The ethical challenges identified through the use of the Matrix were classified into six categories.

1) Animal welfare vs farmer income & affordable food: The welfare of pigs can be affected as a side-effect of two common breeding goals: breeding for prolificacy, and breeding for lean tissue growth rate. Breeding for prolificacy may negatively affect the piglet survival rate and sow longevity. Breeding for lean tissue growth might affect the robustness of the breed and its ability to adapt to low input conditions. Lean tissue growth breeding can also affect the animals in their natural ability to resist disease, and in their predisposition to leg weakness. Other effects include altering the thermoregulatory function of pigs, which may be especially important in low input systems.
2) Animal welfare vs management choices: Management choices can affect the welfare of pigs by modifying their social organisation through changing the size and composition of pig groups, which may have an adverse effect on group stability. Breeding could improve the social behaviour of pigs through modifying behavioural characteristics such as aggression, which could result in e.g. less tail biting.

3) Animal integrity vs product quality: Castration was identified as the main practical conflict between product (meat) quality and animal integrity as this mutilation is commonly used to reduce boar taint in meat. The problem of boar taint was regarded to be greater in low input systems because of the use of traditional, early maturing breeds with slower growth and imbalanced dietary protein.
4) Environmental impact vs naturalness: The use of traditional breeds with slower growth rates and greater fatness in low input systems results in low feed conversion efficiency. This less efficient use of feed in more natural environments leads to greater waste and an overall greater climate impact.
5) Animal integrity vs technological advancement: Technological advances in animal breeding are considered to affect animal integrity due to the replacement of phenotypic information with genetic markers and single nucleotide polymorphisms (SNP) information. The potential introduction of genetically modified (GM) animals with enhanced traits into low input systems would also affect animal integrity.
6) Product quality vs genetic diversity: Genetic diversity was considered to conflict with product quality in the case of fat composition and its impact on human health as traditional breeds have more saturated fat, which increases human health risks. Breeding for unsaturated fatty acids, especially omega-3 acids would be a positive goal in this respect.

The invited commentator, Anna Wallenbeck from the Swedish University of Agricultural Sciences, started with the observation that, in spite of the growing interest and promotion of organic products, little attention has been paid to which animal breeds to use. The breeding strategy currently applied by most farmers is to use the same breeds and lines as used in conventional production.

Pigs bred for improved production on diets with high nutrient quality will have a poor feed conversion when fed diets with lower nutrient quality. This leads to increased nutrient leaching, which conflicts with the aim of environmental sustainability. Thus pigs designed for organic production systems should be bred for improved feed conversion when fed diets composed of organic and locally produced feedstuff.

Breeding goals for pig dam lines has been focused on increasing litter size for a long time. Additionally, most breeding companies produce hybrid sows for commercial producers in order to make use of hybrid vigor, i.e. increase litter size even further than pure-bred animals. Consequently, the litter size in commercial pig production has increased considerably in recent decades. However, less favorable consequences are that piglet birth weight and piglet survival rate have decreased. Piglet mortality is often higher in organic than in conventional production systems. Furthermore, more pigs die during the growing and finishing periods.

Hence, summing up the demands for organic pig breeding: pigs should preferably be bred for improved ability to adapt to environmental variations such as seasonal weather patterns and variation in diet composition between years; the ability to utilize local feed resources including diets with less optimal nutrient quality; survival at all stages of development; disease resistance and; leg strength.

The discussion revealed recurrent references to a distinction between a pragmatic versus an ideologically 'fixed' (or 'dogmatic') approach to breeding. The group participants were generally predisposed towards the pragmatic stand, which was reflected in the group consensus concerning a series of related issues.

Organic production was perceived to be defined by (certified) fundamental values, while other low input production was perceived to be 'on a continuum with conventional', lacking

'ideological fixed points'. The breeding goals for low input and organic systems were perceived to be the same. However, for organic production, it was essential that breeding programs should be executed under organic conditions.

For low input production other than organic, all innovative technological solutions were perceived to be welcome as long as they did not compromise animal welfare. The adaptation of technological solutions in organic production was perceived to be more difficult. However, from a pragmatic point of view, the breeding program should pay attention to the use of technologies and practices like sperm sexing and genomics.

Much of the ethical tension in the issues discussed was repeatedly attributed to the operating definition of 'naturalness'. Such conflicts become evident in practices like castration, which increases the market value of pork, and also breeding for prolificacy, which reduces piglet survival rates and sow longevity. Nonetheless, breeding was also regarded to have the potential to reconcile economic and animal welfare goals.

The definition of naturalness as 'behavioural freedom' ('as society defines it') and 'genetic integrity' was regarded to result in a series of ethical dilemmas. For instance, naturalness appears to conflict with environmental and economic goals: pigs should be kept outside, but this is problematic because such systems are not very efficient compared to conventional production systems. The adoption of an alternative operational definition of naturalness such as 'biological appreciation of the animal - satisfying its needs' was suggested as an alternative. The participants favoured the adoption of environmental goals into the breeding scheme such as the minimization of waste by-products, although it was not clear how these goals could be supported if they were not demanded by farmers (without state or consumer support).

Tension was also identified between 'global' versus 'local' breeding goals. Global goals were understood to include issues such as impact on climate and food security, while local goals referred to, for instance, rural development. Although the group was positively predisposed to global goals, it was recognized that farmers' primary goals are local, i.e. how to optimize their farm results in line with consumer demand.

Laying Hens

Veronika Maurer from the Research Institute of Organic Agriculture (FiBL) presented an overview of what she considered to be the ethical challenges relating to breeding laying hens. The *first set of challenges* involves killing male layer chicks and discarding layers after 1 year of production.

Poultry lines are highly specialized and are either used for egg or meat production. Thus layers are characterized by high egg production and low body weight, while broilers are characterized by fast muscle growth and high body weight. This divergence between layer and broiler lines leads to several problems.

For layers, health problems are associated with the high egg production in the form of reduced bone strength and keel bone deformation. Health problems are also caused by feather pecking. Female birds are only 1 year in production, after which they are discarded. Male chicks are killed because fattening them is not economically feasible due to slow growth and low feed conversion rate. For broilers, health problems are associated with the rapid growth of muscles compared to the growth of supporting structures in the form of leg deformation and lameness, breast blisters and heart problems.

These problems are mainly caused by creating specialized lines and they can, therefore, be decreased by breeding. There have been several attempts to overcome the disadvantages of

specialized lines with *dual purpose* chicken. However, all the results obtained so far on possible dual purpose lines have not been economically viable for large scale production.

An alternative to be considered is the prolonged use of layers. Egg and feathering quality as well as egg production naturally decrease in older layers. After an unproductive period during which feathers are renewed (moulting), these problems are often substantially reduced. Animal friendly moulting systems without complete feed and light deprivation and with access to the veranda have recently been developed. These have now been approved by the organic regulations and are being increasingly applied in Switzerland. Moreover, model calculations show that using hens for longer without moulting (a 70 week laying period instead of 47) reduces the number of male chicks to be killed and old layers to be discarded per year by about one third. If layers are moulted and used during two laying cycles instead of one, about 50% fewer animals need to be killed and discarded per year.

The management and health of the flock are crucial for the success of prolonged use or moulting. In addition, not all layer lines seem to be equally suited to prolonged use and moulting. Breeding is, therefore, an important element of success.

The *second set of challenges* presented is the uneven use of outdoor runs by large flocks and feather pecking. Hens kept in large flocks use the outdoor run less frequently and less evenly than hens in smaller flocks, which leads to damage to the grass cover and, more importantly, over-fertilization and nutrient leaching.

Feather pecking is considered to be the most serious animal welfare problem on organic and free range farms. In a survey performed in LowInputBreeds on 320 flocks in the Netherlands, France and Switzerland, the proportion of flocks not affected by feather pecking was 34%, while 33% of the flocks were significantly affected by feather pecking. Beak trimming is often used to prevent feather pecking. However, this mutilation is unacceptable in organic farming and is also prohibited by many free-range labels. Both feather pecking and the readiness to use the runs depend on management, but they also have a genetic component and selection is, therefore, possible.

The invited commentator, Gerald Albers (Hendrix Genetics), identified some conflicts. Firstly, ordering the systems in terms of production efficiency would result in the following ranking: ‘cage’, ‘barn’, ‘free range’, ‘organic’ and ‘village’; whereas ordering in terms of publicly perceived welfare (not least putting weight on freedom of movement) would result in the exact opposite ranking. Moreover, ordering in terms of perceived welfare goes together with increased mortality.

The consequence is that breeding for a dual purpose chicken to solve the problem of having to kill day old males and breeding for non-pecking to reduce the problem of feather pecking would both imply decreasing efficiency. The higher costs of improved welfare may also conflict with food security for poor people.

During the discussions, different lines of argumentation were apparent regarding how to solve practical issues such as feather pecking. For instance, is beak trimming an acceptable solution? Some adopted a hedonistic welfare perspective and stated that if beak trimming is effective and if it is conducted in such a way that it has as little negative welfare impact as possible, then this solution is unproblematic. Others objected to this and stated that the emphasis on feelings should be balanced with a focus on species-specific behavior. The evaluation of beak trimming should thus be discussed not solely in terms of feelings, but also in terms of respect for the individual animal and its ability to express its species-specific behavior.

It became clear that these fundamental differences are not easy to bridge, especially when it comes to breeding goals. All agreed that breeding may be relevant, but a number of

participants also stressed that improved management can address many of the current problems and, therefore, the focus should not be limited to breeding. Some even argued that breeding that might mask shortcomings regarding the manner in which the animals are kept should be avoided. Here the difference in argument became explicit. If animal welfare, understood as how the animals feel, is the only criterion, then breeding that improves the feelings of the animal is morally preferable. If one begins from the standpoint of respect for the individual animal, no form of mismanagement can be justified by improvements in sentient welfare through breeding

Concluding Observations from the First Symposium

The various forms of 'low input' animal production set themselves apart from so-called conventional, intensive animal production in various ways and to various degrees. In general, intensive animal production has evolved as the answer to the ever-present desire to increase the efficiency of production in an environment of increasing costs and prices under pressure. In an influential early conceptualization of intensification, the Brambell Committee identified it this way:

> …the chief characteristic of intensification; the rejection of traditional outdoor foraging systems in favour of bringing the food to the stock, housed permanently indoors, often with complete independence of season and weather conditions by the use of artificially controlled temperature, humidity and lightning.
> (Brambell, 1965, p. 5).

Under these circumstances, the primary objective of the farmer is to obtain the most efficient conversion rates on feed.

Low input animal production systems are typically based on specific values, ideas or conceptions that inform and govern the production and that broaden the goals of the production. A clear example is organic production, which is based on a range of ethical principles summarized by the International Foundation for Organic Agriculture Movements (IFOAM, 2017). These principles imply that organic production should be locally rooted and preferably based on local cycles of nutrients and energy. Ideally, this again implies the use of local and traditional breeds. Moreover, the organic principles explicitly refer to the "natural behavior and well-being" of the animals, which implies that, ideally, the animals should be able to live a natural life. Other forms of low input animal production are not organic, but may still be founded on principles which are often based on local traditions that govern the production such as outdoor foraging, or at least allowing freedom of movement and access to outdoors.

The values underlying a low input animal production system, thus, constitute its identity, which often finds clear expression in a brand. It seems clear that any system (such as the various forms of low input production) that deviates from the full potential of intensification will face economic challenges because feed conversion efficiency will be compromised. This challenge is clearly visible for all four species groups.

In some cases, these economic challenges may be addressed by charging a price premium, which acknowledges the particular brand of low input production systems or products. However, since the price premium is additional to the price for a comparable conventionally produced product, the conditions in the comparable conventional production are likely to

define an upper limit for the price premium in the market. Moreover, since productivity is continually increasing in conventional production, low input production is under continuous pressure to increase productivity and reduce costs. This is also clearly visible across all the species groups.

To some extent, the competition from conventional production is met by low input production with increased intensification. This is perhaps most visible in breeding, where high yield (sometimes very specialized) breeds are also used in low input production. However, the consequences in terms of these animals being more challenged because they are not bred to live in the various low input environments are also clearly visible across all four species groups.

Because low input animal production systems are branded in line with the value-based standards on which they are based, particularly concerning different aspects of housing and feeding, consumers have higher expectations, not least among the more dedicated and loyal segments who buy the largest share of the products. This again makes low input production more vulnerable to problems than high input conventional production systems for which expectations are generally quite low - particularly regarding problems that would compromise the value-based standards.

This challenge is aggravated by the fact that the value-based identity of low input production restricts the set of feasible actions that may address the problems. High input conventional production, in principle, is not excluded from using available technologies, strategies or practices. However, because of the value base of low input production systems, a farmer who operates such a system has to adopt certain practices, which define the system such as keeping animals outside or not using biotech based breeding tools. In such cases, going down the road of intensification would violate the principal identity. However, from this identity also follows further restrictions in dealing with the challenges.

For instance, the organic principles put severe restrictions on the use of medicine, e.g. to prevent and treat mastitis. Further, organic principles disallow mutilations such as beak trimming or tail docking. In both cases, the ideal is that a healthy production system involves healthy animals; to treat the symptoms of an unhealthy system is to ignore and cover up deeper health problems. A more complicated issue is the organic restrictions on feed. As previously discussed, these restrictions may result in sub-optimal feed conversion and constitute a risk for animal health compared to intensive production.

For the general public, freedom of movement is perceived as a huge advantage for the animals in terms of welfare, compared with the restrictions placed on freedom of movement and the lack of access to outdoor areas by intensive animal production. For this reason, the perception of low input production systems is generally positive. The question that remains unanswered is whether this positive perception is sufficiently strong to outweigh persistent welfare challenges for low input production if they come to be more widely known.

The Final Symposium

Introduction

The project description (LowInputBreeds, 2009a) envisaged the ethics workshops of Work Package 5.2 as impact assessments; that is ethical assessments of the impact of the research. The first workshop revealed that across differences between the species groups, there is a shared

perceived challenge in meeting the productivity standards set by conventional intensive production. Part of this challenge is that, in general, the animals are more challenged by their environments and that it is more difficult to compensate for this than in conventional production.

Therefore, the follow-up workshop in Newcastle was arranged around the question of how each sub-project (SP) within LowInputBreeds, in light of the research results obtained during the project, perceived the issue of striking the balance between breeding for productivity and breeding for functional traits of importance to the adaptation of the animals to their specific environment. Mickey Gjerris had the role of asking clarifying and critical questions to the presenters. After each presentation, there was ample time for general discussion.

SP 1 - Dairy Cows (LowInputBreeds, 2009b)

Anna Bieber presented on behalf of SP1. From the perspective of dairy farming, productivity is defined as milk yield, and adaptability as the ability of the cow to cope with the given environment while remaining productive and healthy. Until the mid-1980s, most of the increase in yields was achieved by optimizing the feed. Since then, genetics has been the major driver, firstly through the use of artificial insemination with semen from bulls with high genetic merit, and secondly – more lately – through the application of genomic selection.

However, the increase in milk yield has been accompanied by declining fertility, increased incidence of disease, and declining longevity, all of which contribute to welfare problems for the cows. The main reason is that there are substantial negative genetic correlations between milk yield and fertility, health and longevity. These problems can be more difficult to handle for 'low input' production because the production environment involves challenges that cannot be compensated for in the same way as in intensive production.

Because declining adaptability has serious economic consequences, functional traits have become much more important in the breeding goals in recent years, so that today they represent more than 50% in most breeding programs. However, progress has been slow because the heritability of these traits is low – genetics often accounts for less than 10% of the variability of a functional trait. The major proportion is determined by the environment (e.g. feeding, management), which again highlights the special problems for 'low input' production because of its more challenging environment.

However, genome wide selection represents an option when breeding for functional traits. Based on the findings of SP1, there is possibility of changing breeding goals in favor of even higher weight to functional traits, so that the additional progress from genome wide selection is invested in improving health and fertility. Clearly, this priority would be of interest for low input production. However, two conditions were mentioned as important: Firstly, that breeding associations are able (and willing) to publish breeding values for functional traits, and secondly, that farmers better understand and get involved in exploring the potential of genomic breeding values. Finally, some concerns related to genomic selection were mentioned; namely the risk of accelerating unintended negative side-effects, and the risk that farmers' active participation could actually be reduced due to centralization.

A discussion came up about the notion of animal welfare. Mickey Gjerris noticed that the presenter had understood animal welfare in terms of productivity, fertility and health and asked whether other notions of welfare should be considered, particularly the notion of animal welfare as realizing the species-specific potential, as the notion of species-specific behavior as part of animal welfare seems to underlie the general positive attitude to low input production forms in the public.

Many opinions were voiced regarding this theme. However, the general attitude among the present researchers seemed to be that insight into the animals' biology is necessary to be able to assess welfare. This implies that there is widespread skepticism about taking public perceptions of animal welfare at face value; they would have to undergo closer scientific scrutiny to determine how they relate to the animals' biology. Here some participants pointed to the dilemma that low input breeds producers are dependent upon consumers to pay a premium for their products and therefore necessarily have to respect the views on welfare that these consumers find relevant, while at the same time might holding conflicting views on what actually constitutes animal welfare. A further issue here is whether producers should change production towards poorer animal welfare, if consumer interests should shift towards such production methods. The latter was not extensively discussed, but points to an inherent problem within a market driven animal production system. Should the level of welfare be decided by consumers or by external ethical standards – and who should impose these?

SP2 – Sheep (LowInputBreeds, 2009c)

Hervé Hoste presented on behalf of SP2 (the presentation was prepared in collaboration with S. Sotiraki and A. Stefanakis). Hoste started by pointing out that low input production has received more attention in recent years because of emerging alternative priorities instead of just productivity, such as improved product quality, increased food safety, greater interest in animal welfare and environmental protection and concerns about the use of chemical drugs. But as low input production involves variable environments with challenges concerning climate, feed and pathogens, which in turn involves less standardization and lower productivity than can be obtained in indoor environments, a price premium for farmers for fulfilling the changed priorities is necessary.

For sheep production in the mountainous areas of the Mediterranean, there is high breed diversity to cope with different production forms (meat, milk, wool) and variable feed availability and abiotic and biotic stress factors. To some extent, a number of local breeds have been maintained because of the strict requirement to adapt to harsh environments. Hoste's assessment was that welfare is likely to be favored by low input systems.

In order to ensure better adaptation in breeding and management, Hoste favored to preserve local breeds and species, in some cases to increase the use of cross breeding and to better understand and apply genetics. Hoste mentioned the possibility of farmers being paid by governments to preserve local breeds and continue to utilize the mountainous areas. However, during the discussion, the question of whether there is any value in preserving over time what appears to be a random human imposed expression of animals was raised. It was added that climate change would necessitate new requirements regarding adaptation, so it would be unwise not to understand preservation in dynamic terms.

Opinions therefore differed regarding the importance of the preservation of local breeds. However, it seemed to be more of a political reality for sheep that local breeds are coupled with local product brands than is perhaps the case for other species.

SP3 – Pigs (LowInputBreeds, 2009d)

Jascha Leenhouwers presented on behalf of SP3. He described the market for the production of piglets as both variable and uniform worldwide. It is uniform regarding the ambition to

produce high quality piglets at the lowest possible cost. Therefore, he expected breeding goals to be similar everywhere: vitality, mothering ability and longevity for sows; survival, growth and feed rate conversion for piglets. However, the market for the production of pigs is variable with regards to the challenges facing the sows, e.g. the availability of quality feed, climate, diseases and the availability of quality labor.

In general, intensive production systems aim to remove the challenges by establishing controlled environments, whereas in low input systems, the sows have to cope with the challenges. Consequently, low input systems are less efficient in terms of feed conversion, but may better satisfy societal expectations regarding freedom to live a natural life under outdoor conditions.

The challenges for low input production systems are typically met by adapting the conventional breeds to organic or other low input conditions by cross breeding. Purebred conventional boar lines bred for sow vitality, mothering ability, and sow longevity are crossed with (organic or otherwise) sows on farm for replacement sows. These sows are then crossed with purebred conventional boar lines which are bred for vitality, growth, and feed conversion to get slaughter pigs. In this way, the genetic progress from conventional intensive production is transferred to organic or other types of low input production. Leenhouwers mentioned that conventional breeding goals (e.g. breeding for more teats together with higher litters) are, to some extent, considered controversial by the general public. On the other hand, the system of adapted cross breeding appears to be more competitive on the market than possible alternatives.

The strong focus on efficiency in pig production and its possible negative side effects on the animals led to a discussion about how much pork should be produced. Looking strictly at the efficiency of resource use, it seems most efficient not to produce pork at all. Ruminants are able to utilize areas that are not arable, but pigs are not.

The discussion revealed two lines of argumentation. Some stressed that not meeting the growing demand for pork would amount to unjustified paternalism, and that it would result in a form of social inequality. Why should some be denied having their demand for pork fulfilled, while others (read: rich Western people) can have their demand fulfilled? Others stressed that it might not be unjustified to demand others to reduce pork consumption for moral reasons (concern for the environment and climate) if we (read: rich Western people) demand the same of ourselves.

SP4 – Laying Hens (LowInputBreeds, 2009e)

Ferry Leenstra presented on behalf of SP4. She described the situation for poultry as being the most extreme of the four species groups, characterizing the systems for laying hens in the LowInputBreeding project as ‘intensive’. The reason is that these systems depend on commercial compound feed; outdoor access is only intended for welfare reasons.

While organic and free range systems are challenged compared to barn systems in terms of costs, mortality rates, and productivity, the gap between systems is diminishing, probably as a result of a combination of better management and some genetic progress. Apparently, cross breeding also has huge advantages for adaptation in organic and free range systems compared to farm specific breeding. Highly specialized breeding companies can select multiple pure lines to obtain the optimal crosses for specific conditions.

However, a consequence of the rapid genetic progress is significant specialization, which means that cockerels from laying lines have to be killed because they cannot be commercially

utilized. This is a problem for all systems, but likely to be more pressing for systems intended to be more welfare friendly. Leenstra considered the solution of raising dual purpose chickens. Because of the genetic development, this would have to be based on current laying genotypes. In favor of dual purpose chickens would be fulfillment of the respect for life. Moreover, there is in fact a market for layer males in Asia and Africa, and cooks appear to receive them well. The Bruderhahn[2] initiative uses a price premium on eggs to finance the cockerels – one cockerel per person per year is sufficient to balance the average egg consumption.

Against dual purpose chickens would count consideration of resource efficiency. Leenstra's calculations show that a male layer requires 2,3 kg more feed per 2 kg slaughter weight than a broiler. Is it reasonable to spend these resources and burden the environment to raise these cockerels? Continuing this line of thought, Leenstra concluded her presentation by discussing further environmental challenges for egg production which need to be solved in order to reach sustainability.

Various themes from the previous discussions came up again in response to the presentation: the relevant notion of welfare to assess the killing of cockerels; whether efficiency in the end would dictate a production stop, and whether organic and free range systems represent a true welfare gain. Leenstra's vision for future organic egg production was: free range systems at least have greater potential for increasing welfare, while using hens in the face of widespread food waste might be a way of making such systems more sustainable.

Concluding Remarks

It is striking that the researchers perceive both challenges and solutions for low input production as something which is on a continuum with the development of conventional intensive production (only sheep appear to represent a more diverse picture). To understand the problems as related on a continuum seems to make good sense from a biological perspective. Low input production and intensive production both share the aim of increasing productivity, and they both share a breeding history with a focus on productivity. Solutions to the specific challenges are, therefore, also found by learning from developments in intensive production and trying to adapt them intelligently to local and variable environments.

LowInputBreeds was designed to meet the special needs of low input production. From a biological perspective, the project has showed a variety of possible ways of better meeting the needs of low input production. However, these solutions also underline that low input production, to a large extent, shares both problems and solutions with intensive production. The question is, therefore, whether these solutions will meet consumer concerns. The project description raised the concern that if these needs were not better met, consumers might lose confidence in the system, which again would undermine the often necessary price premiums. Furthermore, some consumers are likely to expect a qualitative difference between the systems. However, as shown in this paper, the consumer perspective is almost absent from the researchers' perceptions.

Since one of the defining differences is that low input systems explicitly emphasize care for animal welfare, and consumers are likely to put great weight on this priority, the answer will, in our opinion, greatly depend on whether or not the general public is able to perceive a genuine welfare gain in these systems now and in the future.

[2] Cf. http://ww.bruderhahn.de

In many discussions, the participants oscillated between a hedonistic view of animal welfare focusing on the mental experiences of the animals that they felt consumers ought to embrace and a more perfectionistic view of animal welfare where concepts of naturalness and integrity plays a large role (Yeates, Röcklinsberg, & Gjerris, 2011) that they perceived consumers as embracing; they felt that such a perfectionist view should be incorporated or maintained in low input breeds production systems to ensure consumer willingness to pay a price premium for the products.

Broadly speaking the future of low input breeds production seems to face two possible future scenarious: Either to adopt methods used within conventional production systems and convince consumers that the level and kind of welfare possible within such a system are worth paying for or to develop the production in line with current consumer demands trusting that this will be an economically viable road even though the price difference between conventional products and low input breeds production products will increase.

Both from an ethical and a pragmatic perspective this choice can be evaluated differently. Here we have sought to show the ethical issues that this raises from the perspectives of researchers and producers involved in low input breeds production. It is a future task to provide a normative analysis of this choice.

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