

The welfare implications of animal breeding and breeding technologies in commercial agriculture.

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Summary

The aim of this paper is to consider the potential welfare problems associated with new developments in animal breeding and breeding technologies, and to provide advice on an appropriate framework within which such developments may be monitored and, where necessary, regulated.

There can be no doubt that the commercial applications of new breeding technologies, as well as conventional breeding strategies, have the potential to influence animal welfare in a positive way. For example, in FAWC's *Report on the Welfare of Dairy Cattle (1997)* we recommended that, when commercially available, the sexing of sperm should be used to reduce the number of unwanted male dairy calves, provided that the technique had not been shown to produce adverse effects. Other potential 'positive' applications include breeding for longevity in dairy cows, improved neonatal survival in pigs and breeding for anatomical characteristics to reduce the risk of fly strike in sheep. Breeding for disease resistance in a range of species is also attracting increasing research interest.

On the other hand, inappropriate use of breeding technologies may create new problems, or exacerbate welfare problems that may already have arisen within conventional livestock breeding. Some of the most serious welfare problems in commercial agriculture are the outcome of a lack of balance in genetic selection in conventional livestock breeding programmes.

It is the impact of any breeding technology or strategy that is important to welfare, whether it is the quality of life of the offspring that is compromised, or whether it is the application of the technology itself that affects welfare. Furthermore, where genotype-associated welfare problems are recognised, we believe there is no reason to separate commercial applications of new breeding technologies from conventional livestock breeding. Indeed, the boundaries between conventional breeding and biotechnology have become increasingly blurred, particularly as a result of developments such as "marker assisted selection" which allow faster genetic change in target traits compared with conventional livestock breeding methods. Such developments should not necessarily be viewed as a threat to animal welfare. If they are applied to animal breeding in a responsible way, they have the potential to improve welfare.

Nevertheless, we believe that safeguards are required with regard to the suitability for introduction of breeding technologies into commercial agriculture. Additional safeguards are also required for the importation of new breeding technologies developed outside the protection of the European Union, and for the importation of certain breeds of livestock, whether they are the product of new breeding technologies or the result of conventional

breeding. We are also of the opinion that there should be a proper assessment of welfare, not only for novel or existing technologies but also for conventional breeding programmes. It is clear that, in welfare terms, it is in conventional breeding that many serious and extensive farm animal welfare problems are currently found in commercial agriculture.

We therefore recommend that Member States, either separately or together, should consider the establishment of Standing Committees for the evaluation of welfare problems associated with new and existing breeding technologies. Such Standing Committees would provide advice to their Governments, and to the EC, on the effectiveness of existing legislation and practices relating to farm animal breeding procedures in order to assure animal welfare. They would also give consideration to ethical questions associated with animal breeding even where measurable detrimental effects on animal welfare may not be immediately evident. Any breeding technology, whether developed within the EU or overseas, should be thoroughly evaluated prior to, and during, its incorporation into commercial agricultural practice.

We are also concerned that targeted surveillance should occur on farms where new breed types or new breeding technologies are first introduced into commercial practice, and that the welfare impact of all such developments should be reviewed throughout a period of normally not less than 5 years after introduction into commercial agriculture. Furthermore, in order to determine the consequences of current breeding strategies or any new breeding technology and to provide essential feedback on welfare performance, we believe that a robust welfare surveillance system should be established. This should accurately monitor the incidence of specified on-farm welfare problems and be capable of providing information on welfare problems associated with breeding strategies or technologies and to determine the respective genetic and environmental contributions. This surveillance system should include the extensive data currently collected by breed societies and breed companies as well as by government departments.

Finally, we recommend that industry, possibly with EC support, should sponsor research and training programmes for the development of husbandry systems to support the demands of new genotypes in relation to their production system.

FAWC'S philosophy and methods

The Farm Animal Welfare Council (FAWC) was established in 1979. Its terms of reference are to keep under review the welfare of farm animals on agricultural land, at market, in transit and at the place of slaughter; and to advise Great Britain's Rural Affairs Ministers of any legislative or other changes that may be necessary. The Council has the freedom to consider any topic falling within this remit.

Animals are kept for various purposes and in return their needs should be provided for. They are recognised as sentient beings in the Treaty of Amsterdam, thus FAWC considers that we have a moral obligation to each individual animal that we use. This obligation includes never causing certain serious harm to animals and, when deciding on our actions, endeavouring to balance any other harms against benefits to humans and/or other animals.

The achievement of high standards of animal welfare requires awareness of animal needs and both caring and careful efforts on the part of all that are involved in the supervision of farmed animals. General guidelines as to what those who use animals should provide in order to avoid suffering and other harms, are contained in the five freedoms:

Freedom from hunger and thirst, by ready access to fresh water and a diet to maintain full health and vigour;

Freedom from discomfort, by providing an appropriate environment including shelter and a comfortable resting area;

Freedom from pain, injury and disease, by prevention or rapid diagnosis and treatment;

Freedom to express normal behaviour, by providing sufficient space, proper facilities and company of the animal's own kind;

Freedom from fear and distress, by ensuring conditions and treatment which avoid mental suffering.

EU legislation on farm animal breeding procedures

Specific legislation on farm animal breeding procedures is now in force as a result of European Directive 98/58/EC concerning the protection of animals for farming purposes. This is implemented in The Welfare of Farmed Animals (England) Regulations 2000, and the equivalent Regulations for the devolved administrations, which state that: "natural or artificial breeding procedures which cause, or are likely to cause, suffering or injury to any of the animals concerned shall not be practised", and that: "no animal shall be kept for farming purposes unless it can reasonably be expected, on the basis of their genotype or phenotype, that they can be kept without detrimental effect on their health and welfare."

Other welfare initiatives relevant to animal breeding

Within the UK there are examples of initiatives by animal breeders as well as veterinary bodies to address welfare concerns associated with breeding and breeding technologies. For example, the dairy industry has developed a nationally available selection index (EProduction Lifespan Index (EPLI)) that incorporates longevity, as an inclusive measure of cow health, in addition to production traits. Plans are in place to expand the EPLI to include additional health traits, for example, lameness, that will increase opportunities for dairy farmers to select bulls for both health and production. The UK Sheep Veterinary Society and the British Cattle Veterinary Association (BCVA), amongst others, have both produced guidelines on advanced breeding technologies which recognise welfare concerns to reduce certain breeding associated problems.

The Royal College of Veterinary Surgeons (RCVS) advises on artificial breeding techniques, including embryo collection and transfer, in its Guide to Professional Conduct (2004). The advice is based upon the Bovine Embryo (Collection, Production and Transfer) Regulations 1995, but through its professional guidance, the RCVS extends the principles to other species and techniques used in advanced breeding technology. It is stressed that, at all stages in such procedures, the welfare of animals

should be paramount. Nevertheless, the RCVS has no mechanism to routinely monitor compliance with this advice. Furthermore, this advice is only applicable in techniques where veterinarians are directly involved or are responsible for supervision.

In the EU, in response to growing public concern about farm animal breeding and reproduction, the Sustainable European Farm Animal Breeding And Reproduction (SEFABAR) project was initiated in 2000 by the Farm Animal Industrial Platform (FAIP). It was an EU funded Thematic Network of representatives from all sectors of the livestock industry, breeding scientists and economists, brought together in a series of workshops over a three year period. During this time, the remit of SEFABAR was to discuss the future sustainability of livestock breeding within Europe, including a consideration of future European and world markets. Animal, human health and environmental considerations also formed important parts of the discussions.

One of the outcomes of the workshops is the agreement by breeding organisations represented within SEFABAR to develop Codes of Practice for farm animal breeding. These codes are now being developed under a new 18-month FAIP co-ordinated project, Code of Good Practice for European Farm Animal Breeding and Reproduction (CODE-EFABAR). A draft of these Codes is expected in September 2004.

If welfare is given a high priority within these proposed Codes, and European breeding organisations agree to operate within them, they have the potential to raise the prominence of animal welfare as a key issue in changing breeding strategies. However, it must be recognised that many breed organisations operate within world markets and this may constrain the degree to which such Codes may address welfare concerns, particularly those which, in order to enhance welfare, might constrain the ability to achieve the gains that commercial sustainability usually requires.

This is a view supported by The Federation of Veterinarians of Europe (FVE) who in 1999 adopted a resolution urging, "member countries and the European Commission to consider the introduction of measures designed to safeguard the welfare of animals with respect to the risks inherent in selective breeding programmes, while preserving the unique characteristics and genetic advantages of European breeds".

Gaps in current regulations

We recognise the value of the EU legislative requirement specific to animal breeding but we are concerned about how effectively it is enforced. For example, we are not aware of any cases where it has been used successfully to restrict any breeding procedure. Examples of genotype associated welfare problems in commercial agriculture, such as those documented in the modern dairy cow or broiler chicken, demonstrate the obvious difficulties in defining what is unacceptable in terms of animal welfare. It is also clear that when problems are recognised in species in widespread commercial use, there may often be no easy solution to rectify them, particularly when they have arisen as a result of past breeding strategies or changes in husbandry and management. Effective advice, and possibly legislative control, is needed to define acceptable and realistic breeding goals if such welfare problems are to be addressed.

We have also sought to determine how those sections of European Directive 98/58/EC concerning animal breeding are interpreted and implemented in other parts of Europe. However, we have found no detailed regulatory framework in any Member State which addresses fully the particular problems associated with the breeding of farm livestock for commercial purposes. Member States such as Italy have taken a similar approach to the UK in that the wording of the European Directive has been incorporated into national legislation. Denmark and Sweden have introduced legislation which allows the possibility of future controls. For example, the Danish Act on the Protection of Animals 1991 states that the Minister of Justice may lay down rules prohibiting the release of bred animals which have difficulties living in nature. A further provision gives the Minister of Justice the power to lay down more detailed rules on biotechnology, including a prohibition on the use of such methods on animals kept for farming purposes.

German animal welfare law attempts to define more precisely the nature of problems associated with breeding which are considered unacceptable. It is prohibited to breed vertebrates or to change them through biotechnology or genetic engineering if it is expected that the offspring are lacking parts of the body or organs for species specific use or they are unfit or deformed thereby causing pain, suffering or harm. The German legislation specifically mentions behavioural and other welfare problems and prohibits the production of vertebrates where it is expected that behavioural abnormalities will occur resulting in suffering or increased aggressiveness. The law also prohibits breeding vertebrates if their keeping is only possible under conditions causing them pain, avoidable suffering or harm.

We have concluded that the lack of an adequate framework for the detailed consideration of how European Directive 98/58/EC may be interpreted and enforced is a significant gap in current welfare controls in most Member States.

There is a further potential gap in the existing welfare legislation in relation to “the generation of what might be judged intrinsically objectionable changes to animals” even in the absence of clear animal welfare, animal or human health, or environmental concerns, as applicable to both GM and conventional farm animals. This may include insentient animals or animals with their physical characteristics, or normal patterns of behaviour, radically and unacceptably altered.

A problem in the case of novel technologies is that many are developed from commercial sources, often overseas, and are therefore not initially covered by EU regulations for research animals. Technologies can be introduced into the EU by veterinary surgeons as part of “recognised veterinary practice”. These could become established within livestock farming before there had been any proper evaluation of welfare implications. This potential problem is well illustrated by juvenile in vitro embryo transfer (JIVET), a technique currently used commercially in Australia. JIVET is the mechanism through which follicle growth in juvenile animals (calves of 8-10 weeks old and sheep and goats of 6-8 weeks old) can be stimulated, offering the potential to substantially reduce generation intervals and produce multiple progeny. Practically, the technique requires hormone treatment of prepubertal animals, followed by oocyte recovery under general anaesthesia and via laparoscopy. Although this procedure, which presents clear ethical questions and may carry potential welfare problems, is not currently used in EU commercial agriculture, the possibility that this may become the case, as in Australia, is real.

Methods of detecting such imports, perhaps through liaison with veterinary practices and organisations, breeding and agricultural representative organisations, and Government departments will be important. In addition, the continued monitoring of imported techniques for an extended period following their introduction is important to ensure that welfare problems which may exist, but which may not be immediately obvious at the time of import, are detected further down the line.

Even for technologies developed within the EU, once they are outside the protection of research animal legislation, any animal that is subjected to or is the product of new technology is protected only under the general welfare legislation. For example, concern has been expressed about initiatives to promote the incidence of twin calves in the beef industry through the implantation of multiple embryos. Whilst the technology required to achieve this may not be, in itself, a welfare concern, we are aware that problems, such as poor calf survival and disease have arisen in some commercial agricultural systems. Additional welfare problems may be associated with the implementation of breeding technologies already in existence. For example, there are no rules to govern the number of embryos which may be implanted into sheep or cattle, or the number of times such a procedure may be performed.

It is essential that targeted surveillance is made of farms where new technologies, developed under laboratory conditions, but recently released into commercial practice, have been implemented. There is a strong argument for a period of commercial trials before novel techniques may be available for general use. This would provide a bridge between the controlled conditions of the laboratory and general farm use.

Welfare consequences of animal breeding

Since 1992, all FAWC reports on the welfare of different species of livestock have highlighted welfare concerns associated directly with animal breeding strategies. However, compared to many other issues we have addressed, it has been far from straightforward to offer useful advice or to make recommendations as to how such problems may be resolved.

The example of lameness and mastitis in the modern dairy cow demonstrates the need for a broad strategic approach to addressing welfare problems associated with genotype. Such an approach must, of necessity, involve the co-operation of breed companies, farmers, geneticists, veterinary and other advisory organisations. There is an argument that if real welfare improvements are to be made, there is a need for some level of independent advice, and possibly regulation, of the genotypes that are being promoted within commercial agriculture.

Welfare problems associated with conventional breeding methods are also demonstrated in the modern broiler chicken where there is evidence to link past selection for fast growth with associated leg and cardio-pulmonary problems. The *FAWC Report on the Welfare of Broiler Chickens (1992)* raised particular concerns about the level of leg problems and proposed four principle methods of reducing the incidence, including the increased selection of breeding stock for strong and well-formed legs. Recognition of such problems has encouraged broiler breeding companies to

modify selection programmes. However, there is a need for assurance that these changes have had positive effects on animal welfare.

We also commented on the selection of broiler breeding stock in the *FAWC Report on the Welfare of Broiler Breeders (1998)*. We emphasised the importance of ensuring that factors such as cardio-vascular health, foot and leg health, social behaviour and resistance to disease were given high priority in selection procedures. We also expressed concern at the problem of hunger in broiler breeders and recognised that it was likely to get worse if selection for fast growth continued. We made the specific recommendation that the objectives of the breeding companies in the future development of strains of broilers should include welfare improvement, in particular the avoidance of problems of prolonged hunger in broiler breeders.

The resolution adopted in 1999 by the FVE summarised their concerns associated with animal breeding. They stated that "Selective breeding programmes may cause animal welfare problems. It may become difficult or impossible for natural copulation or parturition to occur; offspring produced by selective breeding for certain specific characteristics may be unable to express their natural behaviour; or they may be predisposed to hereditary, congenital, metabolic or infectious disease, disability or early death. The introduction of such selective breeding programmes may make it impossible for the breed to be maintained by natural means".

On the subject of breeding technologies, the FVE stated that, "the use of new and emerging technologies in artificial breeding, such as ovum and embryo transplantation and genetic manipulation, may also be a source of concern, and it is likely that some future advances in science will also have animal welfare implications. The technique used may carry inherent welfare risks for the animal (e.g. the particular method by which semen or ova are obtained); the intended outcome of the procedure may be intrinsically objectionable (e.g. the development of animals with unnatural physical or behavioural characteristics); and offspring may be produced with welfare disadvantages such as those mentioned above".

A recent report published by the UK Department of Trade and Industry, 'Genetics and Genomics of Sheep and Cattle in Australia and New Zealand' effectively highlights the "technological crossroads" that animal breeding has reached. The report emphasises that, "new opportunities are opening up that are likely to transform the way breeders improve their stock", for example, growing commercial interest in the potential of marker assisted selection looks set to accelerate the rate of genetic change to livestock by conventional selection methods. We recognise that the application of gene-mapping to selective breeding programmes may be used to rectify welfare problems, for example by selecting for specific health traits such as improved leg health in broilers. We are concerned, however, that with the considerable commercial competition between breed companies, the primary focus of attention will be for production-related traits. In the case of the dairy cow this might be for higher milk volume and changes in constituents, and for the broiler chicken, faster growth rate, improved feed conversion ratio, or greater breast muscle mass.

We are aware of research groups using marker-assisted selection for animals with greater levels of disease resistance, for example, salmonella resistance in poultry and parasite resistance in sheep. The Dti report also states that in Australia and New

Zealand, “there [is] considerable interest from a number of groups to identify and exploit genetic variation among livestock for disease resistance”. Whilst this will have obvious welfare benefits, it is important that the development of such strains is not used to disguise welfare threatening conditions which would otherwise produce disease and does not discourage the development of higher standards of stockmanship and provision of a good quality environment.

Genotype and environment interactions

The selected examples of welfare problems described in the previous section are those where narrow breeding objectives, or novel breeding technologies have had adverse consequences for animal health and welfare. However, breeding related welfare problems cannot be viewed in isolation since most are inextricably linked with the environment in which animals are kept. Of fundamental importance is the quality of management of any animal throughout its life, but there are many other aspects of the environment which, if inappropriate for a particular genotype, may have consequences for welfare which are just as serious as poor management. For example, welfare problems may also arise where a particular breed of animal is poorly suited to the environment in which it is reared

In our *FAWC Report on the Welfare of Sheep (1994)* we expressed our concern about the potential problems associated with changes in breed structure in response to the commercial demand for different carcass and conformation characteristics. We recommended that if any change in breed or breed type is contemplated in challenging extensive conditions, replacement must only be with one that is sufficiently well adapted to the environment. We also recommended that within breed selection programmes, monitoring is carried out for problems associated with selection for greater muscularity.

We made a similar recommendation in our *FAWC Report on the Welfare of Pigs Kept Outdoors (1996)* where we stated that, breeding companies, and those responsible for the selection of breeding stock to be kept in outdoor enterprises, should ensure that only those strains of pig with the genetic potential to thrive in the conditions are used. In the report the importance of temperament was also raised and we recommended that when selecting pigs, attention should be paid to the need for good temperament and mothering ability.

We hold the general view that the welfare of some breeds of high performance potential may be adversely affected when kept in more extensive or organic environments. The increasing demand for organically produced food has encouraged greater interest in this aspect of animal welfare with some research directed towards the suitability of breed types for organic systems. For example, a recent study has examined the suitability of two commercial broiler strains, one fast- and one slow-growing, in a free range system. Both strains became very heavy at the minimum age of slaughter specified by organic requirements with the fast-growing strain having the poorest feed conversion ratio. This, in addition to poor mobility, as reflected in low usage of the outdoor area, and the presence of deep pectoral myopathies led the authors to suggest that the fast-growing strain was particularly unsuitable for free range production. Given that organic standards require chickens to be slaughtered at a greater age than is now the normal age for

standard broiler production, it is likely that exposing certain commercial broiler strains to such systems would be a welfare concern.

The standard of management is an aspect of the environment in which an animal is kept and we recognise that, with high levels of management, many of the genotypes of higher production potential can often be reared without major welfare concerns. However, we are concerned over the importance of high levels of skill required by those persons responsible for some genotypes given the known variation in standards of management across farms. We recognise and welcome the attempts made by many sectors of the livestock industry to improve the management provided to emerging genotypes, and encourage the maintenance of research and training programmes for the development of these.

Welfare surveillance

Since breeding strategies, either by conventional breeding or using novel technologies can have such major influences on animal health and welfare, it is essential to have accurate information on the extent to which any trait which influences welfare is improving or getting worse, in addition to the respective impacts of genetic and environmental factors. Breeding companies test the performance of new genetic strains under highly controlled conditions with very high standards of management. It is on release to the commercial sector, when breed company management guidelines are sometimes ignored, standards of husbandry might be lower, or livestock are reared in less than optimal environments, that welfare problems often become apparent.

The importance of welfare surveillance to animal breeding strategies has been demonstrated in Scandinavia where, for the last 20 years, integrated databases and comprehensive recording schemes have been developed for both cattle and pig breeding. In the 1970's Scandinavia developed a philosophy that breeding objectives should include health and production traits rather than just production goals. It was recognised that an essential prerequisite for the efficient operation of such breeding objectives was the accurate recording of health, reproduction and production traits. Integrated databases, initially between the milk-recording scheme and the artificial insemination (AI) service, were developed and subsequently expanded to include health traits. For example, in all Scandinavian countries, veterinary reports on clinical treatments are now incorporated into the databases. The result is that Scandinavian countries have adopted Total Merit Indices (TMI) in selection programmes. Not only has such an approach improved animal health, as demonstrated for example, by a steady decline in mastitis levels in dairy cattle, but the total economic gain from selection for a TMI in dairy cattle has been shown to be 10-25% superior to single trait selection, despite a reduced gain in milk production levels.

The Scandinavian model has shown the importance of integrated databases and comprehensive recording schemes. The information obtained has provided effective management tools at farm level with economic benefits; it has produced valuable information for research and development at a national level; and it has provided a vehicle for the application of research findings into commercial practice.

In some livestock sectors, much of the desired information is already being gathered by, for example, breeding companies. This should be utilised and supported by additional monitoring and surveillance where necessary. However, it is essential that although data may be obtained from a range of sources, their analysis must be carried out by a body which is considered by all to be independent. In addition, where data is not of a confidential nature this should be made available for further analysis by interested parties.

We believe there is an urgent need to develop on-farm welfare surveillance systems capable of providing reliable, robust information on the prevalence of a range of health and welfare traits for different species of livestock. The information obtained from such surveillance systems would be of value to, and must be available to, farmers, breed companies, veterinarians and researchers.

Genetic modification

The term 'GM animal' refers to animals modified either via transgenesis (when individual genes from the same or a different species are inserted into another individual) or by the targeting of specific changes in individual genes or chromosomes within a single species. There is a range of technical barriers that have to be overcome before the production of GM livestock for food production would be viable, notwithstanding its acceptability to the public. These include; the low efficiency of genetic modification of the genome for pigs, sheep and cattle; the high levels of embryonic loss; the incomplete knowledge of the genome for most of the major farmed species; and the fact that potentially desirable traits such as disease resistance and improved production are polygenic and require the alteration and co-ordinated expression of several genes. Funding agencies are not currently supporting GM livestock projects to a high level since investment returns were considered to be low. It is considered that the commercial development of GM animals as a source of food is unlikely to be progressed unless the regulatory, ethical, economic and environmental issues, as well as public concern can be addressed. The extent to which genetic modification will become incorporated into future livestock breeding strategies may well be determined, not by scientific developments, but by public acceptability of the technology. Opposition to GM crops by consumers, retailers and environmentalists continues to influence the commercial application of GM technology in the plant sector, and there is no reason to believe that a similar level of opposition would not develop if the technology became incorporated into livestock breeding.

Cloning for commercial purposes

Although cloning may be used in conjunction with genetic modification technology, it is fundamentally different in that a clone is an organism or cell derived from a single ancestor by asexual means. It was the production in 1997 of a cloned sheep (Dolly) from an adult cell that resulted in considerable public debate on the implications of cloning, particularly the wider ethical issues. In 1998 we produced a *FAWC Report on the Implications of Cloning for the Welfare of Farmed Livestock*, which considered the welfare implications of the techniques involved and the regulatory controls which might be necessary. We considered both the ethical and welfare issues associated with cloning and made a number of important recommendations. One overriding

recommendation was that, until the problems of oversized offspring, embryonic and foetal losses and birth abnormalities, and the possibility of problems associated with aged DNA, have been satisfactorily resolved, there should be a moratorium on the use of cloning by nuclear transfer in commercial agricultural practice.

We also recommended that a Standing Committee should be established to oversee the developments of cloning technology. We stated that the Committee should review outputs of research aimed at tackling the welfare problems identified in our Cloning Report (and any other problems which may emerge); it should determine the time when it may be appropriate to introduce cloning into commercial agricultural practice; and it should ensure that the controls put in place at that time are both adequate and effectively implemented. The report also recommended that the Standing Committee should play a role in both promoting public awareness of the facts and issues concerning cloning and related technologies, and conveying public concerns to Government and Scientists.

The problems associated with cloning identified in our 1998 report still remain. In all species the efficiency of the technology is still very low: for example in cattle, which is the most studied species, on average only 3% of the transferred cloned embryos develop into viable calves. There are a number of welfare problems associated with nuclear cloning. For example, clones tend to have higher birth weights and may have a greater propensity in later life for respiratory problems and immune system deficiencies compared with normal animals. In addition, placental and foetal abnormalities that can lead to death of the clone at various stages of development are common.

It is difficult to predict the extent to which cloning will become incorporated into food animal production in the future. Research has suggested that because of the current technical and welfare problems, there will be few practical applications of cloning in commercial agriculture in the foreseeable future. However, representatives of commercial breeding companies developing cloning for commercial applications see many potential benefits and have predicted that cloning will become a routine part of livestock breeding within 20 years. They suggest that cloning will serve a number of purposes such as the commercial development of disease resistant animals, improved feed conversion, greater muscle mass, and the production of meat of more consistent quality. Breed companies also see an application of cloning to evaluate the performance of animals of the same genetic make-up under different management systems and also in preserving the genome of both premium and rare breeds of animals.

Ethical considerations

We addressed the subject of ethical aspects of biotechnology in our cloning report and adopted an ethical framework in that a procedure may be considered intrinsically objectionable for any one of the following reasons:

- a) It results in very severe or lasting pain on the animals concerned;
- b) It involves an unacceptable violation of the integrity of an animal;
- c) It is associated with the mixing of kinds of animals to an extent which is unacceptable;

d) It generates living beings whose sentience has been reduced to an excessive extent

Whilst points a) and c) in the above should be adequately catered for under current welfare regulations, decisions about unacceptable violation of integrity or reduction in sentience are not. Our Cloning Report commented on potential problems concerning violation of integrity or unnaturalness which, in the absence of suitable controls, might well result in a significant insult to the animals involved. We stated that we shared concerns that “an attitude may be developing which condones the moulding of animals to humankind’s uses, irrespective of their own nature and welfare”. In the case of cloning, this was a perception of a cloned animal as a manufactured being, which to some in society is offensive. We also stated that, “it is not clear that a radical distinction between human and non-human is now defensible, either biologically or ethically, nor that any such disjunction is sufficient to warrant the treatment of other living creatures merely as means. We owe respect to other animals, and especially to those which we choose to domesticate.”

Both conventional and novel breeding techniques have the capacity to produce animals whose integrity has been altered to an unacceptable degree. An example of a possible candidate for such ethical consideration is the featherless broiler chicken, produced in Israel by conventional breeding methods. Such an animal might not be excluded from commercial production on welfare criteria since it is feasible that the environment for which it was selected may actually favour baldness. However, it might be argued that such a significant change to genotype or phenotype should be prohibited from entering commercial production on the grounds that it constitutes an intrinsically objectionable change to the nature or ‘integrity’ of the animal.

Another example where a broader set of ethical considerations, rather than a purely welfare based approach, might be required is for the commercial acceptability of a strain of laying hens that are “genetically blind”. Researchers in Canada concluded that when compared with sighted hens, the blind birds laid more eggs, consumed less food, were less affected by flock size and stocking density, and had better feather cover. The researchers suggested that on the basis of their evaluation of welfare, the blind birds may have reduced stress levels and that it was worthwhile to explore further the potential of this mutation in egg-laying strains kept in cage systems.

A final issue is that of selecting animals for behavioural traits. A reduction in sensitivity to the environment is a general effect of domestication in many species, but we are aware that selection for temperament is becoming increasingly important in breeding programmes. This is particularly the case for species such as pigs and laying hens, where a move away from close confinement systems, driven by either legislation or market forces, has revealed the importance of behavioural traits such as reduced levels of aggression. Whilst breeding for temperament has been carried out for hundreds of years, the protection of behavioural flexibility and sentience in animal breeding is becoming an issue where regulation may be necessary.

The above examples demonstrate the wide range of issues that demand proper ethical evaluation on the basis that they constitute major changes to the integrity or sentience of animals. For simplicity, we have chosen not to address the possibility that these

examples pose a more obvious risk to welfare, for example, that 'blind' chickens are more efficient because they are less active.

Concluding remarks

We have considered carefully the options available for addressing the broad range of ethical and welfare issues that relate to breeding and the application of breeding technologies in farm animals, as raised in this report. We believe that any failure to address the issues highlighted presents a significant risk to Governments, to the livestock industry and, most importantly, to animal welfare. For example, there is considerable public disquiet about genetic modification, cloning and some novel breeding technologies. At the present time it is difficult to predict the extent to which developments in these fields will become incorporated into livestock breeding programmes. However, it seems reasonable to assume that public opinion will be an important factor influencing developments in these areas. A crucial role of our proposed Standing Committee would be to be seen by the public as a trusted and reliable body to provide balanced advice to Government and at the same time to listen to public concerns about such matters.

In addition to helping avert potential risks, the proposed model for a Standing Committee would provide a number of other benefits. For example, analysis of data from an effective welfare surveillance system would provide information on both genetic and environmental influences on health and welfare, thus allowing both aspects to be addressed in a coherent way. Such a welfare surveillance system would also allow welfare problems to be addressed when they first become apparent and not, as is often the case, many years after they develop.

In the same way, research effort in many areas of farm animal welfare could be much more effectively and carefully targeted if accurate data on the prevalence of welfare problems were available. The proposed welfare surveillance system would, in itself, be a resource of enormous value in that it would allow trends in a wide range of welfare problems to be monitored, thereby assisting Government and other interested parties (e.g. research groups) to focus attention on the most pressing problems. At the same time it would allow industry to demonstrate where recognised welfare problems were being addressed, both through selective breeding as well as through management.

Animal breeding and the use of breeding technologies is a dynamic and growing field that has the potential to influence animal welfare in a positive, as well as negative, way. The proactive approach we recommend to address the issues raised in this paper would ensure that neither progress nor welfare are compromised.