All-Party Parliamentary Group on Science and Technology in Agriculture

Notes of a Zoom Meeting held on Tuesday 26 April 2022

Hosted by NIAB, Cambridge

Nuffield Council on Bioethics report on gene editing in farmed animals

In attendance:

Members:
Julian Sturdy MP (chair)
Lord Cameron of Dillington
Lord Carrington
Professor Lord Trees
Lord Inglewood
Lord Curry of Kirkharle
Fay Jones MP

Guest speaker:
Pete Mills, Nuffield Council on Bioethics

Stakeholders:
Dave Ross, Agri-EPI Centre; Tom Allen-Stevens, Bofin; Prof Jim Dunwell, Reading Univ; Prof Helen Sang, Roslin Institute; Jonny Hazell, Royal Society; Mark Buckingham, Bayer; Calum Murray, Innovate UK; Steve Morgan, Defra; Dr Craig Lewis, Genus/PIC; Karen Holt, Regulatory consultant; Judith Batchelar, Food Matters Intl; Elena Rice, Genus; Clint Nesbitt, Genus/ABS; Chris Jackson, UKTAG; Graham Teakle, Warwick Univ; Ana Granados Chapatte, EFFAB; Mark Fife, Aviagen; Martin Emmett, NFU; Geoff Mackey, BASF; Jon Williams, BASF; Marco Winters, AHDB; Prof Brendon Noble, Westminster Univ; Rob Hill, Rothamsted Research; Duncan Barker, FCDO; Jennie Wilson, USDA; Cameron Hughes, CLA; Megan Gittoes, British Sugar; Diane Wray-Cahen, USDA; Prof Huw Jones, Aberystwyth Univ; Jim Duncumb, Syngenta; Julian South, MAGB; Ross Houston, Benchmark Genetics; Dr Helen Ferrier, NFU; Rachael Speed, NFU; John Royle, NFU; Claire Smithson, Sense About Science; Dan Burling, NFU; Janet Talling, Defra; Andrew Simpson, Defra; Pamela Thompson, Defra; Sue Whitehead, Defra; Oscar Pepper, NFU; Anna Wright, NFU; Liz Warner, NFU Poultry Bd; David Alvis, Elsham Linc; Oli Watson, Defra; Zoe Davies, Royal Society; Harriet Davenport, House of Lords; Prof Gideon Henderson, Defra; Laura Marshall, RSB; Alex Durk, Science Media Centre; Marcus Bates, NPA; Harrison Ostridge, Royal Society; Louise Courts, Defra; Rob Beckett, YorkWold PigPro; Anne-Marie Neeteson, Aviagen; Bethan Postle, NIAB; Daniel Pearsall, Group Co-ordinator.

1. Introduction

Welcoming members and stakeholders to the All-Party Group's fourth meeting of 2022, the chair introduced guest speaker Pete Mills, Assistant Director at the Nuffield Council on Bioethics and lead author of a report issued last December into the social and ethical issues of using gene editing techniques in the breeding and production of farmed animals.

Pete Mills has researched, written and advised on many subjects in biomedicine and biotechnology, including assisted reproductive technologies, genomics and genomic medicine, Artificial Intelligence, agricultural biotechnology and public engagement.

The Council's inquiry into gene editing and farmed animals was prompted by the observation that despite being that a comparatively near-term application, the use of gene editing in farmed animal breeding has been relatively little discussed in public - compared, for example, to applications in crops.

The chair noted that members of the All-Party Group had been particularly active - alongside scientists, breeders and farmers - in highlighting the potential benefits of precision breeding technologies in both crops and livestock, as a means of accelerating our response to the urgent global challenges of food security, climate change and pressure on finite natural resources.

The world must produce up to 70% more food by 2050, and over that same period demand for meat-based protein is projected to double. The ongoing conflict in Ukraine, and the resulting impact on food prices and availability, as well as key farming inputs such as fertiliser, has underlined the precarious balance which now exists between global food supply and demand.

The chair emphasised that members and supporters of the All-Party Group see new agricultural technologies and innovations – and genetic innovation in particular - as a potential source of positive solutions to these challenges.

2. Guest speaker

[Please note that speakers' slide presentations are available to download via the meetings section of the All-Party Group website at www.appg-agscience.org.uk]

Pete Mills, Assistant Director, Nuffield Council on Bioethics

Pete Mills (PM) introduced the Nuffield Council on Bioethics (NCB) as an independent body, established in 1991 to inform policy and public debate about ethical questions raised by developments in biological and biomedical research. Most of the Council's work to date has been in the area of biomedicine with a few notable exceptions, including GM crops, biofuels and the most recent inquiry into genome editing in farmed animals.

PM explained that NCB's approach to examining emerging biotechnologies was based on avoiding two 'hypothecation errors', namely that solutions to particular societal challenges might be attributed to specific technologies and that alternative pathways might not be properly explored (eg GM crops are needed to feed a growing world population), or that technologies might be perceived to have fixed purposes and other implications not properly considered (eg genetic testing as a purely medical tool rather than having wider identity-confirming applications).

Explaining the background to the report, PM suggested that the introduction of genome editing techniques such as CRISPR/Cas-9 in 2012 had potentially disruptive implications across the whole of biological science.

Beginning in 2014, NCB recognised that developments were taking place rapidly, and conducted an initial programme of work to review applications of these techniques and their ethical implications. This review led NCB to prioritise work on two areas – the first in 2018 on human reproductive applications, and the second on farmed animal breeding, where the potential use of genome editing was considered to raise distinctive ethical considerations, about which there had been relatively little public discussion compared to applications in crop plants.

PM explained that NCB saw this as an opportunity to get ahead of that debate, to inform the discussion and if possible, help avoid the polarisation seen first time round with the GMO debate in the 1990s and 2000s.

The inquiry (2019-21) involved convening a multi-disciplinary working group bringing together a broad range of expertise in farming and food systems, animal biotechnology, biological research, veterinary epidemiology, law, philosophy, social science, sociology, animal welfare and ethics. The work programme included an open call for evidence, commissioned research, a site visit to the Roslin Institute and a range of fact-finding meetings, as well as desk research, stakeholder interviews and public dialogue. Once drafted, the report was also submitted to a process of external review.

PM explained that the inquiry approached the issue of genome editing from a long historical perspective, to help set in context what was particularly ethically distinctive about genome editing. He suggested that the domestication of farm animals over thousands of years had left its mark on the behaviour and biology of the people and animals involved. This made it difficult to establish a primary, 'natural' reference point for the animals involved, or to understand in what way the changes introduced through genome editing might be meaningfully different from those introduced through conventional breeding, particularly since the 1760s when selective breeding became more of the norm and brought a step-change in genetic gain in domesticated species.

PM suggested that the success of modern agriculture was, to quote Henry Dimbleby's National Food Strategy report, "both a miracle and a disaster" in placing our food and farming system at the centre of a number of profound societal challenges – grouped in the report under five headings: animal health and welfare; human health; demand and supply; social, cultural and political; environment and ecosystems.

The inquiry's ethical questioning, given our dependence on farming to secure basic human interests, focused on what a 'just' food and farming system looks like, and considered that "humans and animals should have the opportunity to live their lives in a state of safety, security and wellbeing, with access to the experiences that constitute a good life, according to their form of life."

From there it sought to establish what sort of governance the use of genome editing should be subject to in order to secure those basic interests, and how the further innovation, diffusion and normalisation of these novel biotechnologies might affect justice in food and farming systems, given their profound capacity for biological change, and that they should not be considered as *merely* tools.

Working through the potential applications of genome editing in farmed animal breeding – from avoiding mutilations (horns, tails, castration); improved resistance to disease and environmental conditions; production traits such as faster growth, sexing; to reduced environmental impacts (eg improved feed conversion, reduced GHG emissions) – in seeking to establish whether genome editing would become the presumptive technology for 'genetic gain'.

PM suggested that the answer was probably not, but the report considered that GE could accelerate genetic gain in some directions and make step changes in others, and therefore advised that GE should <u>not</u> be used: to enable animals to endure conditions of poor welfare without manifesting adverse health effects; to further entrench the results of conventional breeding in producing animals constitutionally unable to enjoy an acceptable quality of life; or where it will entrench damaging farming practices or compound undesirable outcomes.

The inquiry also commissioned independent desk research to examine how members of the public might respond to the use of genome editing in farmed animal breeding, particularly in relation to its use in crop plants and in the context of lessons learned from the GMO debate. However, PM observed that this uncovered relatively little other than there is a lack of qualitative

research in this area and that our understanding of public attitudes lags behind new technologies and their applications.

In the context of the continuing Covid pandemic, the inquiry also conducted a rapid online public dialogue to gauge attitudes towards the potential use of GE in farmed animals, which revealed a clear distinction between how questions were posed – ie 'consumers' are concerned with issues such as food safety and freedom of choice, while 'citizens' are more concerned with common public interest issues such as animal welfare and justice.

PM noted that the Defra consultation in January 2021 and the proposal to remove retained EU GMO regulation from certain GE organisms raised a number of questions in terms of how new breeding technologies will be used: eg in what circumstances; with what aims; in whose interests; and with what effects?

PM suggested that – for good or bad – the GMO regulations have acted effectively as a brake on the introduction of genetic technologies, and the concern is that once those brakes are removed the system should not accelerate down the wrong path, given that conventional livestock breeding has resulted in some less than desirable outcomes, particularly in relation to welfare.

Turning to the report's recommendations, PM highlighted the need for a policy framework which extended beyond narrow considerations of safety and risk to shape the future of our food and farming system in a way that addresses broader societal challenges. Within that, PM emphasised that there is a place for genome editing in farmed animal breeding, indeed GE may be a preferable solution in some situations.

PM suggested that the report's five principles and 14 recommendations could be distilled down into the following three clear policy objectives:

- clear and meaningful **standards** for responsible and sustainable breeding (underpinned by research)

- better use of **data** to understand what is happening on farms and how well those standards are being met; and

- **incentives and regulation** to guide breeders, farmers and retailers towards a desirable vision for the food and farming system and to guard against overreaching or externalising social costs.

PM indicated that NCB is particularly interested in taking forward discussions about better, more coherent governance of responsible breeding practices in farmed animals, as well as encouraging responsible behaviours among retailers and consumers.

Concluding, PM added that NCB is also commissioning a rather larger public dialogue (80 participants across the UK in June/July – findings expected in September), in partnership with BBSRC and Sciencewise, to explore public attitudes towards the use of genome editing in livestock farming and aquaculture, and in particular the issues raised by the NCB inquiry.

3. Questions & discussion

The chair introduced the question and discussion session by inviting four leading figures from the veterinary, genetic research, breeding and livestock farming sectors to share their thoughts on the NCB report and the issues raised by the prospect of using genome editing in farmed animal breeding.

Professor Lord Trees, House of Lords
Lord Trees (LT) observed that disease is probably the single biggest welfare issue in rearing farm animals, and genome editing offers the potential to accelerate the development of disease resistant breeds. This would in turn reduce drug and chemical use with positive effects for problems such as anti-microbial resistance and environmental pollution. Other applications of GE include the potential to reduce greenhouse gas emissions, to aid sex determination and other management practices, with significant potential benefits for animal health, welfare and the environment.

LT also noted that some welfare issues had resulted from conventional breeding systems, such as double-muscled Belgian Blue cattle which can only deliver through Caesarean section, as well as chickens and turkeys with excessive breast muscle development, and dogs condemned to chronic ill-health through bronchial obstruction.

He suggested that there is now greater awareness of these issues, and to focus regulation on welfare outcomes, rather than specific inputs such as breeding techniques. LT pointed to the existing Farmed Animal Welfare Regulations 2007 which state that “natural or artificial breeding, or breeding procedures which cause or are likely to cause suffering or injury to any of the animals concerned animals must not be practised”, with similar, more recent legislation enacted in 2018 in relation to the breeding of dogs.

LT concluded that there is model welfare legislation in place, which may need to be strengthened, but he cautioned against excessive restriction of specific breeding technologies, such as genome editing, could not only compromise the UK’s world-leading position in terms of genetic research on livestock health and welfare, but could be a major missed opportunity to deliver significant improvements in global health and welfare, as well as the environmental impact of livestock production.

Professor Helen Sang, Roslin Institute
Offering a genetic research perspective, Helen Sang (HS) underlined the major opportunities of applying these technologies to deliver benefits for animal health and welfare, and noted that UK research has been leading the world in many respects – a position which could be lost as these technologies become more widely used elsewhere.

Working closely with breeding companies in her research, HS emphasised the changes that have taken place in breeding programmes over the past 20 or so years, from targeting a limited number of production-related traits to now focusing on a much broader range of some 30 characteristics, many of which are welfare-related. HS added that breeders – many based in this country - have been extremely responsive to historical welfare issues once identified, such as leg weakness in broilers, and that responsiveness should be something to recognise and be proud of.

HS challenged the suggestion, in the context of a report drawing an ethical distinction between genome editing and conventional breeding, that all farmed animal breeding should be subjected to a different regulatory system and standards. She indicated that the tension which exists between animal welfare groups and the breeders has been extremely constructive in driving both genetic and welfare improvements in recent decades, and the assumption in the report that the direction of travel will suddenly change, and needs a different regulatory approach – when the UK is a standard-setter - is quite concerning, and would simply drive research and innovation in these fields overseas.

Overall, HS found the report disappointing in the perspective it provided of animal breeding as a whole, with not enough emphasis on the major opportunities of improved breeding to advance the cause of animal welfare.

Dr Craig Lewis, Genus/PIC
Craig Lewis (CL) acknowledged the effort put into the NCB report on the use genome editing in farmed animal breeding, but suggested that the report's portrayal of modern livestock breeding as it stands is out of date and inaccurate. Disappointingly, evidence presented to the report's authors by the livestock breeding industry to underline the balance of modern, responsible breeding programmes, including welfare and sustainability considerations, appears to have been overlooked.

Modern breeding goals have changed radically over the past 20 or so years, from simple growth rate, feed conversion and meat quality objectives to a much more balanced range of parameters including health and welfare traits such as disease resistance, robustness and resilience, and achieved over time through dialogue with producers and others in the supply chain.

But CL added that it was also wrong to suggest that breeding for improved productivity would deliver worse outcomes for animal health and welfare, when more often than not some of the most efficient and productive livestock systems are also those which demonstrate the highest standards of animal health and welfare.

CL noted that some of the concerns raised in the report about the implications of using genome editing, especially in relation to animal health and welfare, could equally apply to conventional breeding, vaccination or treatment with other drugs. In relation to breeding and rearing livestock in the UK, separate regulatory safeguards already exist to protect farm animal health and welfare, as pointed out by Lord Trees, and this should not be treated as a GE-specific issue.

CL observed that the UK's animal welfare standards are among the highest in the world, and the introduction of genome editing would not adversely affect those already high standards. In fact these breeding technologies have the potential to benefit animal health and welfare in many production systems, especially those where effective alternative treatments are not available.

Speaking on behalf of a company which has successfully used genome editing to deliver effective resistance to the devastating PRRS virus in pigs, which impacts both intensive and extensive production systems, it could be viewed as unethical from a welfare and sustainability standpoint not to support the application of these more precise and accelerated breeding technologies in UK agriculture.

Rob Beckett, YorkWold PigPro
As a livestock farmer with over 35 years' experience in the industry, Rob Beckett (RB) started off as a stockman and has managed farms and multi-site operations leading to his current position as MD of a large independent pig business in Yorkshire. RB sits on a number of industry committees including the AHDB Pork Council, the Red Tractor Pork Board, the Pig Health and Welfare Council Welfare Committee, as well as several other industry welfare working groups. This involvement across the industry provides a good understanding of the challenges facing the industry, as well as the progress being made.

RB expressed pride in the continuous progress made by the industry on husbandry and welfare issues. He indicated that the direction of travel was undeniably positive, with significant reductions in antibiotic use, stocking densities and confinement of sows, and surgical procedures such as castration and teeth reduction. These improvements reflect changing consumer expectations and greater interest in the provenance and integrity of their food.

Much of this progress in improved farm animal health and welfare is due to breeding innovations, driven by a joined up, collective approach involving consumers and retailers, processors, farmers, vets and genetics companies. The two-thirds reduction in antibiotic use by the UK pig industry since 2014 can be attributed not only to better standards of management and husbandry, but also to development of more resilient and disease resistant breeding lines.

As a farmer, RB indicated that he did not identify with the Nuffield report's description of modern farming as 'morally indefensible and unsustainable' when such improvements are taking place. He suggested that farm animal welfare standards today are almost unrecognisable compared to 30 or 40 years ago.

RB added that it was therefore disappointing and frustrating that much of the report reflected the views of those with deep-seated prejudice against livestock farming per se, rather than focusing on the application of advanced breeding techniques with such enormous potential to deliver positive improvements for animal health and welfare, including resistance to diseases such as PRRS.

RB warned that viral challenges in the pig industry should be the primary focus, adding that the Covid pandemic should be a reminder of the need to embrace new knowledge and technology to protect human and animal health.

RB signalled his agreement with several aspects of the report, including the need to persuade the public sector and retailers to commit to only sourcing meat from farm animals that are bred responsible, as the UK is currently only 50% self-sufficient in pork and imports product that would not meet UK health and welfare standards.

However, RB disagreed with the report's suggestion of an inverse relationship between farming scale and impact on welfare.

RB noted that UK-based scientists at places like Roslin and Pirbright are world leaders in using techniques such as gene editing in research aimed at improving livestock health and welfare, preventing future zoonoses, reducing drug use and mitigating climate change. He suggested that it would be unethical to prevent or discourage such research as a result of out-of-date or ill-informed prejudice against the livestock sector.

PM responded that the NCB report is emphatically not antagonistic to the use of genome editing technologies in agriculture.

However, while he suggested that data was widely available documenting the historical welfare problems caused by livestock breeding, NCB had struggled to get hold of data to support breeders' claims of more recent improvements, although he accepted this was possibly due to the integrated nature of many pig, poultry and aquaculture supply chains and the proprietary nature of such data.

He suggested there was a need for reassurance on this point, noting that arguments describing genome editing as simply an accelerated version of existing conventional breeding did not play well against those background perceptions of poor welfare outcomes.

CL highlighted the challenge of developing consistent metrics to define welfare, but indicated that evidence was available to demonstrate recent improvements delivered through more balanced breeding programmes. He pointed to initiatives such as Code EFABAR – a code of responsible conduct developed by European farm animal breeders – as a further indication that the modern livestock breeding industry takes its responsibilities seriously and is prepared to be much more open and upfront in explaining the business of modern breeding and its contribution on issues of public concern such as animal welfare and environmental sustainability.

Anne Marie Neeteson (Aviagen) explained the background to Code EFABAR, which began in 2005/06 as a publicly funded EU project with wide involvement from a range of stakeholders, including ethicists and animal welfare groups, all with the opportunity to contribute to its development. Various options were considered for the delivery of responsible breeding standards, including statutory rules, although it was agreed that an industry-based approach,

with outcomes measured at farm-level, was the most effective and responsive approach. She also noted that concerns raised in a report on the welfare implications of animal breeding and breeding technologies in agriculture from the Farm Animal Welfare Council in June 2004 were found to have been addressed by the industry in 2012. She agreed with PM's point that not all information can be made publicly available because in commercial livestock breeding there is no protection for intellectual property, but peer-reviewed studies of outcome-based measures are available. As an example, she pointed to an article from the World Poultry Science Journal by Santiago Avendano which showed that the welfare of the best birds in 1996 was much worse than the welfare of the worst birds in 2017. If such improvements were not taking place, she suggested that breeding companies would not be able to remain in business.

PM acknowledged that there was no doubt some very good practice taking place, with improvements being made, but this was by no means universal and he suggested that there remained a challenge to move the whole industry towards those higher standards and to keep the baseline moving upwards. PM welcomed Code EFABAR as a good thing, which NCB would be keen to explore giving some more texture and detail in terms of the standards.

Concluding the session, the chair thanked Pete Mills, members and stakeholders for their contribution to a thought-provoking and highly informative session.