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OFFICIAL REPORT
GENERAL COMMITTEES

Public Bill Committee

GENETIC TECHNOLOGY (PRECISION BREEDING) BILL

Second Sitting

Tuesday 28 June 2022

(Afternoon)

CONTENTS

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Saturday 2 July 2022

The Committee consisted of the following Members:

Chairs: † Esther McVey, Graham Stringer

Bowie, Andrew *(West Aberdeenshire and Kincardine)* (Con)
† Brock, Deidre *(Edinburgh North and Leith)* (SNP)
† Churchill, Jo *(Parliamentary Under-Secretary of State for Environment, Food and Rural Affairs)*
† Clarke-Smith, Brendan *(Bassetlaw)* (Con)
† Duguid, David *(Banff and Buchan)* (Con)
Fletcher, Katherine *(South Ribble)* (Con)
† Glindon, Mary *(North Tyneside)* (Lab)
† Green, Kate *(Stretford and Urmston)* (Lab)
† Howell, John *(Henley)* (Con)
† Jenkinson, Mark *(Workington)* (Con)
† Johnson, Gareth *(Dartford)* (Con)
Jones, Fay *(Brecon and Radnorshire)* (Con)
† Jones, Ruth *(Newport West)* (Lab)
† Lewis, Clive *(Norwich South)* (Lab)
† McCarthy, Kerry *(Bristol East)* (Lab)
† Shelbrooke, Alec *(Elmet and Rothwell)* (Con)
† Zeichner, Daniel *(Cambridge)* (Lab)

Huw Yardley, Abi Samuels, *Committee Clerks*

† attended the Committee

Witnesses

Professor Robin Lovell-Badge CBE FRS FMedSci, Principal Group Leader and Head of the Laboratory of Stem Cell Biology and Developmental Genetics at the Francis Crick Institute, Royal Society

Alessandro Coatti, MRSB, Senior Science Policy Officer, Royal Society of Biology

William Angus, Owner, Angus Wheat Consultants Ltd

Professor Johnathan Napier, Research Group Leader, Rothamsted Research

Professor Nigel Halford, Crop Scientist, Rothamsted Research

Roger Kerr, Chief Executive, Organic Farmers & Growers

Steven Jacobs, Business Development Manager, Organic Farmers & Growers

Joanna Lewis, Policy and Strategy Director, Soil Association

Christopher Atkinson, Head of Standards, Soil Association

Dr Richard Harrison, Director of Cambridge Crop Research and member of the BBSRC Agri-food Strategic Advisory Panel, NIAB

Professor Giles Oldroyd, Professor of Crop Science, Cambridge Crop Science Centre

Sam Brooke, Chief Executive, British Society of Plant Breeders

Dr Alan Tinch, Vice President of Genetics, The Center for Aquaculture Technologies

Public Bill Committee

Tuesday 28 June 2022

(Afternoon)

[Esther McVey *in the Chair*]

Genetic Technology (Precision Breeding) Bill

2 pm

The Chair: The Committee agreed this morning not to meet in private to discuss the lines of questioning but to go straight to the questioning, starting with the Minister, then the shadow Minister and other Members. Are we happy to proceed with that? Okay. We can bring in our panel of witnesses.

Examination of Witnesses

Professor Robin Lovell-Badge and Alessandro Coatti gave evidence.

2.1 pm

Q63 The Chair: We welcome Professor Robin Lovell-Badge, the principal group leader and head of the laboratory of stem cell biology and developmental genetics at the Francis Crick Institute, Royal Society; and Alessandro Coatti, the senior science policy officer at the Royal Society of Biology. Professor Lovell-Badge, would you like to start with a few words?

Professor Lovell-Badge: I should say that dealing with plants and animals is not my day job—I work at an institute that is better known for medical research—but I do know an awful lot about genome editing methods and genetically modified organism techniques. I chair the Royal Society's genetic technologies group, in which we discuss plants, animals and humans in this context. I helped to develop the Royal Society's submission to the whole process at various stages.

I guess the main point that the Royal Society has been trying to make is that we are a little uncomfortable with having yet more regulations based on techniques rather than outcomes. For us, it would make much more sense to focus on the outcome—the purpose of what you are doing—rather than on the method you are using, partly because scientific methods evolve so rapidly that it is hard to keep track. When reading the first part of the Bill, which includes the definitions, I struggle in some places to understand exactly how certain techniques would fit into it. That is one issue.

If the argument is that genome-edited plants and animals are essentially the same as those that could be bred by traditional methods, yes, that certainly can be the case, but it is not always the case. To give one simple example, if you have two genes right next to each other in the genome, and they both need to be altered to have the trait that you are after—that is possible in normal circumstances—you can do that with genome editing, because you can target both genes at the same time. To do that by conventional, traditional breeding methods may be impossible, however, and it would certainly take an awfully long time to ever get both changes together in the genome. When two genes are next to one another, it is very hard to separate them in normal breeding processes.

There are all these complications that I envisage because that is what I do—I think about the techniques all the time. If your approach is based on outcomes, it is easier to justify, "I'm doing this; the outcome is this." You can also judge what effect your change has on other things like farming practices, environment and so on. This is a little bit narrower, I think, in that respect.

The Chair: Thank you. Alessandro, please introduce yourself to the Committee, and then you will have questions from members of the Committee.

Alessandro Coatti: With pleasure. Thank you for having me today. I am one of the science policy officers at the RSB. I am biologist by training, and particularly a molecular and cellular biologist. At the society, I provide support to our animal sciences group. I look a lot at policy and research developments in the animal science field, so less so in the plant sciences, which are very important for the Bill. I have been involved, however, in writing our response to the Department for Environment, Food and Rural Affairs consultation on the future regulations in genetic technologies, and that is why I am here today.

I agree with Robin Lovell-Badge's statement and with the approach that the RS takes. The RSB has also argued that it would be better to have regulations based on looking at the traits and products that you would develop using the technologies, and to monitor the impact in risk assessments of the outcomes, or the impact of the organisms. However, in our response we envisioned a bit of what is happening with the Bill, because there is a need to enable development and innovation on a faster timescale, in the sense that the United Kingdom has inherited the EU regulations that have a process-based trigger. They are designed to list a lot of technologies that are "modern" biotechnologies and not block their use, but make it subject to additional risk assessments simply because the technologies were new 30 years ago. They pulled out some of those techniques to create exemptions, to allow the use of mutagenesis in plant breeding in the past few decades.

Basically, we inherited that, so in a way I see what the Bill is trying to do: to define a new category of exempted organisms from that GMO framework that would allow research and innovation to progress faster in this country at this stage. However, this should not be the end of the story. There are good things in the Bill, but in order for the technologies to be properly regulated in the future, a move towards a truly trait and product-based regulation, which looks at the outcome, is really important.

I also commend the report of the Regulatory Horizons Council on regulations in genetic technologies. They consulted us and many other stakeholders, and they have provided a view on how the evolution of regulation in the UK could proceed.

The Chair: Thank you. We will open questions with the Minister.

Q64 The Parliamentary Under-Secretary of State for Environment, Food and Rural Affairs (Jo Churchill): Thank you and welcome to Professor Lovell-Badge and Mr Coatti. I believe, Professor, that you are at the Crick for your day job.

Professor Lovell-Badge: I am, yes.

Jo Churchill: I would like to take a little from the narrative that you have given us, and from something that you stated in your returns to the consultation. Thank you for saying that the Bill has been consulted on widely; we are trying to get it right, so any advice would be gratefully received. You stated:

"If appropriately managed, precision breeding offers a route to achieving many potential and much-need benefits to society."

That rather articulates your argument that it is outcomes-based. With that in mind, you stated that you support the advice of the Advisory Committee on Releases to the Environment that precision breeding poses no greater risk than traditional breeding methods. Can you explain why, and can you refer to whether you think the current regulatory framework has held up? I think that was what you were saying in the narrative about research and development. Where would you go with that regulatory framework in order to optimise the R&D so that we can evolve into being outcomes-based, both in environmental and human health terms?

Professor Lovell-Badge: Right. There is a lot there.

Jo Churchill: There is a lot there, but there was a lot in your opening remarks to try to encapsulate.

Professor Lovell-Badge: The first question was about risk, I believe. Generally, on the risk of a random mutation versus a genome-edited one, you are actually better off with a genome-edited one because you know what you are doing. Of course, there can be some examples where you might not know exactly what is happening. There is very little mention of human health in here and so there is concern about zoonosis, where an animal virus can jump to humans, for example. You could, in theory, make what you think is a fairly simple change to give a trait that you want, but inadvertently you allow an animal virus to jump to humans. That needs to be looked at, in terms of risk. Exactly the same thing can happen with traditional breeding, but I imagine it is not generally looked at. That is a risk.

Alessandro Coatti: The case that Robin used before is quite important, where you think about adding multiple changes to genes in the same organism. The Bill covers plants and animals, but it does not cover micro-organisms, which are an interesting aspect that we can discuss later. You also really have to think about the fact that the dynamics of the genomic changes in different organisms are different, just like the way they reproduce is different. The type of gene flow that you would see in plants is different from the one you would see in animals.

The case that Robin was discussing of adding multiple changes in neighbouring genes in an animal is harder, through traditional breeding, than it has been in plants. For example, you can mutagenise into this very big screening. You might get to that point faster in plants than in animals. Perhaps the fast pace where this technology now allows development is not, as you say, either a morally or a practically neutral question. It is interesting that the Government have decided to frame it as something that could have arisen through traditional breeding or spontaneously. There is a reason why that is. However, at some point, it becomes a bit stretched, because in traditional breeding it would take many generations, and it would be quite hard to do it in certain animals.

However, this is again talking about the techniques. When it comes to adding those two traits in neighbouring genes, you might end up actually making the life of the animal way better. That is why you look at the outcomes. By using genome editing, people have corrected genetic defects that have arisen traditionally in breeding, for example of cattle. There is this Japanese breed of cattle that has a genetic syndrome. With genome editing, they corrected it because it was due to a single gene. In fact, even if it were very unlikely that you might have done it with traditional breeding, it is a very valuable use and we should do that because it enhances the welfare and the health of the animal.

Q65 Jo Churchill: That is sufficient, because everybody will want some time. I think I glean from what you have said that it would take many generations but it is still possible, particularly in plants. It therefore allows you to target derived beneficials, but this is caveated with the regulatory framework being appropriate.

Professor Lovell-Badge: The question would be: if someone made a plant or an animal where you have targeted two adjacent genes, would that be permitted or not under these rules? It is hard to think that it might be, because you could not simply do it by traditional methods. You might have to wait thousands of years and it would cost you a lot of money. That is the question.

Jo Churchill: Right—noted.

Q66 Daniel Zeichner (Cambridge) (Lab): I start by thanking you and your colleagues for your excellent evidence, some of it submitted to the consultation. It has certainly informed a lot of our thinking, although it also raised a lot of questions. In your introductions, you restated what was essentially in the evidence, which is that there is a problematic set of definitions and this would not necessarily have been the way that you would have gone.

I want to explore something slightly different: the role of advisory bodies. You began to touch on that in your last answer. The Bill at the moment is very thin on what the advisory bodies are there to do. In some of your written evidence, both your organisations suggested that the different bodies should have some kind of remit to look at the wider public good. Could you say a little bit about that? I have been taken by the example of the Human Fertilisation and Embryology Authority, or some aspects of the work that it does.

Professor Lovell-Badge: I have been very much involved in the HFEA public engagement exercises. When you are considering a broad area, or potential uses and outcomes, it is really important to have proper public engagement, including democracy, dialogue, or however you want to refer to it, where you really get to understand what the public will think about a topic.

When it comes to assessing technical aspects, it will be challenging. It is fine to have a lay member on a panel, but I do not know whether consulting the public about really detailed, technical issues might be challenging. It depends on what the advisory committee's role is and whether it is to look more broadly at potential uses and outcomes or to focus on the specific techniques that are being used.

Q67 Daniel Zeichner: Let me press you on that slightly. In terms of some of the animal welfare issues, it is pretty clear that some of the things that could be done could be designed to make animals more resistant to

[Daniel Zeichner]

heat or more liable to be able to survive certain conditions. That does not seem to us a good use of this technology. It is not entirely clear to me on what grounds the advisory bodies would make decisions. If it is just left to a market-driven system, you could argue that, provided it produces a better return, that is good enough, but the ethical issues would be wider than that.

Professor Lovell-Badge: This is another point. I was a bit confused because there is quite a lot of emphasis in the Bill on animal welfare and how they would have a role to play in that. If you are doing an experiment with an animal, you have to have Home Office approval. Animal welfare is a top priority. Many of the things that you might want to do would already be weeded out at that stage. If you wanted to make an animal that felt no pain, for example, you might just about be able to get away with justifying that for research purposes, but certainly not for developing any product.

The regulations about welfare are already there. Sure, it is important to have some input into your advisory committee that says, "This has to be looked at. Have they thought about all the consequences of what they are doing?" Exactly how you would achieve that under the Bill, I am not certain.

Q68 Daniel Zeichner: There is now a new player in town: the animal sentience committee, which is not established yet. How would you see the interplay with that, given what you have just said?

Professor Lovell-Badge: I know little about that.

Alessandro Coatti: It is an interesting new player, welcomed by many parties across the House. It looks like it will be an expert committee. Mostly the members will be people with relevant expertise in veterinary sciences, potentially neuroscience, so it would not be an arena for a public dialogue, but that is not to say that they cannot commission it and then take recommendations on board. In my view, they could play a role, but it would be hard. The new animal welfare committee that would overlook the authorisations in the Bill would look at a notifier that said, "We want to do this on an animal, but we do not foresee any health or welfare implications for it." That committee would focus very much on the health and welfare of the single individual animal, but it is not clear to me whether it would consider higher-level questions such as, "What does it mean for the production of that livestock, the density, the husbandry and so on?"

Of course, the existing DEFRA Animal Welfare and Animal Sentience Committees could be brought in. You could say, "We have a new line of pigs that are resistant to this disease. On paper, it looks very good, because we made a very small, tailored change to a part of it, not a rough deletion of an entire gene. The animals under research and development look fine in contained circumstances and they are well. Would you be happy for us to license them to go on to a breeding trial to expand the number of animals from the 20 in the research study to 200, and to map whether there are any health and welfare impacts on a bigger number of animals?" Those committees could advise the new animal welfare committee on that matter.

Following on from that, the bigger question is: "What do we want for UK farming, agriculture and so on?" That is one of those pillar questions that bigger Government policy, not the Bill, will resolve.

Professor Lovell-Badge: My colleague makes a very good point. If you take things out into the field, the conditions are different from lab conditions in which you originally generated the animals. If you introduce another breeding programme, or a different genetic background, the consequences of what you have done could change. It is the same with traditional breeding, but on all those things, there needs to be long-term feedback. As you would have with humans in clinical trials, you get a phase 3 clinical trial in which you get a lot of people feeding back information—much more than in a phase 2 trial—and then there is always post-market reporting whereby any adverse effects are notified over the years.

Q69 Daniel Zeichner: That is a really important point. I may be wrong, but I do not see anything in the Bill enabling that.

Professor Lovell-Badge: Nor do I.

Alessandro Coatti: Under clause 11, when a marketing notice is given in relation to a precision bred animal, the Secretary of State reserves the right to get information from the notifier, over a specified period of time, about the health and welfare of the animal, so that is already covered in the Bill.

Professor Lovell-Badge: But how you do that is not clear.

Alessandro Coatti: No, and a lot will depend on very good guidance from DEFRA or ACRE about how to do that. But that power is in the Bill, at least.

Again, the need for post-marketing monitoring comes down to the trade that you are introducing, not whether you use a technique. It will be important for whoever advises the Secretary of State to be able to tell them, "This change warrants longer-term monitoring, but this other one does not, because we have seen it in the species over many years. This is just a better way of doing it, and it will not dramatically alter what we already know about the trait."

Professor Lovell-Badge: Remember, many genes have effects in multiple tissues, so you may be focused on changing something—modifying CCR5 for HIV resistance, for example—but not realise that it may also be active and play some role in the brain. That is a clear example of where you may have an issue.

Q70 Deidre Brock (Edinburgh North and Leith) (SNP): The Regulatory Policy Committee brought out a report just a few days ago that concludes that the Government have not made a convincing business case for the deregulation of precision bred organisms in the food system, and it suggests that more narrative around "competition, innovation, consumer and environmental impacts" should be included in the Bill. Would you agree that there is insufficient detail on that in the Bill currently?

Professor Lovell-Badge: I think I would agree it is insufficient. You have to factor in everything: the environment, farming practice—how whatever you are doing, whether it is with plant or animal, is going to fit in with or change farming practices. I think there needs to be a lot more thought about those issues.

Alessandro Coatti: I am not entirely sure I agree. Could you tell me again—those people said that the Government have not made a case for deregulation of these organisms?

Q71 Deidre Brock: Yes, it is insufficient currently. They feel that there is a need for wider discussion of the impacts on the environment—woven throughout the Bill, I think—than currently. I wonder what kind of environmental impacts you would like to see included.

Professor Lovell-Badge: It depends. If you are saying it is the same as traditional breeding, then yes, it is probably the same, often, or very similar.

Alessandro Coatti: The case for deregulation—let us put it that way—is that basically, with these technologies, you can achieve changes in the genome that are potentially done already in traditional breeding. You are just doing it in a more energy and resource-efficient way—faster, etc. So there is definitely a policy case for this Bill, because research and innovation in this country can really provide those beneficial traits in plants and animals that we desperately need at the moment.

On the question whether this Bill captures all the potential impacts on the environment, for example, from a release of one of these organisms, you would think that the organisms that are passed through this Bill will not particularly need extra monitoring relative to the traditionally bred counterpart, if you see what I mean.

However, there could be boundaries or grey areas where a change could have arisen traditionally but it is not so common. Therefore, the committee should be able to trigger an additional risk assessment; and in my view, it looks like it can. Now, the question is this. On the environmental risk assessment, there is not much detail in the Bill—that is true—so it will be down to ACRE to provide more detailed guidance and analysis on how it would want the environmental risk assessment to be done.

Q72 Deidre Brock: If I may, I will ask one very quick question—well, it will not be that quick, actually. The answer will probably be quite long. I want to ask about the difference in regulatory regimes, potentially, between the UK and the EU. No matter how long that might be—we do not know; obviously, the EU will come back after its consultation next year. I just wonder what you think the impact might be, and whether in your view that will affect trade and potentially investment in the UK. Is that a tricky one?

Professor Lovell-Badge: That is a hard one. The EU will have to change—that is my view—because it is going to be way behind other countries, too. We are not talking just about the UK and the EU; we are also talking about the US, Canada, Argentina and other countries. If the whole regulation about genetically modified organisms and genome editing is not made more compatible with actually getting on and doing stuff that is useful, the EU will suffer, because it will ultimately—

Deidre Brock: But the impact here, in the UK, on trade? Obviously, it is the UK's largest trading partner, so if it continues to be—

Professor Lovell-Badge: I can imagine there could be an impact. It is hard for me to tell what that might be. It is not my area of expertise at all.

Alessandro Coatti: Yes, I would not be able to discuss in detail how that might be. You probably need to have experts on it. But I am aware that the Food Standards Agency has produced a report on these changes in regulations and this evolution across the globe, and there is definitely a case for the UK to try—we say we would like the UK to lead the way, as it has done with the Human Fertilisation and Embryology Act 2008. The UK could still lead the way by making legislation—regulation—that other countries would copy, but there is already a lot out there, so it has to harmonise with the regulations in other countries, such as Japan and Canada. It seems like the Bill is going one step in that direction. In terms of the relationship with the EU, as the closest economic partner and one of the biggest markets that the UK trades with, it is important for the UK, not necessarily to slow down excessively, but to maintain dialogue with the EU Commission while it reviews. The UK in the past has created legislation that the EU has then taken on. For example, when it comes to animals and research, the UK has led the way on the protections—eventually the EU adopted some of those elements. Even though the EU is not politically obliged to anymore, it could still value that.

Professor Lovell-Badge: You may be about to get to labelling. I think the registry is a good idea, because if someone wants to import something from the UK, at least it is then obvious that it could have been genome edited—otherwise they might not know.

Q73 Ruth Jones (Newport West) (Lab): We have already established that the Bill covers plants and animals, but not micro-organisms. Given that there were suggestions from DEFRA that animals would be considered later down the line, I wondered if you had any thoughts on the fact that they are now included in this Bill.

Alessandro Coatti: In our response we commented mainly on plants and animals, while making some reference to other uses. There are already leading labs in the UK looking at genome-edited livestock species, for example, and how doing genome editing in those species could be beneficial on many levels. I am quite sympathetic to the fact that animals are included in the Bill, even though there is less of a history of genome editing, and genetic modification, in animals than there is in plants.

It seems to me that more safeguards are added here for animals than for plants. There is animal health and welfare assessment as part of the Bill. With animals, it seems clear to me—but Robin can correct me—that genome editing can be used quite safely. We are talking about the techniques and the process, not the outcomes and the traits. If you look at the techniques with the animals, with a number of species you can be pretty sure that you are making the right change in the genome that you wanted and that you are not adding unwanted changes anywhere else. We can say that there are not many additional risks when it comes to technique, relative to traditional breeding. However, that still has to be caveated a bit.

Professor Lovell-Badge: Some of the methods of genome editing are now so efficient and precise that I do not think it is a great concern, but you always have to check. There are good ways of checking what you have done and what you have got. I would not be that concerned. You would have to check the original animal that has been modified, but once you get to subsequent

generations, you will be pretty certain of exactly what you have, and of anything wrong. The methods are being used in humans for somatic genome editing. We know a lot about them and how accurate and safe they can be.

Alessandro Coatti: We pointed out two things in relation to the methodological aspects. Robin mentioned one aspect before: how the gene relates to the phenotype. You change something and then you have a trait change in the animal. Some genes have functions in different organs and tissues, so you want to ensure that by doing something you are not messing up something else. That can be done and has to be done as part of the Bill—you should make sure that it will be done.

The other question is about the reproductive techniques you sometimes use to work on the embryos. Those can also have health and welfare implications for the animals, but it should all come down to an expert committee reviewing the application for the genome edited animals, which could say, "Okay, it looks like they checked everything they should have on the technique."

The Chair: Order. Sorry to interrupt, but that is the end of the time allocated for this panel. I want to thank the panel very much for coming today to give evidence.

Examination of Witnesses

William Angus, Professor Johnathan Napier and Professor Nigel Halford gave evidence.

2.35 pm

The Chair: We will now hear oral evidence from William Angus, owner of Angus Wheat Consultants Ltd, who will join us via Zoom, Professor Johnathan Napier, research group leader, and Professor Nigel Halford, who is a crop scientist. Both are from Rothamsted Research and are with us in person. Could you introduce yourselves for the record? I will go first to William Angus.

William Angus: My name is Bill Angus—christened William, but anyway. I am a wheat breeder, and my job is to breed new varieties of wheat. I have been doing it for quite a long time. I started in the public sector at the Plant Breeding Institute, and then moved to the private sector with Nickerson. I started my own wheat breeding and oat activities in 2016, which has resulted in us being the largest privately owned wheat and oat breeder in the UK. That is not too hard, because the agricultural landscape is dominated by multinationals. I am also vice-chairman of the International Maize and Wheat Improvement Centre board of trustees in Mexico. This is the largest publicly funded wheat programme on the planet, breeding for 200 million hectares. To put that into context, that is 100 times the size of the UK. Their focus is primarily on the developing world.

Professor Napier: Hello. My name is Johnathan Napier. I am a project leader at Rothamsted Research. I am a plant biotechnologist. I have a degree—PhD and DSc—from the University of Nottingham. Rothamsted is a publicly funded research institute. I am passionate about using basic research for public good and translation. I am very keen to see the research move beyond just discovery. I ran the first gene edited field trials in the UK in 2018. I have run GM field trials at Rothamsted since 2011 or 2012, and I am looking forward to talking with you.

Professor Halford: I am Nigel Halford. I am also at Rothamsted Research. I have been there a long time—all through the biotech period. In fact, I was involved in GM wheat trials in Bristol in the 1990s. Like Johnathan, I am very passionate about taking our research through to products that are actually going to help British farming, agriculture and consumers. I am currently running a gene edited wheat field trial at Rothamsted. We are looking at reducing the acrylamide content of wheat products, so it is a food safety target.

Q74 Jo Churchill: Good afternoon Bill, Professor Halford and Professor Napier. I would like to declare for the record that Bill is a constituent of mine, but I think we have only met once, in a field—to my memory—looking at wheat. I will ask Bill one question and then move on to the professors.

From the point of view of small and medium-sized enterprises, do you think this Bill will help smaller players to have some access to market, or would you like to see this Bill enable smaller breeders, such as yourself, to have access to these technologies?

William Angus: That is a good question. I have worked for a large multinational company. I was interested to hear both Johnathan and Nigel talk passionately about public good—that is what I do. When I was at the PBI this was part of your culture and it became part of my culture when I was at Limagrain.

I love the entrepreneurial spirit that we have in the UK. We started off this, which may be considered by some to be a slight mission of madness, but I had the opportunity to do it. We started in my lounge, then we moved to the greenhouse and then the garage, and now we have built up quite a significant activity.

I am worried about perhaps an agenda that this could be dominated by large multinationals, although one of the joys of wheat-breeding globally over the last 100-plus years has been the freedom to exchange germplasm. As soon as we start putting constraints on that, as soon as we start having people talking about ownership of genes and ownership of genetic material, or licensing genes that are already in the public domain, it starts to fill me with a great sense of foreboding.

Also, being on the CIMMYT board, I am really concerned and very passionate about the smallholder farmers that we have around the world. It has changed my life being on CIMMYT, in that it opened my eyes to the fact that there are millions and millions of people in very dire circumstances. Many people do not realise that the vast majority of farmers in the world are women.

So, yes, I am concerned about that and I would like to see some mechanisms whereby the freedom that currently exists for small companies, or individuals, to start up is not diminished. Therefore, I hope that some protection will be put in place.

Johnathan and Nigel may agree or disagree, but what we have in the UK is that, if you go back 40 years ago, we had a publicly dominating plant-feeding activity in the PBI. We have a really mature situation now. Globally, we are probably the best, and I have seen a lot around the world, of having these public-private partnerships. These guys at Rothamsted, or the John Innes Centre, or whatever, cannot take it to the market and we have a wonderful relationship with them, in that they do the

fundamental research and then we, as the plant breeders, translate it into the field. And I include the multinationals in that.

We have a very mature situation and we must make sure that, whatever comes out of this Bill, that relationship is not damaged in any way and continues.

Q75 Jo Churchill: Lovely; thank you. Perhaps a question that you could think about is how gene editing, in your view and with your international experience, might help those developing countries.

However, I will direct my next question to both professors, in the hope that you both cover it to a degree. You have both expressed a passion, and have longevity about looking at this issue, and I think it was Professor Halford who said that he was involved in the GM trials in the '90s. Can you please help us to understand how far we have come and say what benefits we should try to capture through this Bill in order to drive things forward?

Professor Halford: Any target you can think of for plant breeding—whether it is something that aids farmers, such as nitrogen-use efficiency or simplifying weed control, climate resilience, which is an urgent problem that we have to address in agriculture, or the kind of things that we are working on, benefits to consumers—gene editing can play a role in it. It is not sweeping anything else aside, but it certainly enables you to do some things that other methods in plant breeding do not allow you to do. That is what we are talking about.

Professor Napier: Nigel and I are veterans of the GM of the '90s, the problems that emerged from that and the hiatus of seeing none of our research translated for a decade. Then, at Rothamsted, we restarted GM field trials in 2012, just because we realised that there was this urgent need to translate the research. The UK has a fantastic reputation for doing basic plant sciences, making lots of fantastic discoveries in labs, but that is no good to feed people or to solve the challenges of climate change and food security. You cannot eat promise; you really need a product.

The reason I am in agriculture is that it is the ultimate scalable solution: once you demonstrate that you can grow something in one field, you can grow it in a million fields. But until you have actually done it in the first field, you do not know whether the technology works. That is the exciting thing that has already changed in the regulation in the past few months—it is easier to do experimental gene edited field trials. Nigel and I are doing those at Rothamsted under the new regulations, and that is great, that is enabling. That is what we need.

We want to enable the technology to advance, which is not to say that we ignore the importance of safety and all those other things. On one level, it goes without saying that those are important, but it should not go without saying—you have to say that those are of paramount importance. What we want is enabling regulation. I am not totally sure I have answered your question, but it gives you the idea.

Q76 Jo Churchill: That gives us a very clear picture: to be overly prescriptive might be as difficult, and the regulatory framework needs to be appropriate.

Professor Napier: That is exactly right. Even if you look at the situation in the US, which is imagined to be the most tolerant and enabling of regulatory environments for GM, for example, it still costs probably $10 million to deregulate a crop. That is an utter barrier to entry to any small or medium-sized enterprise. The reason why the market is dominated by the large corporations is that they are the only people who can afford to pay those costs. If the barrier to entry is lower, basically you make it much more open to the more entrepreneurial, smaller, nimbler but less deep-pocketed organisations.

Professor Halford: The GM revolution is now a generation old. It is a 20th-century technology. We see varieties in the Americas and Asia with multiple input traits, output traits, insect resistance, herbicide tolerance, high lysine with a cherry on the top. None of that is available here—absolutely nothing, not a single GM crop plant grown commercially in the UK. We have completely missed the boat on that one, and it is really important that we do not miss the next boat.

We will have to go some way to persuade plant breeding companies, biotechnology companies, that there is a market in the UK. Currently, I can tell you, nobody is thinking about developing a GM or GE commercial crop for the UK or Europe. We will have to have regulation in place that gives breeders confidence that when they get their product to market, they can actually sell it. If my wheat all pans out, it works really well and I hand it to breeders to incorporate into their breeding programmes, we are still talking probably five to 10 years before we could possibly see anything on the market. That is a lot of work and investment. So farmers need to be confident that, at the end of that, they have a market.

The Chair: I remind people that we have until 3.15 pm for this session. A couple of Members have caught my eye. I will start with Daniel Zeichner.

Q77 Daniel Zeichner: Thank you, Ms McVey. Bill, I was very taken with what you were saying about your concerns about the intellectual property rights associated with some of this issue. I got the sense that you do not feel that the Bill as it stands answers those questions. What would you like to see? What would give the protections that would reassure you on these issues?

William Angus: At the moment, what I would like to see is no change to the status quo. Let us take this as an example: company A produces a variety and he introduces a trait into that variety. In two years' time, once that variety has been added to the UK national list, another breeder can use that trait. That is the freedom to operate. It is really important that that is sustained and that people are not locked out of new developments. What may happen—this is an area I feel quite uncomfortable with—is that we may start to see larger organisations move the goalposts in terms of trying to stop other breeders from using genetic resources that have been developed.

Now, I am quite happy—here, we develop our own genetic resources and we give those away freely, to anybody. If anybody on the Committee would like some wheat, I will send them some genetics, no problem at all. That is freedom to operate. That is really all that I would look for—that we do not change the current status so that people think that, somehow, a naturally developed product or a GE product is any different, and that there is still that freedom to operate.

Can I make one comment on Johnathan and Nigel's remarks? I have sat on a number of Biotechnology and Biological Sciences Research Council committees. I chaired the horticulture and potato initiative and so on. I am not saying this because they are here, but the UK is absolutely blessed with the best public research on wheat around the world. They are absolutely right to make the point about the fact that this is not developed as well as it could be, primarily because the promotion system is based on paper publications. It is lovely to hear both of these guys talking about taking stuff to the market. That would be another comment that I would make. It is great to hear.

Going back to your question, let us be careful that there are mechanisms in place to protect this freedom of exchange of germplasm that happens not just in the UK but globally. It is really important that we do that. There have been steps in America to patent genes. We really must not go down that route. In my opinion, it will stifle innovation and it would put the control of our food supplies in the hands of large multinationals, which I would be very concerned about.

Q78 Daniel Zeichner: To be clear, this follows on from the notion that these could have occurred naturally. They should be treated in that way, rather than being put in a special category.

William Angus: Yes. You cannot have it both ways. You cannot say it occurs naturally and then I am going to change it and now it is different. I agree.

It is very difficult when I come from the environment I do—my views tend to be slightly different from those who come from large multinational companies—but I think it is a really important point, that we protect innovation from big companies and so on, but that we also protect the right of individuals to start up their own businesses. The way I look on it is, you know, Richard Branson started Virgin Atlantic—he was allowed to do that. One man started with one aeroplane, and off he went; brilliant, great, good for him. It would be sad if people like that or companies such as easyJet were excluded from the market because someone said, "This is an aeroplane, and you're not allowed to fly it." I would like to reiterate that we need that protection in there.

Q79 Daniel Zeichner: Thank you, that's helpful. May I turn to the two professors? On innovation in general, in essence, the argument is that innovation will happen because obstacles are being removed. Is that enough to foster the kind of innovation that you would hope to see, based on your passion and excitement for this technology?

Professor Napier: I think it was mentioned earlier that with innovation, it probably needs to be developed as a public-private partnership, which sort of implies that there needs to be a market pull. Using the term "market" can be slightly perturbing because, in reality, the drivers for what we want to see translated are much bigger than the economics. They are things like global climate change, food security and all the global pandemics associated with malnutrition and overconsumption. Those are the challenges enshrined in sustainable development goals and things like that. Those are the things that we should be occupying ourselves with. We need to use everything we can to try to fix those challenges. Rothamsted and other places like that—in fact, everybody—should be working towards those goals and overcoming those challenges.

Listening to what Bill said about IP, I spend an enormous amount of time thinking about IP because it is an area that I have to think about a lot. The beauty about the UK is that we have a really strong research use exemption, which allows us to operate in a way that is not encumbered, at least at the research level, by IP. We are in a really good place. I think the bigger barrier to innovation is what I have already mentioned: it is not IP but the cost of regulatory approval. That is why I am so worried that in new legislation, if we start building in layers of costs associated with more regulation, we are just replicating what we had previously under the EU regulation. I think that would be an enormous missed opportunity if we go down that road. That is my personal view.

Q80 Deidre Brock: I want to go back to Mr Angus's comments about ownership or the licensing of genes and his concern about that. How would you address that, as people involved in this area? What measures should be taken? Clearly, people are concerned about the patenting of crops.

Professor Napier: You cannot patent a gene. There was a case in the US that made it quite clear that you cannot hold a patent on a gene. That legal precedent is quite clear, from the famous case of Myriad. I am not too worried about that. In reality, it is analogous to what you see in the pharmaceutical sector and relates exactly to your point about understanding the drivers for innovation. You need to couple it with economics.

All these things are moving parts, which you need to make the whole thing work. To pull it forward, you need to have an economic case and some form of protecting your invention—patents are a good way of doing that. The example I always give is that my mobile phone probably has 2,000 patents-worth of components in. Nobody gets upset about that. It is about understanding how you can best use this technology. I also do not want to sound like some sort of gung-ho free marketeer, because I am absolutely not. I work in a Government-supported institute. I do not work in the private sector. I probably want the best of both worlds.

Professor Halford: As public sector scientists, at times in our careers we have been told we should be patenting everything, and at times in our careers we have said, "Well, it's unethical to be patenting this stuff." I think we have a pretty robust patents system. You cannot patent discoveries of genes; you have to patent an invention. That seems to have worked for mobile phones and it works with pharmaceuticals, many of which are biologicals. I do not see why it cannot work in crop high technology.

Q81 Deidre Brock: Professor Halford, you mentioned that you have the largest gene edited wheat crop trial in Europe—is that right? Could you talk us through what will happen if this Bill becomes an Act? What steps will you go through to get the product to market, and where will your involvement end? I would find some clarity on this really helpful.

Professor Halford: We have used CRISPR-Cas9 to knock out a gene that makes an amino acid called asparagine, which gets converted to acrylamide. That is our target.

Deidre Brock: You are giving *Hansard* a few challenges today.

Professor Halford: Acrylamide is a processing contaminant, so it only forms during processing; it is not in the plant. For consumers, it is not an issue—we could talk about that all day—but it is quite a big regulatory compliance issue for the food industry. We are trying to reduce the potential for acrylamide to form during processing by reducing the amount of asparagine in the grain of the wheat. That is where we are at the moment.

Because you do a GM step to put the CRISPR machinery into the plant, some of those components are still in most of the plants we have, so the field trial is running under GM regulations at the moment. The editing has been done, and it has worked. We have very low asparagine wheat grain growing in the glasshouse, at least. We are in the process of crossing away the GM bit, and we do have some plants now—not in the field trial, but under glass—that are now GM-free. They are a qualifying higher plant, and we have registered them as such.

Q82 Deidre Brock: I am thinking about getting it to the commercially available stage.

Professor Halford: We have five plant breeders working with us. If it pans out in the field and it all looks good, we could hand our genotypes over to those breeders and they could start incorporating the trait into their breeding lines. That process would take probably five to 10 years. We have five years' consent to run the field trials. You need several years before you are going to convince a breeder that your trait is stable and it will give them what they need. There is nothing rapid about the process.

Deidre Brock: That is really helpful, thank you.

Q83 Clive Lewis: I am just trying to get my head around some of the comments that have been made so that I can apply them to the legislation. I think Mr Angus felt that intellectual property rights were a potential barrier to entry, whereas you felt that an excessive regulatory framework was a barrier to entry. What would the main barrier be?

Professor Napier: In my opinion, it is regulatory approval that is the barrier.

Clive Lewis: Why? What does that do?

Professor Napier: It is mainly the cost and the uncertainty. If you think about the way GM crops are regulated, for example, in the US it will cost you something like $10 million and take several years to get regulatory approval. In Europe, you could spend that money two or three times over, and because the approval process also has a political component, it will never be approved, so you have this uncertainty. From an entrepreneurial point of view and a commercialisation point of view, what you want is certainty. Even if you think, "Okay, the horizon is five years and I know I need to spend $10 million," at least you know what it is. If there is uncertainty, I am not going to go on "Dragons' Den" and say, "Here is my pitch. I don't know how much it's going to cost. I don't know how long it's going to take. Can I have some money, please?" I suspect they will tell me to—

Q84 Clive Lewis: So a stable regulatory framework is necessary. I am not trying to be some kind of QC; I am just trying to get to the bottom of this. I guess that profit maximisation in one form or another is a motivator for having a regulatory framework that enables you to do that. Whatever we think about the reality of the world we live in, that is probably the one golden rule that dominates markets and businesses in the mainstream. There are others—B Corps and others—that have different approaches.

I am interested in your views, as individuals who operate in the private-public sphere. When it comes to food security and the climate crisis, I would have thought that profit maximisation will probably not be the route map to solving those problems. What is going to be needed is a private-public partnership where we get the best of both, but some things may cost more. It is going to cost us to tackle the climate crisis; it is going to cost us to ensure that we can feed the world with a climate crisis in the 21st century, so it is even more important that we get the regulatory framework right and that it is robust. Freedom from regulations for businesses means freedoms against consumers, the public and those who do not have access to those sciences to be able to utilise them.

Professor Halford: Look at what has happened to GM technology in Europe. The last GM crop approved for cultivation in Europe was approved in 2010, I think. Only one GM crop is grown to any extent in Europe, and that got approval before it became difficult in the mid-'90s. So nothing is happening—for climate resilience or anything else.

Clive Lewis: That is the extreme version, isn't it?

Professor Halford: Everyone pats themselves on the back and says, "We've got a great regulatory framework," but nothing is happening. Burkina Faso has more experience—

Q85 Clive Lewis: That is an extreme example. Do you not think that there is a happier halfway house in terms of a regulatory framework for gene edited and gene modified materials?

Professor Halford: The simple answer is that it has to be proportionate to the risk. You can also compare gene editing to what we have already. We already have chemical and radiation mutants; that technology has been going around since the 1950s. They are already on the market, with exactly the same kinds of genetic changes that gene editing introduces, but completely random.

Q86 Clive Lewis: But from our perspective as legislators, the risk is not just the science. History shows us that scientists—Oppenheimer and others—often have brilliant ideas, but it is then about how those ideas are used by corporations, politicians and others. The risk is not just the science, but how those patents and that science are used further on down the line. That is part of the risk, and it is the part of the risk that regulation—

Professor Halford: You could make exactly the same comment about anything in plant breeding. The argument is, "Why should you look at gene editing as being different?" Is it more risky? Is it more likely to be misused? I would say no.

Q87 Clive Lewis: I think a really good case has been made today that gene editing is something that is found in the natural world, and it is something that we are just utilising. I get that. For myself as a legislator, yes, the risk is scientific—there is some—but it is also about how it is then applied outside of the laboratory, what the political implications of that are in the commercial world, and how other powers for whom profit is the bottom line may utilise those technologies in a way that is harmful to the public good.

Professor Napier: I know what you are trying to say. I tried to write an article about this a couple of years ago, taking the example of Golden rice, which was developed to deliver a public good and took decades to get to market. Why? Because it had been demonetarised. Effectively, all the economic drivers had been taken out of it, so the impetus for it to be delivered to market was not there. You could not monetarise it, which on one level is exactly as it should be: why should you be monetarising what is effectively misery—childhood blindness and things like that? But it also basically depowers the way the world works—the way that modern economies work. That is just the way of the world, isn't it? We all know that.

I understand what you are saying. For us, we really want to see stuff applied and translated. People get far too hung up about intellectual property. I am not an IP lawyer, but I know a lot about IP. People feel it is a hindrance in plant biotechnology, but compared with the costs of getting regulatory approval, IP is not the barrier. The reason why we have all these big corporations dominating the field of plant biotechnology is that they are the only people who can afford regulatory approval.

When we ran GM field trials in 2012 at Rothamsted, there were big demonstrations about it. Most of the people had come from the Occupy London demonstration, so they were anti-globalisation protesters. They were protesting about the globalisation and corporatisation of the world; they were not actually that concerned about GM. That is not to dismiss their concerns, but that is what they were really worried about. You can end up conflating a whole load of things and saying, "These are all the things that people should worry about," but I am not sure that is what you need to worry about. It sounds like I am telling you what to do, but I am absolutely not. There are other things to think about in the Bill.

Professor Halford: If you are going to say that you should regulate how people use the technology—can you do that?

Q88 Clive Lewis: No—I think there is a discussion that will now take place in Committee about the level and type of regulatory framework that we have for these technologies and what the outcome of that is. There is obviously an argument for a low-regulation framework, and there are those of us who believe that there should be a higher level of regulatory framework. That is the debate, and I am just interested in hearing the points of view.

I am sorry, Mr Angus, that I have not brought you into this conversation very well, but that is not my job. If you would like to come back on anything—

The Chair: William Angus, would you like to say a few words on this subject?

William Angus: Yes, and I assure you that I will be brief. First of all, I have some comments about various things. This is not a short-term solution. It has been bandied about by many that this is like, "Oh, well, in three years we can do this and that." We can develop genetic resources in three years already; we do not need that. I am actually a really big supporter of gene editing. I think it allows us to short-circuit when we have major key traits that will be of significant global benefit. Gene editing comes into that very well.

We already have a very strong regulatory system for national listing of varieties. The Committee may or may not know that currently, before we can put varieties into the marketplace, they have to go through a pretty robust national listing system. They have to be distinct, uniform and stable, and they also have to have a value for cultivation and use, so those mechanisms are already in place. I would feel confident that, by beefing them up a bit, we could cover the regulatory issues without huge quantities of over-regulation in terms of entry to the market.

I want to make the point that this is not the shortcut that people perceive it to be, because once you have your trait of interest, you then have to transfer it into a variety or something that is genetically good; then you have your in-house testing process, which is usually three to four years; then you have two years of statutory tests; then your wheat, for instance, gets a recommended listing, and then you have two or three years of seed modification. The idea that we can somehow wave a magic wand with gene editing and create something within three years is complete nonsense; it would take 10 or 11 years. This is the thing about plant breeding: it is a long-term venture.

I am weird—I admit that I am slightly strange. You are quite right that all the big companies are profit-driven. I have absolutely no interest in money, but as a plant breeder you can make a huge difference, not only globally but domestically. I suspect that if you have had a bit of bread today, you will have had part of a variety that I was involved with. That gives me a huge amount of satisfaction, and I hope you enjoyed the bread. That is what plant breeders do: it is about impact. Now that I work on a more global scale, it is helping so many people whom I have met who live on $2 a day. That is really the important part. I do not necessarily represent the interests of large multinationals, I am afraid.

The Chair: Thank you, William. We have less than a minute left. I know the Minister wants a quick question—it is less than a minute for your question and the answer.

Q89 Jo Churchill: You want to see this applied and translated. Bill, you stated that you already feel that, with some tweaks, we have a strong regulatory appeal in this country anyway. In one word, is the Bill proportionate?

Professor Napier: Yes.

Professor Halford: Yes.

William Angus: Yes.

Jo Churchill: This feels like "Britain's Got Talent". There we go; we have finished before 3.15 pm.

The Chair: That brings this session to an end. I thank all our contributors for a really informative session.

Examination of Witnesses

Roger Kerr, Steven Jacobs, Joanna Lewis and Christopher Atkinson gave evidence.

3.15 pm

The Chair: We will now hear oral evidence from Roger Kerr, chief executive, and Steven Jacobs, business development manager, both of Organic Farmers & Growers, and from Joanna Lewis, policy and strategy director, and Christopher Atkinson, head of standards, both of the Soil Association. All the witnesses are with us in person. We have until 3.50 pm for the session. Will each of you in turn introduce yourself for the record, and then we will come to questions?

Roger Kerr: My name is Roger Kerr. I am chief executive of Organic Famers & Growers. I am also a trustee of the Organic Research Centre, which is an independent organic research organisation. I am also a director of the Organic Trade Board.

Steven Jacobs: I am Steven Jacobs. I am the business development manager for Organic Farmers & Growers.

Joanna Lewis: I am Joanna Lewis. I am the policy and strategy director for the Soil Association and a trustee at the Food Ethics Council and at Sustain, the alliance for food and farming.

Christopher Atkinson: Hello. I am Chris Atkinson. I am head of standards at the Soil Association charity. I am also an elected board member of IFOAM Organics Europe, our European umbrella organisation.

Q90 Jo Churchill: Welcome, lady and gentlemen. The organic industry currently keeps supply chains separate between organic and non-organic. I wonder whether you could explain how that system works and what you view as the challenges in carrying on that system, given the current legislation.

Christopher Atkinson: Organic is a regulated activity, so the requirements for organic production, including separation and segregation, are laid out in law. In the UK, that is currently a retained European regulation, No. 834. That mandates an inspection and certification system based on international norms for product certification. The way in which producers who are under the control system specified in the regulation notify their activity and interaction with independent third-party certifiers, such as Organic Famers & Gowers and the Soil Association, is described in that regulation.

It is very much a farm-to-fork regulation: it covers all parts of the production process, from the farm, beyond the farm gate, right through to the point of sale. There is complete traceability, which is overseen by the certification bodies and maintained through record keeping and some elements of testing and checking, which are carried out both by those who are subject to the regulation and by the certification bodies that oversee their activity.

Roger Kerr: The question was also about the risk of GM to the supply chain.

Christopher Atkinson: Yes. At the moment, there is prohibition of GMOs in organic production, and organic producers rely on the current labelling regime to verify and identify freedom from GM. There is also a testing regime based on detection thresholds for GM specified in the legislation, and there are duties both on the producers and on the certification bodies to apply those requirements.

Q91 Jo Churchill: With respect, we are not talking about GM products but about gene edited products and precision breeding. Therefore, I suppose I would like to tease out why it does not work for precision-bred crops that arguably are akin to traditional breeding. In the animal world, we already have scientists at Roslin and so on working on avian flu in our bird population, and we have porcine reproductive and respiratory syndrome devastating our pig population. Looking some 10 years hence, are you saying that advances to combat such diseases would not be compatible in your current system, given that those are arguably beneficial in stopping an animal dying in distress? I am trying to understand your world, if you see what I mean. It will be quite difficult to undo the potential benefits.

Joanna Lewis: Your mention of PRRS offers a good way to explain why the global organic movement currently does not support the genetic engineering approach. That movement is very much founded on the principle that you harness natural processes to stop pest and disease problems arising in the first place. For instance, PRRS is widely accepted to be a disease that arises from industrial farming systems as a result of overcrowding. The crucial thing is to make sure that there is a public interest test at the heart of the Bill, and that is what we are calling for.

We noted that the Regulatory Policy Committee has raised a red flag about the impact assessment—I am sure that it has been discussed before. We found that the impact assessment had overlooked three crucial areas: first, clearly, the freedom of choice for citizens; secondly, the needs and interests of organic agroecological farmers and growers, who have a key role to play in the Government's ambitions for a sustainable farming transition; and, thirdly, the impact on the Government's ability to achieve their own really important legal biodiversity and climate targets, and to address their professed concern about animal welfare and their desire to improve those welfare standards.

One does not need to doubt the good intentions of the research institutions that are involved in the research, but there are strong commercial drivers at play here. It is no accident that current and recent developments on gene editing of crops relates overwhelmingly to herbicide resistance. When you have four companies controlling 60% of the global seed market and two of them, Bayer-Monsanto and ChemChina, which owns Syngenta, account for more than half the agrichemical market, it is no accident that there is that commercial bias.

When it comes to the interests of farm animals, the Nuffield Council on Bioethics held a public dialogue on gene editing and farmed animals. The concern expressed by the public, now backed by the support of the Biotechnology and Biological Sciences Research Council, and Sciencewise—I am on the oversight group for that dialogue—was clearly centred not so much on the distinctions between gene editing and conventional breeding, but on the fact that the direction of travel for conventional breeding had been to prioritise traits that came at the expense of animal welfare and which facilitated the keeping of animals in inhumane industrial farming systems. The concern was that gene editing might accelerate that trend.

That brings us back to the question of where the public interest test is that could allow the Government to do more than just presuppose and gamble on the

benefits of this for climate, nature and health. Norway has developed a gene technology Act, which places that public interest test at its heart. I do not know if that has been discussed yet, but there is a test that requires evidence of community benefit and support for sustainable development, so we would like to see that considered in the deliberation of this Bill.

Steven Jacobs: Just to pick up on where we stand as an organic control body, our role is to maintain integrity through the whole chain of custody, from farm to fork and from seed to shelf. You cannot necessarily tell that a bottle of milk is organic by testing it—actually, there could be tests for that. You can tell a bottle of milk is organic because we have inspected every stage of the process. According to our licensees—and we license more than half the organic land in this country—that is not onerous. They already do various certifications, such as Red Tractor. Our inspectors will be able to do two, three or four of those in one visit. Asking the same question can generate two, three or four certification requirements.

The situation we have is one where there is an established market. In this country, it is worth around £3 billion. Globally, it is worth around $100 billion. It has been going for 60 or 70 years. The regulatory regime has been in existence since the early '90s. That integrity is accepted in the marketplace and is being bought by shoppers. In the consultation, something like 85% of respondents said it was not that they necessarily objected to gene editing, but they would like to see existing regulatory frameworks upheld. We work in a regulatory framework. We have ISO standards. We are audited by a Government-approved auditor every year. That is how we ensure that that integrity is maintained. For us, those customers have said they do not want GE or GM.

Jo Churchill: Right, okay. I am not sure that I entirely understand why you feel it would be any different with GE, which is a completely different technique—with all due respect—from GM. If I could tease out that animal welfare point, you are predicating your argument on the idea that everything is detrimental on a welfare front. Surely the eradication of avian flu—particularly as we have had the challenge in the last year—would be beneficial to free-range birds as well. I am keen that the rest of the Committee has its chance to contribute, though.

Q92 Daniel Zeichner: Good afternoon and welcome. I am glad that you raised the impact assessment because there is a lot of interesting stuff there. Some of it is a touch surprising, which we will probably explore in more detail when we go through the Bill line by line. You already touched on some of this, but what are the threats from these developments for your sector? What would you like to see in the Bill to deal with those challenges, as you see them?

Roger Kerr: From an organic regulatory basis, as Chris has already indicated, GE is still defined as GM. We need to be much clearer about what GE is being defined as, and we still do not have that clarity. As things stand, it is not allowed within the organic regulation, so the risk is where there is a lack of co-existence measures in place, which means that organic crops are contaminated. Organic consumers make these purchasing decisions because they believe they are avoiding GM, and that is a right they should have.

By not having robust co-existence measures in place, we are obviously putting our consumers at risk, because they are purchasing organic products on the basis that they do not believe they are consuming GM. It is a personal choice—I am not saying that you should not—and the organic sector is not saying per se that we should not have genetic editing. What we are saying is that it is incompatible with organic. Organic is out there, and there is a market for it, as Steve has clearly stated. There is a significant opportunity, both domestically and internationally, for the UK organic sector.

We should protect the organic sector, and there should be some visibility in terms of GE—where it is being grown, what is being grown and what the potential risks associated with that are for the organic sector—so we can ensure that the organic sector remains free from GM or GE, as it is at the moment. There is concern that if we are looking to provide consumers with the choice of having GE or not, we will end up with quite a significant cost within the supply chain to ensure co-existence, in terms of space and time, between GM and non-GM. This is not organic per se; it is just GM and non-GM. We will then have to have extra storage, more vehicle movements and a much higher level of testing. There are concerns that, without real clarity about what is going on and where the potential points of contamination arise, a significant cost will be borne by the food sector, which is already under significant pressure.

Joanna Lewis: I understand that you are addressing us as the organic industry and the organic sector, but I just want to reiterate that the Soil Association is a charity of 70 years' standing that represents all citizens, farmers, growers and scientists who want to see a mainstream transition to agroecological farming and regenerative farming for climate, nature and health.

The response to the consultation on the Bill—85% of people and businesses were opposed—reflects a deeper unease not just about the safety issues and technicalities around the distinction between gene editing and GMOs. That is what I was trying to bring through with reference to the Nuffield Council on Bioethics's public dialogue. It is really important to emphasise the very legitimate public concerns about the fact that breeding as a whole—plant and animal breeding—has been on an unhelpful trajectory that is not up to the challenge of the Government's goals on sustainable farming transition. We therefore need to ensure that we are not accelerating that trend through carte blanche deregulation.

There is an opportunity to put good governance at the heart of this Bill, set that public interest test, and ensure full supply chain traceability, transparency and labelling for citizens who want and deserve the right to choose whether this is the solution for them. I would not want it narrowed down to saying we are representing an economic sector. This is a broader movement, and it is very much one for mainstream transition.

Q93 Daniel Zeichner: How would you achieve that public interest test?

Joanna Lewis: I would really recommend that you look to Norway's gene technology Act. I have not gone through it line by line, but it feels like a valuable precedent from a country that also sits outside the European Union and is looking at what governance can apply—to make sure we are not just presupposing the

benefits. Commercial drivers are not given free rein, and if there is to be a relaxation of regulation, you can do it with the confidence that it is going in the direction of supporting more sustainable farming. I believe the test that it set is that something is of community benefit and supports sustainable development. I do not know whether that is fully adequate, but it is a precedent that is out there and merits some consideration.

Q94 Deidre Brock: Clause 3 sets out the conditions under which a person can release a precision bred organism in England. Do you think the measures within that are sufficient? Probably not. I would be interested to hear where you think they might be strengthened.

Christopher Atkinson: You are right in supposing that we feel the measures are insufficient. We need a high degree of traceability and the ability for organic producers in particular to understand where crops are being grown and the risk of contamination.

Roger Kerr: The other aspect is that, as we have heard from previous speakers, there is not going to be a significant amount of investment in producing this material unless there is sufficient visibility over where it is, because of the likelihood that it will disappear into the food system and the businesses that have developed the technology will not be able to recover the costs. There is an issue in understanding the full and public visibility over where these crops are being grown, who is growing them and where they are going, so that there is the opportunity to see where that product has gone, so that people can recover their investment.

Steven Jacobs: The Bill says that the organism is

"a marketable precision bred organism"

and

"the qualifying progeny of a marketable precision bred organism".

One of the issues is what will happen if there are—and we are assuming there will be—many precision bred events put into one product, whether that is livestock or crops. In crops, for instance, you can have stacked traits. The issue is around that crop being bred with something else and some of those traits being passed over, perhaps unknowingly.

We have seen incidents where herbicide resistance has gone out into the wilder environment and that has caused problems. For instance, there was a case on the Swiss-Italian border where herbicide-resistant oilseed rape that was not grown in Switzerland was found on the railway. It had leaked out of the railway carriages. That is a problem because they spray herbicide to keep the railway sidings—all the ballast—stabilised. Now, they have a situation where there is a herbicide-resistant weed in a location that would normally be sprayed in order to keep the railway safe. There are incidents where one would need to see some measure of traceability in order to evaluate. It is not just our need; I would suggest that there is a public and commercial need.

Roger Kerr: On livestock, take a genetically edited bull, for argument's sake—I have picked cows because I like cows. He will have sired innumerable daughters that will go on to be crossed back. They may be crossed back with a non-GE sire. At what point do they become non-GE? Obviously, going back through their parentage, there will be GE material in there. From our point of view—from an organic standpoint—the question is: at what point is it no longer a genetically edited animal, if its forebears were genetically edited? There is a lot of concern around how we manage this issue, how those things are defined and who, ultimately, owns the genetic material within that animal, albeit it is the great-great-great-great-granddaughter of something. There are concerns there.

Joanna Lewis: It also feels that the solution in terms of implementing supply chain transparency, traceability and labelling is eminently achievable. It does not feel like a big barrier to bring that into the scope of the Bill in order to address those concerns and allow the legitimate needs of citizens who reserve the right to choose to reject this technology, and to preserve the integrity of organic systems. We are obviously at a point in time where the industry is buzzing with big data supply chain solutions and wanting a whole new resurgence in food labelling to show the citizen everything about the provenance, origin and production practices of their food. It should not be a big barrier to this Bill's intent to include that requirement for full supply chain transparency and labelling.

Q95 Deidre Brock: So a real commitment to transparency and some effort to address the possibilities of unintended consequences on the back of this need to be tightened up in the Bill?

All witnesses *indicated assent.*

Q96 Kerry McCarthy (Bristol East) (Lab): Going back to what was being said about animals, particularly what Joanna was saying, I want to try to unpick this. It has been mooted that one of the benefits of the Bill is that it could result in the breeding of more disease-resistant animals and in less use of antibiotics in livestock management. The downside is that that could pave the way for more intensive farming, because disease obviously spreads when lots of animals are herded together. That does not necessarily mean that making animals more disease resistant and not having to use antibiotics on them is a bad thing.

Some witnesses who gave evidence this morning said that it is not the Bill that is at fault. There is a completely separate argument, they said, about whether we want to increase the intensification and industrialisation of animal farming. Where do you sit on that argument? They said that the animal welfare codes deal with some of the concerns. I would say, however, that they are not operating in the right way at the moment, because we already allow a degree of intensification and, to my mind, animal welfare standards are not good.

On the separate issue of increasing yields from animals, cows produce an awful lot more milk than they would have done a few decades ago, and certainly a lot more milk than they need to feed their own calves. Where do you sit on the use of this technology for that purpose? Finally, do you think that the Bill's provision for the Secretary of State to refer things to a welfare advisory body is a sufficient safeguard? Sorry, that was an awful lot of questions, and you do not have much time to answer.

Joanna Lewis: You asked whether you can separate the intention of gene editing to solve animal welfare problems from the broader challenge of facilitating the perpetuation of systems that result in very poor animal welfare. I think it is important that we bring these

together—as the public brought them together in the Nuffield Council on Bioethics public dialogue. We know that conventional animal breeding trends have been to prioritise greater yield, litter size and fast growth over the welfare of sentient animals, and we know that the argument for gene editing is partly that it speeds things up and is likely, therefore, to accelerate those trends. The public were saying, through that dialogue, that this is where they want to see governance. They want the Government to come in and say, "This is our vision for the future of animal farming. This is how it is going to become a higher welfare system that also delivers for climate, nature and health. This is the role we want to see gene editing play in that context."

I know that you will be hearing evidence from Compassion in World Farming on Thursday, and I know that amendments will be proposed to try to make sure that there are additional tests—which could be linked to the Secretary of State's powers, secondary regulation or the role of the welfare advisory body—on whether these traits are going to focus on yield, litter size and fast growth and cause lasting harm to the welfare of the animal. Also, are they going to perpetuate, facilitate or enable a farming system that is very detrimental to the welfare of animals? Those are the amendments that will be coming through from animal welfare bodies.

Roger Kerr: In terms of the disease-resistance issue, we have to be really careful about how we approach this. What we have seen, albeit through the use of antibiotics, is the reduction of disease. Again, unfortunately, I am referring back to the dairy industry. We have seen farmers driven to reduce cell counts in dairy cows to a point where the cow's immune system has been suppressed to such a degree that the more virulent diseases come in, because there is not the natural, more benign flora around any more. Therefore, you have cows going down with E. coli and other things, which is killing them. We have seen this continual drive to reduce the immune system and reduce the cell count.

What we have found more recently is that allowing the cow to have a more natural immune system actually allows it to live a longer and healthier life. We have to be really careful when we start talking about disease that we do not start messing with something but then find that we end up with a whole lot of unintended consequences in terms of opening the animal up to other disease implications. Ultimately, we will just end up on the same old wheel of trying to continually firefight because the animal is going down with disease.

On the yield aspect, again, we can keep saying, "Oh, well, we can genetically breed them to produce high yield," but what we find is that the longevity of the animals is massively impacted. These cows that can produce 12,000 or 15,000 litres of milk do not live very long because, unfortunately, cows are just not designed to do that. We have to be really careful about what we consider to be a farm animal and what it is there for. If we continue to drive it, we are effectively supercharging its physiology, and therefore it will ultimately not be able to live as long.

Using cows as an example, if you go into a collecting yard or a cubicle shed, you will see the cows breathing really quickly, even though they are lying down, because their physiology is going so fast. What we are effectively doing at the moment is turning what was a very low-input, low-output animal into a Formula 1 car. Unsurprisingly, they do not cope with it and they fall over. What we are doing now in terms of genetically editing is stepping that up a whole other gear. We have to be really careful about what it is that we are seeking to achieve here, and I think we have to look, in terms of welfare, not only at disease resistance but at longevity, quality of life and ability to withstand other disease impacts.

Q97 Kerry McCarthy: Is one of the concerns when it comes to the hormones of an animal—I am talking about animals that are being killed for meat; I know that this came up in the discussion about slaughterhouses—that if the animal is stressed throughout its life, that could affect the meat from a human health point of view?

Roger Kerr: It can affect—

The Chair: Order. I just point out that we only have just over two minutes.

Roger Kerr: Sorry. Chris was going to say something.

Christopher Atkinson: Going back to what you said about what sort of tests should be applied to animals by any regulatory committee, the Farm Animal Welfare Committee introduced the concept of a good life for animals. Our view of animal health and welfare is based on positive aspects of an animal's life. You have referred to the codes of practice; generally, they are based on absences of harm. For a long time in animal welfare science, absence of harm was equated with good welfare. We have moved significantly beyond that, so we would encourage you to look at the good life framework and ensure that those tests for a good life for animals are applied to any traits and outcomes.

Roger Kerr: On your point about slaughterhouses, we talk about a good life, but we also talk about a good death. It is important to recognise that a lot of stress is experienced when animals have to be moved a significant distance, or even away from the farm and environments that they are familiar with. The fundamental issue is how many abattoirs we have and how far animals have to move. To say, "Oh, well actually, what we'll do is we'll genetically manipulate their genes so that we can transport them hundreds of miles before we kill them," seems to be a perverse and illogical approach.

Q98 Kerry McCarthy: I was more asking whether stress—you were talking about being able to increase yields, and about cows being put under stress—would affect the animal's meat in the same way that—

Roger Kerr: I am not sure. We were talking about dairy cows, which, as you know, are not bred to be eaten. Beef animals would be different again. There is an issue around stress with killing an animal, but that is more about the environment that it is in. I think we should look at that in a holistic way in terms of the environment and not necessarily just say, "Let's tweak something so that we can still treat—"

The Chair: Order. I am afraid that I am going to have to bring the session to an end. Our allocated time is over. I thank you all for another interesting session.

Examination of Witnesses

Dr Richard Harrison and Professor Giles Oldroyd gave evidence.

3.51 pm

Q99 The Chair: We will now hear evidence from Dr Richard Harrison, director of Cambridge Crop Research and member of the BBSRC agrifood strategic advisory panel, from NIAB, and Professor Giles Oldroyd, professor of crop science at the Cambridge Crop Science Centre. Both witnesses are with us in person, and we have until 4.30 pm for this session. If you could both introduce yourselves, and then we will begin questioning.

Dr Harrison: I am Richard Harrison and I am director of crop research at NIAB. NIAB is an independent research organisation based around the country. It receives both public and private funding, and it sits in the area of strategic and translational research in crops. My role in NIAB is as the director of Cambridge Crop Research, which encompasses most of the arable crop research we do in the organisation. That include genetics, biotechnology and some of the statutory work that we deliver in seed certification and variety valuation for the Animal and Plant Health Agency on behalf of DEFRA. My own research is in the area of plant-microbe interactions in complex trait genetics. Most of that work has been done over the past 10 years in horticultural crops—strawberries, cherries, raspberries and other tasty things—where my group have worked on disease resistance but also developed and implemented gene editing technologies in those crops.

Professor Oldroyd: I am Professor Giles Oldroyd. I am professor of crop sciences at the University of Cambridge. I am a fellow of the Royal Society and I am director of the Crop Science Centre, which is an alliance between the University of Cambridge and NIAB. I am the University of Cambridge component of that alliance. My research focuses on how we improve the sustainability of farming systems, with a particular focus on removing the need for inorganic fertilisers from farming. I work on driving sustainability in developed-world farming, but also for smallholder farmers in sub-Saharan Africa. I get most of my funding from the Bill and Melinda Gates Foundation. I currently have a field trial ongoing in Cambridge that uses a combination of genetically modified lines as well as genetically edited lines.

Q100 Jo Churchill: Good afternoon, gentlemen, and welcome. I will go for a broad-brush question. What impact do you think the Bill could have in terms of the benefits from translating research and freeing up research and development? Given your experience in particular, Professor Oldroyd, how will it help to address challenges such as food security, climate change and so on?

Professor Oldroyd: I think that the current Bill would be truly transformative in our ability to see impact from the foundational research that happens in many of our universities around the country. The UK is a world leader in plant sciences. It has been very frustrating for plant scientists to struggle to see impact from their research because of the restrictions that are placed on the release of potential products from their work.

I believe that gene editing is equivalent to what you can achieve from conventional natural processes, but the level of precision that it provides allows us to do things in a way that we could not—or found it difficult to do—when restricted to only what is available in the natural diversity of that crop. It really does allow us to move things from the lab to the field to the consumer in a manner that is much more straightforward, to apply the phenomenal knowledge that we have developed in plant research in the UK over the last 30 or 40 years, and really to drive what I believe is a crucial transformation in food production. We have phenomenal challenges facing us: we have to feed a growing population, drive sustainability and cope with climate change, all over the next 30 years. That is not easy and we cannot do it with our hands tied behind our backs.

Dr Harrison: I could not agree more with that synopsis. One of the major strengths in the UK is our fundamental research base. Over the past 30 years, we really have understood at a deep level how genes function—in plants and in animals—and the ability not only to capture what is there in nature through conventional breeding, but to use technologies that allow the directed introduction of mutations that could occur naturally but are not necessarily present or are not in the right pre-adapted germplasm. Bringing those into the gene pool and using them for crop and animal improvement is, as Giles says, transformative to our abilities to address the major challenges that we face in food production and the sustainability of food production.

Q101 Jo Churchill: When you are doing this research, you are bound by regulatory frameworks and have to keep the safety of the product. How do you, as leaders in science, challenge yourselves to make sure that the products that end up on our shelves—albeit that they have to go through FSA approval and so on—are bred for safety, and how we and the consumers assure ourselves of that?

Professor Oldroyd: There are currently very tight restrictions on validating the health and safety of GM products. For products produced by conventional breeding, we also have tests with regards to their performance in the environment, their performance relative to other varieties and their health. We have a robust regulatory framework in place that addresses the safety of the consumer, and it has served us well over many decades. I cannot think of an example where we can say, "Okay, this line has caused genuine risk to human health," and that is because of the regulatory framework that exists.

Q102 Daniel Zeichner: Good afternoon and a warm welcome to you. May I say how much I enjoyed visiting your splendid new offices a few months ago to meet your new director?

My questions are about public confidence. We know that this has been a vexed debate over many years. There is fantastic science being done in Cambridge, but it often strikes me that the wider public have very little idea about it; that is hardly a unique issue there. Do you think there are sufficient measures in the Bill to secure the public confidence that is needed? If not, what extra could be put in to secure that?

Dr Harrison: The key point is proportionality. In all the preamble to the Bill, it is suggested that there is a proportionate response to how the technology is regulated. What we must never forget about gene editing and the scope of the types of changes that can be introduced is

that they are indistinguishable from nature, so fundamentally we are not doing anything that could not happen or arise through natural processes.

The level and proportionality of the regulation of, and the transparency of, those products is important, and it is important that the public are aware, which I suppose is why there are systems in the Bill to register intent to put into the existing system gene edited products, but I do not think we need to stretch much beyond that. We have, as Bill Angus said, very well established regulatory frameworks in which to evaluate the performance of crops. We have the DUS system—distinctiveness, uniformity and stability—and we have the value for cultivatable use system. They have shown over many years that when varieties are put on the market, they are safe. The legislation that exists beyond that gives any country the right, if they find a problem with a variety, to remove that from what is the common catalogue in the EU, or, in our case, from our national list. As long as the proportionality is adhered to, the Bill is appropriate.

Professor Oldroyd: There are a lot of studies that have looked at the general public's position on biotechnology. There are really only a few at either extreme—who absolutely support it outright or who are very scared of it. Most of the general public are looking to people like me—to scientists—and to the regulatory framework to define what is safe to consume.

Within precision breeding, as is intrinsic to the Bill, is the fact that these are events that could happen by exactly the same natural diversity and so already could be introduced, theoretically, through a conventional breeding process. One of the issues is that some—in particular, those on the previous panel—have taken as a presumption that anything that is biotechnology is inherently dangerous, and that is not correct. It is not correct to say that just because it is being developed by this mechanism there is an inherent danger in that approach. That is the erroneous position to take when comparing with conventional breeding.

We use many varieties that have been generated by mutagenesis breeding, by double haploid production. These are conventional breeding approaches. There is very little about gene editing that is different from that in the end product; it is just how you get to that event.

Q103 Daniel Zeichner: Where do you stand on the labelling issues? What kind of labelling do you think would be appropriate, given the advice from the Food Standards Agency?

Dr Harrison: My personal view is that I do not think there is any scientific rationale to have additional labelling criteria for gene-edited products, because they are fundamentally indistinguishable from nature. There is a sort of logical incoherence in saying, "Well, they are indistinguishable in nature, yet we must discriminate and show that they are different." I think there is transparency in the system because there is a register. When farmers choose to grow varieties or there is a protected chain of production to discriminate one set of things from another, people are growing varieties—it is not magicked out of thin air. When people are planting, they will know whether it is a gene-edited variety or not. That is the point at which the choice can be made. I do not think there is any scientific rationale for then extending that labelling requirement to the post-marketing of products.

Q104 Daniel Zeichner: What do you think the purpose of the registers are, in that case?

Dr Harrison: Everybody has said, and many panels have shown, that there is a need, when you are bringing a new technology into the market, to have an additional level of transparency in order to inspire public confidence. I think the question is what level of balance you need for public confidence. I think that the registers are there in order to say, "This is a product that has been produced with this technology," and there is therefore then the ability for people to choose it, should they want to. That is what I see them being there for—to give people freedom of choice.

Q105 Daniel Zeichner: There seems to be a slight inconsistency to me, though.

Dr Harrison: That is why I was saying that, at the time of planting, people can choose. The supply chain fits around that decision, at that point, much as it does with other production systems. To distinguish a gene-edited product on the basis that it is somehow different from a conventionally bred product is the thing that I am saying is a bit logically incoherent.

Professor Oldroyd: If I may add to that, the Bill itself states that only those that are considered to be equivalent to something that could be achieved by natural transformation are included under the Bill. So by definition we are saying that this product could be achieved by more conventional methods. Therefore, it is illogical to separate it out at some later stage and say, "This product is different", when intrinsic to the Bill is the fact that it is not different. That is the only way it can be taken forward.

Daniel Zeichner: Which begs the question of why you had to register. However, I think we could probably go round in circles on this. Chair, I am quite happy for us to move on to other questioners.

Q106 Deidre Brock: Professor Oldroyd, you mentioned tight restrictions on validating the safety of gene-edited organisms. I just wondered whether it is possible to use field trials to assess sufficiently whether there are major impacts, or even minor impacts, on local ecologies once the crops are grown at a commercial scale. How do you take that into account?

Professor Oldroyd: Let me describe how we get to the point. For instance, I have some gene-edited material out in the field right now and we measure everything we can possibly measure in that material, from its effect. These are affecting plant microbial interactions, so we are particularly looking, for instance, at what is happening in the soil. We have the wild type and we have the gene-edited line, so we can precisely compare, to understand any differences in the local environment caused by the gene-edited type or the wild type. That is intrinsic to the research programme and we have to do those field trials before anything even gets close to commercialisation.

Therefore, intrinsic to working with this material is that we are already putting it out in the field. If I then hand it to breeder, they will then be doing breeding in their lines with that material and also doing extensive field trials, testing many factors, according to their performance relative to other lines. Ultimately, if it gets released as a variety, then NIAB, under the jurisdiction from the Government, tests and compares those lines relative to other lines on their performance in the field.

So there are many points along this track where we are actually testing the performance—as a researcher myself; as a breeding company; and then as NIAB, creating the recommended list. There are multiple factors all along the way that are already intrinsic to the process.

Q107 Deidre Brock: All of that would provide sufficient protection before any of these were grown commercially, at such a scale that it would be, I would imagine, quite difficult to prevent impacts, if they were happening.

Professor Oldroyd: That is the process that we have put in for mutation breeding, for instance. For mutation breeding, I irradiate the seed to create mutations in the seed, look for the lines that give a trait that is useful, and then breed that into the conventional lines. That is already happening; it underpins a lot of our food production and we have a regulatory framework to ensure that what we are actually releasing out into the world is safe and effective.

Q108 Deidre Brock: And you think that the regulatory framework contained within the Bill is sufficient?

Professor Oldroyd: I think it is certainly sufficient for assessing the validity of material produced by methods that are no different from what happens in nature.

Q109 Deidre Brock: Thank you. Finally, you mentioned that your funding was a mix of public and private, Dr Harrison.

Dr Harrison: Yes.

Deidre Brock: What are your thoughts with regard to, say, Mr Angus's previous points about the ownership of genes or the licensing of genes, and trying to ensure that that does not become a problem for breeders such as Mr Angus, or indeed for growers. We have discussed that in a few panels, so I just wondered how his point could be addressed.

Dr Harrison: Bill was talking about the breeder's exemption, which means that once a variety has been protected it is put on the market, and any other breeder can then take that material, cross with it and do onward work.

If I understand it correctly—this is an area that is changing rapidly—there is still uncertainty, as Jonathan Napier said, about what can and cannot be protected. Patenting genes is very difficult, so it is more likely that the technology will be protected than the genes themselves. Even so, there could be some instances where there is some level of protection around a particular trait.

There are schemes now being set up that would allow the breeder's exemption still to apply in the event of a licensing for a particular gene-edited trait in that variety. So those systems are being set up by industry at the moment, because ultimately there is a win-win there, because the licence holder of the intellectual property will want to see that out there at some level, and the plant breeders will want to use the material. I am not an expert in this area, and I am not a legal expert, but I understand that there are schemes being set up to take account of that. That is only in the instances where stuff is actually protectable; most stuff probably won't be protectable, so the breeder's exemption will still apply and people can still cross with it.

The bigger issue—the one raised by Jonathan—is that if you have an overly burdensome regulatory landscape of pre-authorisation to take something to market, for many that will be the thing that kills the technology. It is really important that that proportionality remains. It is only for things that may substantially affect nutrition that you would go down a route whereby the FSA would even class it under novel food regulations. I would expect that the majority of things being developed are agronomic traits, which would—as they do in many jurisdictions, such as Canada—sit outside the purview of food standards and are not classed as novel food in any way. They would progress to the market just as conventionally bred things do at the moment.

Q110 Deidre Brock: I suppose I am thinking back to the Soil Association representative's point about 60% of seed grown in the US—or it may have been worldwide—being held by four companies. Is that a route that we would rather not go down, or is it not something that you are concerned about?

Dr Harrison: Do you mean in terms of additional—

Deidre Brock: If they take over and buy out smaller breeders, for example.

Dr Harrison: You have to look at the situation. The market is one thing, and the Bill is talking about gene-editing technologies and whether they are substantially different. Personally, I do not think that the two are really related.

Deidre Brock: Although it is certainly bound up in the arguments about gene editing and genetic modification.

Dr Harrison: In many ways, among the small and medium-sized enterprises such as Bill's, in a landscape such as the UK, where there is a lot of innovation happening, there are start-ups starting now that want to do breeding and gene editing, so you may well see the opposite happening: a democratisation of the process and more people entering the market as the barrier to entry is much lower because of the regulation change.

Professor Oldroyd: The food production sector is no different from any other sector in this free market economy. I hear a lot of concerns about a few companies owning most of the seeds, but I do not hear the same about a few companies owning most of the drugs, cars, phones, clothes or any other product. That is a reality of our free market economy. The food production system is just like any other sector; there are major players who have a sizeable part of the market share.

Richard made a very important point. The phenomenal restrictions that are being put on traditional genetic modification have actually meant that only the big players that have deep pockets can use that technology. I feel as though we have ended up in the situation that most people feared, where a few companies have total control of a technology, and that is principally because of the cost of releasing those traits. If we follow the Bill and treat them as equivalent to conventional breeding, we absolutely liberate the technology for SMEs to get in the game. At the moment, they could not afford to do that with GM.

Q111 Clive Lewis (Norwich South) (Lab): It is good to see you again, Professor Oldroyd and Dr Harrison. Your last comments have thrown my question in many

[Clive Lewis]

ways. You said that not much is said about pharmaceuticals and other products in the free market, but that is quite a low bar. I have been involved with the trade-related aspects of intellectual property waiver campaign. A big part of the global south is campaigning to have access to the understanding of how to make anti-covid drugs, and they are struggling.

I do not think that is a model that I would want to apply to food. Some of us would like to see something more robust that did not make the mistakes that we have made on pharmaceuticals, for example. Food supply is critical, especially as we move through the 21st century with the climate crisis and a growing population. When I was asking you questions as a BBC journalist a long time ago, I was always struck by your passion for the science and for communicating the science. As currently constructed, does the Bill provide the protections we need? Outside your laboratories, away from the pure science, there are free-market corporations for which the bottom line is the end game and the main driver. Do you feel that this science is beyond abuse and beyond being used in the same way that perhaps big pharma have cornered those markets?

Lastly, I understand the notion that reducing barriers opens up the market to small and medium-sized companies, but the history of any industry shows us that big players begin to hoover up small players over decades, and you end up back in an oligopoly or monopoly situation. That does not necessarily have to happen, but that is what usually happens with new tech. There is a free-for-all when everyone piles in, but ultimately people sell up and move on, and the big companies hoover up. When you get past the science and it reaches the real world, do you feel that there is the opportunity for abuse? Does the Bill protect us from that?

Professor Oldroyd: With the caveat of clause 3, legislating gene editing as equivalent to conventional breeding is the best way to allow small to medium-sized enterprises to become involved in the technology. If you really want to see a break in major corporate ownership, lowering the barriers to how you get a product from that technology is almost certainly going to facilitate that. As I said earlier, the big problem currently with GM is that it is so costly to release a GM variety that only "the big four" can afford to do that. I think that taking this approach will help that ownership of lines.

Certainly from me, as a researcher, the Bill as it currently stands greatly facilitates me to work directly with plant breeders and move products through the conventional plant breeding mechanism into the market and on to the consumer. Some of that plant breeding is in the big four, but quite a bit of it is not. Those are more the medium-sized enterprises, not necessarily BASF or Bayer, although they do have a role in some of that. I think the current Bill will certainly facilitate that broadening of ownership of the technology and a speeding up of the impact to the consumer.

Dr Harrison: If I could add one small point, our public research institutes in the UK have a pivotal role to play here. We do research funded by the Government in this area and we publish that. We can protect it before or we can just publish it so it is free and able to be used by many.

You could really think strategically about how those research organisations are used to direct change in the way that one would want to see, so that varieties come on to the market either nearly complete, so breeders can take them up, which is often what happens, or even release complete varieties, as happens in many other countries, from public funded research organisations. Again, that allows freedom of choice, so varieties come on to the market that have traits that are desirable and do not suffer from the problem you point out, which is that some small companies may become subsumed into larger companies.

Thinking about it more broadly—this is outside the scope of the Bill—there is an absolute opportunity for the UK to lead on bringing those traits to the point at which they can be taken to market, in a variety of different ways that are not just dependent on the big four.

Q112 Kerry McCarthy: You have said that you are funded by the Government for some of your work. To what extent is that related to potentially boosting economic growth by making these crops more profitable for farmers, or to what extent is it about achieving public policy objectives? I am thinking particularly about the drive towards net zero. Is that ever put to you? I am thinking about measures to improve soil quality and, in that way, carbon sequestration. Let us take a potato, which takes an awful lot out of the soil in nutrients and so on. Are you looking at that sort of thing in the broader sense?

Professor Oldroyd: I am probably the best person to answer that, because my research is entirely focused on trying to remove the need for the addition of phosphate and nitrate as inorganic fertilisers for food production. I am absolutely driven by a desire to have sustainable productivity for both rich and poor world farmers. Historically, I got most, if not all, of my money from the British or European Governments, but now, as I said, I get money from the Bill and Melinda Gates Foundation and also from the Foreign, Commonwealth and Development Office. In that regard, it is absolutely policy driven for sustainable productivity for smallholder farmers.

Dr Harrison: I echo that. For the UKRI-funded research that NIAB delivers there are two key components. One is scientific discovery. When you are working in crops, that is about strategic discoveries of things that are important to the strategic objectives of the research councils. Of course, BBSRC is the primary funder of agricultural research in the UK. It is absolutely in that zone of looking at how crop science and net zero intersect and how we can generate more sustainable farming systems. Much of the research, even if it is discovery and frontier bioscience, always has a strategic element to it.

Q113 Kerry McCarthy: The Government have been criticised for not having a net zero strategy for agriculture but you would say that there is a clear direction coming to you that it should be there.

Dr Harrison: There is certainly a clear research strategy.

Professor Oldroyd: Absolutely. In fact, it is more driven by that policy. The drive for sustainability is very much an active area of research in the public sector, probably more so than in the private sector. A lot of the

public sector research is pushing towards some of those policy issues, in contrast to the private sector, which is looking principally at productivity.

Q114 Kerry McCarthy: When it comes to the new subsidy regime—public money for public goods—is that something that could be quantifiable? If a farmer switched to a gene edited product—this is getting a bit techy—could they be rewarded for looking after soil health under the public money for public goods approach? Do you see a situation where a farmer could make the switch because they know they would rewarded for that? Or is that outside your remit?

Professor Oldroyd: I guess so. The subsidies are changing quickly.

Q115 Kerry McCarthy: I suppose I am asking whether it is traceable. Could a product be badged as "This is better for the soil", and therefore ticks the box when it comes to environmental land management schemes?

Professor Oldroyd: In the case of my research, we hope that what we are testing right now in the field are lines that will be productive at lower levels of treatment of phosphate as a component of fertiliser. By that it is absolutely measurable how much fertiliser you are putting on the field relative to your productivity. The landscape for subsidies for farming is changing rapidly, and I think within that there are great opportunities for incentives for farmers to reduce greenhouse gas emissions and sequester more carbon in the soil. The challenge will be how you measure that, and it is probably going to be by encouraging farming practices that we know on average reduce greenhouse gas emissions.

Dr Harrison: I think you absolutely have to measure it at a farming system level; the genetics alone, in isolation, will not do it. Of course, the system that we have at the moment, the value for cultivatable use, includes some public good traits, for example, disease resistance traits, which are ones that have a clearly measurable environmental benefit, because you are reducing the amount of fungicide sprays and so on. There is absolutely scope to look at that system and ask what additional measures could be put in place to ensure that the varieties, whether conventionally bred or using new breeding technologies, have some level of enhanced environmental service. That is a big opportunity for the UK, because we sit outside the common catalogue, so we can define our own value for cultivatable use and national listing system. Again, we could be progressive in the way that we look at this, and lead the way in making sure that the things that breeders are asked to do to put varieties on the market meet the wider policy objectives of sustainable farming and emissions reductions.

The Chair: Minister, you have another point.

Q116 Jo Churchill: Just a quick question in conclusion: could you articulate whether, in your view, this will lead to more investment in R&D in this country, including philanthropically—you mentioned the Bill and Melinda Gates Foundation—for the benefit of others across the world? We know that the majority of the world tends to farm on less than a hectare, so enabling them to have disease-resistant crops or crops that do not need expensive inputs could arguably have a beneficial effect. What is the quality of our research? I think Dr Harrison said that we have the absolute chance to lead. Any comments? I am slightly hesitant, knowing where you are going to be shortly. How do we optimise that?

The Chair: May I jump in here? We have about four and a half minutes left, and Daniel Zeichner wants to ask a question as well.

Professor Oldroyd: A lot of eyes are focused on this country at the moment, with regard to how we approach this. We have to recognise that we influence quite a bit. Countries in sub-Saharan Africa are absolutely looking to Europe, to the UK, for leadership on this. Our position will influence internationally how these technologies are legislated for. Certainly, we have a lot. I am excited about the potential to drive up food production for smallholders, as well as the sustainability of farming practices here in the UK. The opportunities are immense. Definitely, having this, the ability to use gene editing, will facilitate that delivery both to smallholder farmers and to UK farmers.

The Bill and Melinda Gates Foundation is definitely paying attention to what is happening here in the UK. With regard to additional investment, this Bill opens up opportunities for the UK. We are already a leader—we really are a leader in agricultural research—and I think it will position us even more greatly to be spearheading the impact of all that agricultural research.

Dr Harrison: I, too, see a big opportunity for the UK not only to lead, but to garner additional investment. At NIAB, where we operate in both the private and public sectors, we have seen on both sides a big increase in the attention given to the services we offer to industry and academia for crop transformation and gene editing. I definitely think there is an opportunity here. In the kind of ecosystems that you see around major university cities such as Cambridge, there are a lot of start-ups that are very much trying to bridge the gap between the need to use crop science to transform food and farming to be sustainable, and the use of new technologies. A definite opportunity.

Q117 Daniel Zeichner: You made a powerful case for the development of SMEs, although you are publicly funded, and for allowing that space to develop for the public good—but it is a very Cambridge-y conversation, in the sense that we know that the Cambridge experience is often that small start-ups get bought up and are then used for other purposes. Would it not further the cause that you are promoting to have a public good test somewhere in this process to enable that to be done for the public good, rather than to be potentially lost down the line?

Dr Harrison: Personally, I would say that, and not just for this Bill and gene editing. If one wants a public good test, one should apply it to everything in terms of crop varieties, and not single out gene edited varieties as a unique case. I return to my comments on looking at the listing system and making sure that, again, it is proportionate. Breeders have to spend a lot of money bringing varieties to market, so if there was public good funding coming from Government, it should be to support breeders in developing those varieties that have enhanced public good traits. You should look at it in the round.

Professor Oldroyd: I think it would be very hard to define what is not a public good. Production is for the public good. We have to have production. Production tends to be where the private sector focuses—it is total productivity—but it has raised productivity across the past century. That has certainly given it a competitive edge as individual industries, but it has meant that we have kept our production up with the growing population and the growing demand. That is public good. I would find it very hard to differentiate what is public good from what is not public good when trying to manage such legislation.

Daniel Zeichner: I think we might find some examples, but that is for another day.

The Chair: That draws us neatly to the end of the time allocated for this session. A big thank you to Dr Richard Harrison and Professor Giles Oldroyd.

Examination of Witness

Sam Brooke gave evidence.

4.30 pm

The Chair: We will now hear oral evidence from Sam Brooke, chief executive of the British Society of Plant Breeders, who will be giving evidence in person. We have until 4.50 pm for this session. Before we open the questions with the Minister, could you please introduce yourself?

Sam Brooke: Good afternoon, everyone. I am Sam Brooke, and I represent the British Society of Plant Breeders, which is a not-for-profit society. We currently represent 80 members of the plant breeding sector, which is virtually 100% of the plant breeding industry in the UK. As you can imagine, because we have 80 members, we range from one-man bands and SMEs to multinational breeders, so we have a very good coverage of the breeding industry in the UK. Our main aim is to continue to promote plant breeding, the importance of genetics, and the importance of seed and where it fits into the scheme of things.

Q118 Jo Churchill: Having such a depth of commercial experience within your organisation, and looking—as you have said—from the SME through to the international plant breeder, what impact do you think this legislation might have on the seed production industry? In particular, could you talk a little about how we ensure fairness and equity, from SMEs through to the internationals? I saw you nodding when Professor Oldroyd was giving his evidence, but I would like to hear it from you.

Sam Brooke: From our perspective and that of our members, the legislation offers huge opportunities. It will definitely open up investment in the UK for plant breeders. When the European Court of Justice ruled in 2018 to legislate precision breeding techniques as genetically modified organisms, around 70% of our members classed as SMEs ceased investment in those new technologies because of the expense and political uncertainty around being able to bring those products to market. From our point of view, it is critical that these new techniques are now available and can be utilised.

We believe that the legislation will naturally bring the cost of those new techniques down, giving a broader range of our members greater access. As I have mentioned, we have guys who are literally one-man bands, who are breeding locally in the Cambridgeshire area where we are based, and we also have the bigger multinational companies. You have mentioned being fair and equitable: breeders have already established a network of trait licensing platforms, which we see working very well across the UK and Europe. A very successful vegetable trait licensing platform is already established, and an agricultural trait licensing platform is being established as we speak. That is a fantastic way of ensuring that those traits are available across all breeders and all entities, of all shapes and sizes, which is great, because it means they have access to broader diversity, more technologies and more traits. That is really important.

Q119 Jo Churchill: One final question from me before I hand over: what would you not want to see in this Bill?

Sam Brooke: As a whole, the BSPB is incredibly supportive of the Bill and what it is trying to achieve. Our main concern would be around clause 3 and a risk assessment around food and feed. All the scientific evidence would show that there is no greater risk in using these technologies than in using what we currently are in conventional or traditional breeding—or whatever we want to call it—so I feel that there is no reason for that extra risk assessment step. We are very concerned that that could act as a blocker to early stage research and development.

Q120 Daniel Zeichner: Good afternoon and welcome. I will follow on from some of the previous questions and ask a similar question, really. In the end, it seems that one of the big challenges here is in maintaining public trust. While scientists may give a whole a series of assurances, if the public and perhaps some of the major retailers are not convinced, then there is a problem.

The key issue is getting the balance right between reassuring the public and following the science. However, to many of us, this Bill looks very thin on the "reassuring the public" side—so much so that, despite the FSA and its polling showing that the public would really like more information, as the Bill stands, that is not the way it will be. How convinced are you that the issue of public confidence will be resolved in favour of the science?

Sam Brooke: Having lived and breathed plant breeding for just over 20 years, I think we should have shouted more, and earlier, about how regulated the industry is, both at plant-breeding and seed level. We have a rigorous testing system in the national list process. Each variety undergoes at least two years of testing before it comes to the market. Every variety must be on that UK national list before it can go into sale. All that is underpinned, obviously, by laws on food safety, novel foods, and so on. We have this incredible history of safety of plant breeding in the UK, and of bringing those products into the market in a safe, sensible and secure way.

On top of the registration process, we also have seed marketing legislation, which really protects the user. Naturally, it protects the consumer in that it ensures that all seeds that go out into the market meet a common and prescribed standard. I think that is really important, and it is probably our fault as breeders that we have not shouted in the past about how legislated the

process of producing new varieties and seeds actually is. That is what we need to go out and talk about, and tell the consumers. I am a consumer—we are all consumers—and I think, had consumers had more information and knowledge about how regulated varieties and seeds already are, we might already be a step closer to having that absolute trust.

Q121 Daniel Zeichner: I will follow up on that, in that case. If there is that confidence, why the reluctance to allow consumers to know how their food is being produced? Polling from the Food Standards Agency suggests that consumers want that. Is there not a danger that it looks as if you are trying to hide something?

Sam Brooke: We are absolutely not against full transparency of breeding methods. Most breeders have already taken their own initiative to highlight, on their websites and social media platforms, how varieties are produced. I think it was back in March 2021 that we wrote to the Secretary of State, George Eustice, and said, "No, BSPB is absolutely up for transparency on the breeding process." It is just that the best way of doing that is through the chain.

We have worked with DEFRA and looked at how we can easily bring that step into the national list process by highlighting what breeding process was used, because we already do, to a certain extent. For example, if it was a hybridised crop, we would have to highlight if it was cytoplasmic male sterility or a chemical-hybridising agent system, so we are already doing that. That, for me, would be another step forward and would support the public register, which is in the Bill and which we absolutely support.

Q122 Deidre Brock: You just spoke of the UK's considerable reputation for offering protections around the breeding processes and so on, making them very safe. Does that differ markedly from the protections that the EU offers? Is the UK leading in that respect?

Sam Brooke: Naturally, we have been following EU legislation and have been historically aligning, quite rightly, with EU legislation on this, where we have our nearest trading partners and the majority of plant breeders. Because it is such an expensive industry, the majority of plant breeders are breeding at least for Europe if not internationally, because varieties travel quite nicely, especially to our nearest countries in the EU. We align with that. The key difference is probably that we have a lot of expertise in the UK and we want to keep that, because plant breeders are based here and actively breeding here—they have labs and food trials here and we have this fantastic, world-leading research and development in the likes of NIAB, John Innes and Rothamsted.

Q123 Deidre Brock: We had a plant breeder in before—Mr Angus—who talked about his concern about ownership and the licensing of genes and, I suppose, the potential concentration of ownership into larger companies. What are your thoughts on that? Do you share that concern?

Sam Brooke: No, I think the Bill has the potential to open up the technology a lot more. It will naturally open up what traits are available both publicly and privately, but I would imagine especially publicly. The majority of new traits that have come through historically have come through publicly.

Q124 Deidre Brock: Is that is something you would like to see continue?

Sam Brooke: For me, it is all about choice. That is the most important thing. We are not going to get great investment in these new technologies if these commercial business cannot make some money somewhere along the line. We have to be able to protect that IP, which we already do very well in the UK with our current royalty system. We currently protect new varieties and IP on varieties very successfully, which makes us a great area for investment in plant breeding. I would like to see that maintained.

As I mentioned, there are different trait licensing platforms already available. For example, Corteva is one of the big ones, as we may want to describe them, which has already initiated its own platform for accessing its traits. I do not think it should be seen as a concern. There are already breeder exemptions around using new varieties, and I do not see this being any different when we get to using precision technology.

Deidre Brock: Okay, that's interesting.

The Chair: If there are no further questions, we will bring this session to a close.

Examination of Witness

Dr Alan Tinch gave evidence.

4.45 pm

The Chair: We will now hear evidence from Dr Alan Tinch, vice-president of genetics at the Centre for Aquaculture Technologies. He is appearing via Zoom, as we can all see, and we have about 20 minutes for this session. Could the witness please introduce himself? Thank you also for joining a little bit earlier.

Dr Tinch: No problem. I joined five minutes early just to be prepared. My name is Alan Tinch. I work for the Centre for Aquaculture Technologies, which is a company involved in developing technologies for use in fish breeding and aquaculture. I work on projects in genetics, genomics and gene editing. In terms of my background, I am a geneticist. I graduated from the University of Edinburgh and Roslin Institute in Scotland many years ago. I have worked on a number of different species, both terrestrial and aquatic. Throughout my career, I have worked on genetics, genetic development of breeding programmes and developing new systems for improvement of livestock.

Q125 Jo Churchill: Good afternoon, Dr Tinch. Can I ask how you anticipate the Bill helping in the area of aquatic species? How do you see it fitting in with the international regulatory environment?

Dr Tinch: That is an interesting question. I think all livestock breeding is now very much international, so it is difficult for small companies based in one country to operate successfully. There are a number of large international operators in genetics. In aquaculture in particular, we are not as far down the development of the species as some of the terrestrial species. We have

been farming and breeding fish for about 40 to 50 years, so we are domesticating many of the species already. We are working hard to improve things such as disease resistance. There is good evidence, and we have seen very good examples, of genes that can be used to improve health and welfare of fish—particularly with Atlantic salmon, where a Scottish group identified a gene that accounted for over 80% of the variation of disease resistance. That was bred into the salmon populations and is now in most farmed salmon populations, making them resistant to the infectious pancreatic necrosis virus.

I see the implementation of gene editing allowing us to do similar things. Without having to go into the field, if you like, and look for animals that are carrying favourable mutations, we are able to identify genes that affect things like disease resistance, make targeted changes in those genes and make fish resistant as a result. I think that is a very positive way of taking breeding forward. It is not the only tool in the toolbox, but it certainly allows us to do some very interesting and valuable things for the health and welfare of the animals we farm.

Q126 Daniel Zeichner: Good afternoon. You will probably find my line of questioning fairly predictable. Animal welfare organisations have consistently said that they are concerned about the introduction of traits, which would allow animals to be farmed more intensively. Given the concerns that have been raised around aquaculture in general, how concerned are you that that is the way it will be perceived and seen? My second question is more to do with the trade issues and comes almost on the back of the first question. If our European partners take a different view on this issue, what effect would it have on your industry's exports?

Dr Tinch: That is a tough question. The association between improving the ability of animals to perform and changing disease resistance, and the idea that that means we are going to increase stocking density and make welfare worse, is very simplistic, and it is not as simple as that. That is not the way farmers tend to operate, and it is not the way that breeders operate practically. That argument is raised quite often as being a reason not to improve farm animals, but it is not like that.

We should use the technologies that we have to improve animals. We are putting them in a farming environment that is different from the environment they evolved in. We have to adapt them, using genetics, to the farming environment, and that is what we aim to do. We aim to improve health, welfare and the sustainability of the animals from an economic point of view and an ecological point of view, and we use a number of different methods to take that forward. The tool is genetics, and gene editing is the next step forward in our ability to change different things. We should look at how we aim to improve animals in a constructive and welfare-driven way.

On the trade issues, if the legislation put us in a position where we were restricted in the use of the technology, we would be faced with the problem of people farming gene edited animals in other countries, and we would not be as competitive. We are already seeing gene edited animals being farmed in Japan, for example, and there is very permissive legislation in places such as Canada and Australia. I think those countries will be the first to bring in this technology. I see that coming first in some of the economic traits, and we will face competition as a result—maybe not in the species that they are planning and gene editing at the moment, but as it comes through the system in these areas, we will see our industries being uncompetitive in their performance.

Q127 Daniel Zeichner: To follow up, I was thinking more of it the other way round. If there was a time lag or a different view was taken in Europe, would you have to have two different production systems—one using gene edited animals, and one not? What are the practicalities of that?

Dr Tinch: If the legislation puts in place a system whereby gene edited animals would need to be labelled, you would need to have parallel systems. My argument would be that gene editing is a means of creating genetic variation that is identical to the variation that would occur naturally. As a consequence of that, we are not seeing products that are different.

If I identified a gene for disease resistance in a group of animals in the population that I was farming and bred it into the population for supply into the food chain, or I gene-edited the animal with the same genetic change—the same mutation—those animals would be identical in their genetics and performance, but if we labelled them and identified them differently, we would be creating two levels of animals within the production system that are essentially different. That would cause more problems than required in terms of the science behind the technology and the proportionality of how we are dealing with that lack of genetic difference.

Q128 Deidre Brock: Hello, Dr Tinch. It is good to see you. We have heard from folk who have been dealing with arable crops and so on, and there is a suggestion that the commercial benefits of this Bill would not be realised for anywhere between five and 11 years, but I wonder what the difference would be for aquaculture. Say the Bill becomes law, how quickly could we see commercial benefits for aquaculture farmers?

Dr Tinch: The key difference—let me know if I get too technical, as I do not want to drift away—is in the amount of time it takes to go from generation to generation. Some aquaculture species have a very short generation interval and can grow up and produce eggs quite quickly. For a lot of the warm water species that are farmed, and imported and exported around the world, we could move quite quickly because they have a short generation interval and they produce large numbers of eggs, so we could quickly be in a situation where we are producing animals with gene edits. That would be species like shrimp and tilapia. Shrimp are consumed at high levels in the UK. Tilapia are not, but they are still consumed at high rates around the world.

Atlantic salmon are much slower in terms of their growth and maturation. It takes at least three years—probably four years—to go through that cycle from egg to egg. From a practical point of view, we are not going to do it in one generation—it would be a couple of generations—so for Atlantic salmon we are talking at least four years, probably nearer eight years, until there were significant numbers of Atlantic salmon edited in the populations.

Q129 Deidre Brock: Assuring quality control, if you like, would presumably add quite significantly to that lifecycle, so are we talking 10 years?

Dr Tinch: Well, if I go back to the example of the gene that was discovered in Scottish populations for disease resistance, it was described in 2008 and was at high levels in commercial populations in 2015-16. Do not quote me exactly on those numbers, but it was that sort of timescale to go from identifying the animals to using them in breeding, going through the multiplication system and coming into production. If we were able to do that, and the technology would allow us to move as quickly as that in some populations by editing the gene, making the change and then breeding from those animals, we could move as quickly as that—a generation and a half to get it to high levels in the population.

The process that breeders go through normally to assess their animals is as you describe: if you discover a mutation, you look at it in the population, look at its effects on a number of different traits, and judge that it is an animal that is capable of performing well in the production environment. If everything is favourable, you then take it forward into production. That was the example relating to infectious pancreatic necrosis in Atlantic salmon. The gene had an effect on disease resistance and it did not have any perceivable effects on any other traits. For the sorts of traits we are talking about in Atlantic salmon, the case would be the same: we would evaluate it within the populations in the breeding programme—typically thousands of animals—and then as that data builds up and everything works out, we would expand that to the commercial populations.

We could go as fast as that. Obviously, with short-generation species with higher rates of reproduction, we could go faster than that. That process of identifying the animal, looking at its performance across a number of traits and judging that is a process that can move at the timescale I have described.

Q130 Deidre Brock: I am not sure whether you will be able to answer this, but I was just wondering about food labelling. What are your thoughts on that, as opposed to the notification systems and the public register that is proposed in the Bill? Do you think there is a stronger case for labelling animal products than crops—plants?

Dr Tinch: To go back to that position—

The Chair: Just before you answer that question, may I ask you not to lean too far forward into the mic, because we will miss your face, and we do not want that? Could you stay neatly there for lip readers who need to follow you?

Dr Tinch: No problem. On labelling—going back to the position that says the genetics we are talking about is indistinguishable and identical variation that occurs in the wild and in farm populations—if we say that they are identical, then logically I see no reason to label that. The product is the same, the means by which it was generated is slightly different, but it is identical, to all intents and purposes, to a mutation that would have occurred naturally. I see no need for labelling.

Q131 Deidre Brock: Okay. What about public opinion on that?

Dr Tinch: That is a different question.

Deidre Brock: Given agriculture is a subject of some contention in Scotland at times, what do you think?

Dr Tinch: It has been a hugely successful industry in Scotland. Your public opinion is interesting. To give a broad analogy, the other example of products being very close in terms of their composition and quality but labelled for production-system differences is organic farming. There is a drive there that says, "Okay, people are interested in the production system and they ask the product to be labelled to identify it as premium." There is that precedent, but I go back to the position that says these are products that have identical composition. They are produced in different ways at the point where the mutation is either discovered or produced by gene editing, but they are identical at point of sale. I see no reason for labelling that, unless, like with organics, there is a premium for that sort of production system.

Q132 Deidre Brock: I see. This is a bit out of leftfield, but I heard earlier that there is a genetic technology Bill that has been proposed—or has gone through—in Norway. Obviously, there is a considerable amount of Norwegian interest in aquaculture in Scotland. Is that something that you have come across, and if you have, are there any elements of it that you think could be applied to this Bill? Do you think it will have any influence on Norwegian-owned aquaculture in Scotland? You are closer to the field than I am, but I am wondering if that is something that might occur.

Dr Harrison: Similar discussions are going on. A position on describing technologies where the outcome is the same but the technology used to produce it is different has been adopted, as it has been in a number of other countries—Canada and Australia. The principle of recognising that the product that is being farmed is the same as one that would have occurred naturally is being adopted by several countries. The danger is that we might come out of line with that.

The influence that Norway has over the UK and Atlantic farming industry is interesting in that it is a major player in the Scottish industry. Norway's industry is technology led; Atlantic salmon farming is technology led and it will take the technology forward. I would expect that Norway takes its responsibilities as farmers and guardians of the livestock seriously, and farms according to good practice. The technology can be used as a means of improving performance, health and welfare of our animals. We should bring those sorts of technologies forward and use them. Those are the arguments that have been made in Norway as well.

Q133 David Duguid (Banff and Buchan) (Con): Thank you, Dr Tinch, it was very interesting to hear your perspective on that. I listened very carefully to your responses to Ms Brock about the time it would take for multiple generations to become viable and to get access to market. In terms of investment here and now, or at least in the shorter term, in research and development, we have heard from other witnesses about the attraction of promoting investment in other food sources. For example, not in today's evidence but from elsewhere, we have seen reports from the Roslin Institute and James Hutton Institute that they are very keen for this legislation to come to pass. Would you say that is the same for your field of expertise, particularly in Scotland?

Dr Tinch: Absolutely. I am a graduate of the University of Edinburgh and studied at the Roslin Institute, and have collaborated on a number of projects with scientists at Roslin in aquaculture, developing genetic solutions to disease resistance and applying those in populations. We are a local leader in terms of our ability to understand these technologies, develop them to the point of application and then deliver them through production systems.

The danger if we do not lead in that area is that the technology will move elsewhere. I now work for an American company working in gene editing in agriculture. I am not saying the reason I am doing that is because there is a lack of investment in the UK, but there is certainly lots of investment outside the UK in the technology and a lot of the technology is going to be applied in breeding programmes outside of the UK in areas where the legislation looks as if it is more permissive.

The UK model, particularly through the BBSRC and identifying projects that will have meaning within industry, is a very good example of how science should be applied and carried out. I have benefited from that on a personal level and a company level, in terms of my career development and the development of companies I have worked for.

The danger is that if we do not allow the application of new technologies, we will become part of the second lane in the use of this technology. I would not like to see that. Our approach as a country towards animal welfare and the way that we set up farming systems is world class. In many cases, we lead the way in the development of technologies. We have some of the highest animal welfare standards in the world and we will continue to review that, I understand, in a constructive way. We have very high standards in farming. If we prevent this sort of technology from being employed because of a precautionary principle, which is one of the areas where technology gets held back—"There's a slight chance that there may be a problem that results from this technology, so we shouldn't do it"— that is regressive. I do not think that is the way that we should take science forward.

We should understand the risks, evaluate the risks and look at the technologies. Where they are able to be used for good purposes, we should take them forward. That is the case for gene editing. If you look at the way that the research is lining up, and the way that the breeding companies are talking about the traits that they are going to use, these are examples of taking the technology forward to benefit animal welfare and the sustainability of animal production, and we should be one of the early adopters of the technology.

The Chair: We have a minute left.

Q134 David Duguid: I think you have answered the question, but just a yes or no: do you think that this legislation would lead to more investment in research and development in agriculture in the UK?

Dr Tinch: I think there are some challenges. If it turns out in the detail to become regressive—if it becomes restrictive—that would act against the development of the technology. We should look to taking this forward by applying the technology in a constructive way. The detail should allow us to work that out and look for examples where we are taking animal welfare forward.

The Chair: There are only eight or nine seconds left, so we will not get another question in. I was hoping to get Kerry McCarthy in there, but we will not. I thank Dr Alan Tinch for being our witness.

Ordered, That further consideration be now adjourned. *—(Gareth Johnson.)*

5.10 pm

Adjourned till Thursday 30 June at half-past Eleven o'clock.

Written evidence reported to the House

GTB01 Claire Robinson, Director and editor, GMWatch, and Dr Michael Antoniou

GTB02 Peter Stevenson OBE on behalf of Compassion in World Farming

GTB03 Samantha Brooke, CEO, The British Society of Plant Breeders (BSPB)