

Science, Innovation and Technology Committee

Oral evidence: Innovation and Global Food Security, HC 1245.

Tuesday 4 November 2025

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Members present: George Freeman (Chair); Dr Allison Gardner; Samantha Niblett; Dame Chi Onwura; Adam Thompson; Martin Wrigley; Daniel Zeichner.

Questions 1 - 65

Witnesses

I: Dr Ismahane Elouafi, Executive Managing Director, CGIAR; and Professor Cristóbal Uauy, Director, John Innes Centre.

II: Imran Afzal, Chief Executive Officer, National Alternative Protein Innovation Centre; and Dr Hannah Cooper, Assistant Professor in Agronomy, University of Nottingham.

Written evidence from witnesses:

- [CGIAR](#)

Examination of witnesses

Witnesses: Dr Elouafi and Professor Uauy.

Q1 Chair: Good morning. Welcome to the launch of the Science, Innovation and Technology Committee inquiry into food security. We have two panels giving evidence and I am delighted to welcome Dr Ismahane and Professor Cristóbal, who will open our panel on some of the global issues that the inquiry goes to the heart of. Then a second panel will look at agronomy and some specific technologies.

I will set the scene. In 2010, Sir John Beddington, the Government chief scientist, warned this Parliament that if we wanted to avoid mass famines and starvation we had to double global food production by 2050 on the same land area, with half as much water and energy. If we didn't, we would have famines and hundreds of millions of people migrating out of Africa and other places.

Broadly, the UK has not properly responded to that challenge. In fact, agricultural productivity has fallen and our reliance on international food imports has risen. Yesterday, the all-party parliamentary group on science and technology in agriculture launched its food security report, in a summit that a number of us were at.

I want to start by asking you both, with your distinguished backgrounds—perhaps starting with Dr Ismahane, given your global background—to say something about how big the global challenge is, how other countries are responding to it, and where you see the UK playing a role. We, as the science Select Committee, look at the incredibly powerful science that we have, and think that we could help to solve the challenge.

Could I ask you to say something about the global challenge, how big it is, and where the UK fits in? The Government have rightly set out a food security strategy, an industrial strategy and a trade and investment strategy. How confident are you that agri-science research will be embedded in that, to tackle the global food security challenge? I will turn to Dr Ismahane first.

Dr Elouafi: Thank you very much, Mr Chairman. It is really a pleasure to be here with you. In terms of the global challenges, the number of people with malnutrition, hunger or extreme hunger is on the rise. The funny part is that it has been on the rise since 2017. We all signed the global development agenda in Paris in 2015, and after a few years the numbers started creeping up. Of course, covid was a huge hit, with numbers rising again, because it disrupted the supply chain; and they also went up with the Ukraine war. There is really a history behind it.

The issue is that about 300 million people are still in extreme poverty—I always say that that means they could die from hunger. As to people in poverty, malnutrition and triple hunger, and particularly malnutrition, there are still about 740 million people. That is based on the latest number from FAO and WFP.



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When you look at the reasons, conflict is always No. 1. The second is climate change. When, Mr Chairman, you said we are producing less, that is the reality, because we are not adapting well to climate change. The rise in temperature, and changes in the variation, are a reality everywhere. We see floods in places where it used not to rain, and drought in regions that did not have it before. That variability is a reality, and it is going to get even worse with climate change. Climate change has an impact through heat, meaning that most of the crops we have may not produce as much as we produce today. There is variability per se. Also, with the heat, insect and pest movements are going to be erratic. We have models that have worked for some time, but even the latest IPCC report said that the model for weather forecasting is not working any more, because the data that we have is completely different. So climate change is still a big issue that we need to pay attention to.

Q2 Chair: The world has set targets on climate change. Have we set targets at an international level on food security?

Dr Elouafi: Formally, yes. We have targets for productivity. There is a number: it says that we need to produce 70% more by 2050. In reality, it is not 70%. To be scientific we have to do it by region, and that says that Africa as a continent, for example, needs to produce almost 99% more. The middle east and north Africa need to produce 46% more. Asia needs about 45% more. The rest of the world does not need to produce more, because they are already at the top. That diversification is very important.

Q3 Chair: Thank you. I do not want to hog all the questions, because other colleagues want to come in. Professor Cristóbal, can I ask you to talk about the UK? How strong a sector is this, and how strong a signal are we sending to our sector to rally to this?

Professor Uauy: I think that clearly we in the UK punch above our weight in terms of the research we do. You just heard from Tropic, based at the research park, how we can really deliver when we have the right regulatory environment and the right funding and partnerships to allow us to achieve it. What the UK can contribute is huge.

When we talk about what the UK can do, a key thing is to continue the funding of innovative discovery research, which is the engine to allow us to deliver on products that work in partnership with Ismahane and colleagues at CGIAR. That funding includes social science, which we sometimes do not think about. Of course there are the biological sciences, but we need to work with social science to make sure that those partnerships deliver on the ground rather than just staying in the greenhouses of Norwich. We need to take that extra step.

Another really important thing where the UK can contribute extremely well is by supporting in-country innovation, mainly through education. With new technologies, rapid pace, and the ability to genome sequence many crops, technology is suddenly becoming a key accelerator. We have



done work with the Earlham Institute in Norwich and ILRI—which is a CG centre—to develop a nine-month bioinformatics training course. That was essential, because, instead of them having to tell us what to do, we developed a course based on local knowledge, with 15 scientists from Africa. They were the keys to drive the first sequencing of African crops, based with African scientists. That was a key breakthrough. They led the sequencing, instead of having us do it.

Chair: Brilliant. You used the key word, “Africa”, which is my segue to Chi, usually our Chair, who wanted to ask about that.

Q4 Dame Chi Onwurah: Thank you so much, Chair. It is great to hear you talk about the adaptation and diffusion of technology in Africa. I chair the all-party parliamentary group for Africa. Yesterday we met with AGRA, the Africa-led food productivity organisation, to discuss food security. Obviously, agricultural productivity is critically important in Norfolk, in Northumberland near me, and in northern Nigeria; but the needs and access to capital and the skillsets are different. I want to understand—perhaps I will start with you, Dr Ismahane—how you choose which innovations and technologies to pursue and develop, and in which circumstances, and how we ensure that it is not one size fits all.

Dr Elouafi: Absolutely. Thank you so much for the question. The continent of Africa did not really raise its productivity based on technology. All the increase in productivity over 50 years or so was mostly by clearing new land. If we are going to stop clearing new land and increase productivity per unit of water and soil, we need to bring in technology. The continent has, for example, only about 7% irrigated land, so mostly it is at the mercy of rain—whether it comes or not—and climate change has affected that a lot. There is very little mechanisation or access to improved seeds, so there is a huge yield gap. Right now, we say that every hectare in Africa, or every cow in Africa, produces about 20% to 40% of its potential, in comparison with the UK or other countries. There is a huge yield gap that could be bridged fairly quickly with technology.

Those technologies include basic things that you have as a reality here in the UK, but also new technologies. As Cristóbal said, new technologies can make things much faster. We think, for example, of gene editing. That has reduced the price of breeding from about \$100 million to \$5 million. That is a huge reduction, but we have to make sure that the technology is accessible for African scientists and farmers, and that is why we require a lot of tech transfer, education and training, and a lot of basic instruments. For example, for gene editing there is a very interesting set-up, but it is very costly. We need to invest in science and technology in Africa, so that it is done in Africa by Africans in collaboration with advanced institutions like the John Innes Centre, CGIAR centres or other universities. Technology will be the key point to fill that yield gap, and it is doable.

Q5 Dame Chi Onwurah: Thank you for answering that question, and talking



about technology as the key to fill in the gap. I would like to understand a bit more about the technology choices. I heard yesterday that, for example, by using wormeries it is possible to create organic matter fertiliser, which is less costly and more effective than commercial fertiliser. That is being trialled in places in Africa. How do you reflect the commercial pressures to use more expensive commercial technologies rather than, as you talked about, growing home-grown technologies?

Professor Uauy: May I comment in terms of the technology? You asked how we do this: it is always in partnership and in conversation with our local partners. That is why the CG is very important. It connects us to the local agricultural systems. We have a very nice example where we work with colleagues in Ethiopia at the Ethiopian Institute of Agricultural Research. Together with the Norwich Institute for Sustainable Development—the social science—we started conversations about what crops they were really interested in. One was a crop called grass pea. The problem is that it has a toxin; but it is the last crop standing when there is drought or civil strife. With the toxin, if you eat only grass pea you get lathyrism, a devastating, crippling disease. Colleagues in Ethiopia said, “We would love to have a grass pea, because it has all the attributes we want—but it has this toxin.” So we worked with them to find the right technology, which would fit in their remit, to improve their varieties. Using the fundamental knowledge of chemistry that we had at Norwich, to understand the pathways, we were able to make mutations in particular genes to start developing low-toxin lines of grass pea. Those lines are currently being tested by our partners in Ethiopia. As a side effect, those are interesting for animal feed in the UK, so we are also testing them in Norwich for that. It is a dialogue that we need to have.

There is another point about technology. Often there is a cost in developing technologies, but I want to show you a technology. It is the most technological thing we have on site today: a bag of seeds. Although the technology we have is biologically driven and is a relatively simple solution, it has a huge amount. All the farmers in Africa know what this is and can use it. They do not need to learn anything.

Q6 Dame Chi Onwurah: Although they can all use it, will they have to pay for it?

Professor Uauy: Through the CG, for example, roughly 50% of wheat varieties in the world come from the CG system, and those are distributed within the local systems. I imagine mostly it is for free. That is one of the key things.

You mentioned the cost of IP for gene editing. That is an issue that we need to talk about, and I would welcome the opportunity, perhaps in another session, to discuss that further, because it is a barrier to the adoption of the technology.

Chair: Thank you. Research partnerships for global impact are one of the things we wanted to ask about, so I turn to you, Adam. There is a global



as well as a UK aspect to that.

- Q7 **Adam Thompson:** Thank you very much, Chair, and good morning, both. Thank you for joining us. I want to come in on, as George says, research partnerships and the view that we take of them. Ismahane, in your written evidence to us you refer to the role of the UK in convening research partnerships. In your view, is the UK still a leader in this space, despite recent cuts to initiatives such as the ODA?

Dr Elouafi: I think, on the science part, definitely: the UK is leading on many fronts, and the new centre of innovation that we created in 2023, UK-CGIAR, is bringing in more UK scientists to the development sphere; but the cut in ODA is going to impact us tremendously. I do not know how much investment in science there is in the UK—if it is continuing or not—but really you need to increase it instead of decreasing it, internally, and bring more funding for your scientists to have more breakthroughs. Right now, the science is so mature. Just 30 years ago, we could do so much; but now, with everything we know—particularly in genomics, nanotechnology and in certain areas where we have had breakthroughs, as well as with AI and computing power—we can do much more. We need to invest more, not less.

The cut in ODA is affecting us at CGIAR. In terms of the UK contribution to international development, particularly through research and development in agriculture, it will really affect us. It has been a tough year, because there was a reduction in the UK but also in many other countries. I think it is not the time to do it. If we help Africa, for example, to produce more and bridge the gap that I am talking about, it will reflect positively on the UK. We showed in the paper—I hope you read it—that although our focus was on low and middle-income countries, and particularly small-scale producers in those communities, the impact on UK farmers is also tangible.

- Q8 **Chair:** If the UK steps back—we were a powerhouse of tropical research, and this links to Chi's question—who steps into the gap? Is it China? Is it America? Who are the international leaders if we step away?

Dr Elouafi: If you look at the latest numbers for investment in science and technology related to agriculture, China is leading. The total numbers, coming in a paper very soon, are about \$130 billion globally, and \$29 billion is in China. China is definitely leading and, to balance it out, there is a need to invest more in science, not less. There is a window of time when we can accelerate our technologies.

Chair: Sorry, Adam; I interrupted you.

- Q9 **Adam Thompson:** It is quite all right, Chair. That was an important point. You talk about China being, I guess, "the" leader as opposed to "a" leader. If we work under the assumption that the UK remains "a" leader, is it purely the level of investment keeping us in that position, or can and should the Government do other things to make sure that the UK stays a



leader in this space?

Dr Elouafi: I think it is investment and partnership—those two: the areas that you invest in, and the countries and institutions that you partner with.

Q10 **Adam Thompson:** Is there more that we could do in expanding partnerships?

Dr Elouafi: Absolutely. I think, really, you can use the CGIAR. We are in almost all the countries in Africa, and about 100 countries across the globe, including in Asia and south-east Asia, the middle east and north Africa; so you could definitely use CGIAR to work with those national systems. At CGIAR, we work with the national and in-country research centres, local farmers and local institutions. We do not do it all ourselves. We co-design it with others, but we need the know-how from universities like the John Innes Centre, or other academic institutions.

Professor Uauy: Can I make a point to complement that? The appetite of the UK research base is incredible, in terms of trying to work internationally. We long to do it, but we need the funding mechanisms to allow that, and to make the partnerships and sustain them over the long term.

Chair: Great. I understand that there is a mix of low and high tech, here. I want to come to genetics. It is the big transformational technology of our time, in human health and in agriculture. Fortunately, we have the former Minister, hotfoot from putting the precision breeding Act through Parliament. Daniel, I know you want to ask about genetics globally, as well.

Q11 **Daniel Zeichner:** I do. Thank you very much, George. Good morning. Professor Cristóbal, when I have visited John Innes, I have always been very impressed by the work that you and others do. You will know that the legislation has been passed. The regulations are in place and ready to go this month. My first question to you is whether that gives you what you need to make the kind of transformative change that the Chair referred to. Are there other countries where you think the regulatory environment is better or worse? In other words, are there things we can learn from elsewhere?

Professor Uauy: As our colleagues Phil and Duncan from Tropic said, it gives us the initial tools to do the trials and get things to market here in England. The key challenge is that we need to harmonise the regulatory environment much more widely. There is a barrier to adoption, currently, for many of the breeders here in the UK, because they do not know if their products will be able to enter Europe. The same goes for other countries. Although we have taken the lead, we need to continue emphasising how we harmonise that regulatory environment so that more countries have similar systems.



As part of that—as part of the UK CG centre, with our colleagues in Ethiopia, Kenya, Pakistan, Morocco and Egypt, we are holding a workshop here next year with the regulators, not the scientists, to see how we can put the same regulatory basis across countries, because we will need that framework to have the impact internationally. Otherwise, every time I try to send a seed, the requests will be different for every country, and that will get very cumbersome and then it will stop. That common regulatory framework is a key element to allow the technology that we develop here to expand internationally.

Q12 Daniel Zeichner: Can I press you on that? It is an important point. You can do the technology, but then you have to quickly get it out there, and get uptake. If those crops are not sellable either in other parts of the United Kingdom or the EU, won't that act as a brake, effectively?

Professor Uauy: That is exactly what is happening right now. It is a brake; it is a barrier. We can get some crops out—especially things that you can consume directly. Take a tomato, for example: we are doing a vitamin D tomato in the UK; the tomato is grown and eaten in the same way. With other things, like wheat, it is made into a grist and into a mixture, so currently if you combine the two it is very difficult. Depending on where that flour ends up—in Wales, for example—will it be GM or not? So it gets very cumbersome, and breeders are currently shying away from some of the technology because of the regulatory environment—not because of the potential. That is a major barrier to adoption, which is why we are working with regulators, in developing countries as well, so we can learn south-south, south-north and north-south and the relationship goes all ways.

Dr Elouafi: The European Union would be a big problem, particularly, because 33% of the trade of commodities out of Africa goes to Europe. If Europe is against it, its use stops completely across the continent.

Q13 Daniel Zeichner: So the risk is that we will have the technology but not be able to use it.

Professor Uauy: Right.

Dr Elouafi: Because of the regulations and because of international discrepancies.

Q14 Daniel Zeichner: Can I move on? We can talk about this for a long time and I am conscious we have a lot of ground to cover. In terms of consumer reaction in the UK, obviously 25 years ago there was a strong kick-back against GM, which is a different technology but in the public mind can sometimes be confused. We saw the reaction to the methane-suppressing feeds, with Bovaer. What would you recommend—I will start with Dr Ismahane—needs to be done to maintain public confidence in the face of what I would say is a rather ill-informed reaction to these new technologies?



Dr Elouafi: I think it would be explaining to people that the commodity is completely different. When you talk about gene editing, you do not have any exogenous DNA. That is one thing.

Also, look at the positive side. If we use this technology it is going to be much faster to breed more species, because we are really narrow in using only 125 species of plants out of 500,000 on the planet. We are not using biodiversity. One reason for that is that it was very costly to breed. Now, with gene editing, we can breed much faster, at lower cost.

The other impact is on soil fertility, or using micro-organisms and synergies in nature. The technologies and knowledge will allow us to be much more nature-positive than nature-negative. Bringing technology to help that narrative, instead of seeing it as bad and as harming the environment, is very important.

The science has a role. We need to show the evidence. I have one example that I love, about the use of AI and low technology—photography—allowing us to use more of our gene banks. In gene banks we have a variety of species across the commodities that we work on. We have 132,000 accessions of rice, for example, but only 5% have so far been used by breeders, because it was very costly to screen them for criteria. With AI, in collaboration with Google Research, we were able to find rice that has a special antioxidant that could be anti-cancer. It is amazing, and we did it in two years because we used the technology. If we had done it through normal planting of the plant, and finding the antioxidant and what have you, it would have taken us 20 years. We did it in two years at low cost because of the technology.

I think those stories need to go to the public so that they see that technology can make us all better, including nature. We also need to be a bit more frank; when we have uncertainty about certain technologies we should say it. We should say, "Yes, we know it's good. But maybe this concept or aspect should be much more strongly regulated, to make sure that we are not harming the environment."

Q15 **Daniel Zeichner:** My final question is to Professor Cristóbal. You mentioned the need to involve social sciences as an approach. That is a perfectly rational response.

Professor Uauy: Yes.

Daniel Zeichner: Yet we know that, in the view, probably, of people in this room, the public do not always respond to these things rationally. Is there anything we can do in terms of structure and regulation that might address some of those concerns?

Professor Uauy: I think it is about finding those mechanisms where social scientists and biological scientists can work together from the beginning, in co-creation, and with industry, to develop responsible innovation. That responsible innovation is not just technology; we need



to understand that technology needs to come with an understanding of public perception.

To go back to Ismahane's response, the way we think about it is that it is, as you say, very rational, but at the same time people are sometimes a little irrational in how they react to technology. But if they see the benefit, people adopt technology; we all have a tracking device with us every day and have no problem with that, because we see the benefit. It is the same with this—for example, the non-browning bananas that Tropic were talking about. We have all had that problem at home. Who would not like bananas that did not go brown? And with vitamin D: we all say that we want to eat more nutritiously, but the problem is that to eat or to feed our kids more nutritiously is more expensive. What would happen if we could feed our kids more nutritiously, on better diets, at the same cost? That is what we are trying to achieve.

That is where the technology has real potential. We talk about food security, but nutritional security also needs to be at the heart of this. That is where the technology can have a huge impact. It will directly affect people's lives, rather than "just" farmers. They will see it on their plate and in their food.

Q16 Chair: Professor, you can feel that the Committee is very interested in how the UK can deploy its science to help tackle the global challenge. To take bits of Africa or Asia, I was in east Africa recently and discovered the Cambridge centre for tropical medicine, which had closed in the '60s. It had a plant growing through the roof. You touched on genetics and IP. Who is doing the on-the-ground communication with local farmers to build confidence that the next generation of crops is healthy and safe? If we are not doing that—if we are just doing it in the lab—how is it going to get into the hands of the farmers in Africa or Asia? Professor Cristóbal, does, for example, UEA, the NRP or the UK have a presence out on the ground doing this, or are we simply doing the academic work and hoping somebody picks it up?

Professor Uauy: As part of the UK's CGIAR centres that Ismahane touched on, there is a funding mechanism that opened a couple of years ago, through FCDO and UKRI funding, to work internationally on making alliances. There we are working on trying to develop improved wheat varieties for nutrition and for disease resistance, for farmers. A key component of that is, exactly that, with social scientists at the UEA, through the Norwich Institute for Sustainable Development. They work with social scientists from CGIAR, ICARDA and CIMMYT on the ground in Egypt and Kenya and also with the Kenya Agricultural and Livestock Research Organization and the Agricultural Research Centre of Egypt—the institutions that are on the ground, and their social scientists. The idea is that it is about not just the technology, but working with social scientists from the CG and local social scientists on the ground. We have farmer days and so on to really understand their preferences, before we deploy technology.



Q17 **Chair:** Would it be fair to say that people out in hungry bits of Africa are less worried about the ethics of genetics and just want better crops, or are they equally worried about it? What are the lessons from that work?

Dr Elouafi: I think, sincerely, that if people can't eat they will eat anything. That is really the population in Africa—when a good variety has good productivity and good nutrition for their kids. However, the policymakers and institutions also have ethical worries—particularly markets. I would say their ethical issues are related to whether it would close a market for us, or not.

I think on extension services and passing the knowledge to the farmers there is a huge gap again. We are not doing enough. There are institutions like AGRA, which you mentioned. It is a great institution doing great work. There are institutions—FARA, the AATF and Sasakawa—but there are not enough. I think the African Governments need to invest more in extension services.

Chair: Thank you. We are lucky in this Committee to have real scientists, including Dr Gardner, who, I know, wanted to ask about the ethics of this.

Q18 **Dr Gardner:** It is an interesting one. A long time ago I lectured on golden rice, if you remember. You talked about ethics and having to sell this good. Public participation in this development is really important and it is absolutely a multidisciplinary approach, which has to be stressed. Thank you for saying that. However, when you look at things like golden rice and ethics, as with AI, it is about finding a balance between the benefits and harms that can occur. Going back to the old story of golden rice, there is the harm and cost of not providing that in terms of the quality of people's lives. It is not just telling them about the benefits; it is telling them that in many ways this helps prevent blindness and saying, "It will help you." We will come to this in the later panel on alternative proteins as well and how they can help people and make their lives better; it is about trying to get that argument across. I lectured on this a long time ago, so can you update me on where we are now with food products such as golden rice? Is it out there or are we still battling?

Dr Elouafi: Golden rice is used right now in Bangladesh because that country has a policy to allow it. It was released in the Philippines and withdrawn because of the movement against it, particularly from Greenpeace, which got a lot of people to talk about it. Despite the huge investment in golden rice, it is used only in countries where there is the right regulatory framework for it. The good news is that, particularly on vitamin A—one of the three main nutrients that we need to continue to increase, along with iron and zinc—we now have sweet potato with vitamin A and we have cassava with vitamin A. That is spreading in many parts of Africa, including Nigeria. We are also doing rice with vitamin A, without the GMO component. What we did at CGIAR is mainstreaming what we call biofortification of those three very important micronutrients in almost all crops. We have beans high in zinc, for example; we have



chickpeas with certain micronutrients, as well as millet and so on and so forth.

Q19 **Dr Gardner:** Is that done by selective breeding?

Dr Elouafi: Yes.

Professor Uauy: One interesting aspect of genome editing is that often, before, there was replacement of local varieties. Because this variety has this trait, you have to replace your local variety with this trait, or you then have to do breeding, which means you would be basically shuffling the genome and starting all over again. It takes a very long time. One of the key aspects of genome editing is that we can now genome edit in local varieties. We do not have to take our UK variety and then give it to Kenya and say, "You need to do it." We can take Kenyan-grown varieties or CG varieties and do the editing directly. That is very important because, if we did not, it would delay technology and impose our genetics on their environment. That is why the training needs to be done locally so they can then use these tools. They are relatively low tech in terms of adopting them in their local varieties and the farmer-preferred varieties, rather than us replacing them. I think that is a very fine distinction.

Q20 **Dr Gardner:** If they are local to the environment, that prevents them from becoming an invasive species.

Professor Uauy: It also allows them to retain the IP in terms of their local variety. That is why the IP is really important, and we should perhaps discuss it in another session, but that is a distinction. It is not just one variety we can do; we can do local varieties with genome editing and different crops. That is the revolution of it. It is not just that we can do it but we can do it in farmer-preferred varieties to make that connection with the social science side.

Q21 **Dr Gardner:** To go back to the point about invasive species, it is important to point out that one of the big complaints was that these would become invasive species and take over. If you do it with a local variety, you have your natural controls there and it creates that benefit as well.

Dr Elouafi: Because the ecosystem and adaptation are already balanced out, you do not need to spend time to get that new material adapted to the ecosystem.

Chair: Thank you. I am keen to keep the conversation going, so I will go to Chi and then Samantha.

Q22 **Dame Chi Onwurah:** One of the other big concerns was about big companies coming into African countries, taking their biodiversity, editing it and selling it back to them at inflated prices, if you like. What you are saying, as I understand it, is that in the case you have given, the IP rests in the country and is owned by local scientists or Government organisations.



Professor Uauy: That is correct. One of the key things is that the technology and the landscape of the machinery needed to do the edit is complicated. The genetics will be locally owned, but to make the edit there is IP that is a little convoluted at the moment. In that area we are trying to argue that there could be more public investment to make public good technology. That could be deployed with an IP strategy that would be for the public good rather than for, of course, the benefit of companies. That is an area that still needs to be resolved.

Dr Elouafi: Also, the International Treaty on Plant Genetic Resources for Food and Agriculture has a benefit-sharing component. A number of species are in that treaty. That is protecting local knowledge and local species, but it does not include all crops. It is a particular list and we need to extend it to be more inclusive of the biodiversity we might not know about in certain countries.

Samantha Niblett: I apologise for being late. I came from another meeting, with the Mozilla Foundation talking about AI ethics and open source.

When we talk about investment—you already alluded to this—there is always talk of the importance of wider partnerships. I wonder whether you can talk a little about the importance of public institutes working with commercial entities, but also how that works from an ROI perspective. We probably believe in the betterment of society, but we heard the horror stories about Nestlé giving formula milk to mothers who then stopped producing their own milk. They were then reliant on something they had to buy, when they could have naturally produced it themselves. How does that work? Also, how do you get investment from manufacturers that are seeking to make a profit? How do you make sure you are working with good organisations?

Apologies—I am newly elected to this Select Committee and this is my first presence here—it would be remiss of me not to mention that in my register of interests I am the founder of Labour: Women in Tech, an officer on the UAE all-party parliamentary group, chair of the diversity in tech APPG, co-chair of fintech APPG, an officer on the ITV APPG, an officer on the motor APPG, co-chair of PICTFOR APPG, and chair of the Interparliamentary Forum on Emerging Technologies.

Chair: You are fully compliant.

Q23 **Samantha Niblett:** I am fully compliant; thank you. In a roundabout way, how do we make sure that we are working with that wider ecosystem, and how do we keep it ethical so it is not just all about ROI?

Dr Elouafi: On one side, let me say that, if we want to scale, we need the private sector. We can't do it ourselves; we have been trying that for years. It is very clear that we need the private sector. How can public investment incentivise that investment from the private sector, but ethically make sure it is not only about ROI? I think it is really through



policies and regulation; it is the checks and balances. We need to ensure that we make them accountable in terms of certain ethical issues, but also in terms of environmental and social issues. That is necessary.

What is the model? I do not think I have the best model in mind, but it is a necessary partnership and we need to make sure it works. Otherwise, particularly in emerging, low-income countries, we have tried it through last-mile organisations and others, but we are not yet at scale. The only way is to inject private sector funding. The private sector does not all need to be huge multinationals; it could be pushing a bit more the small and medium enterprises that are local, with some collaboration, be it south-south, be it south-north.

It is a difficult question, to tell you the truth. I do not think I have seen great examples, but it is definitely needed. Public investment should be incentivising but it should also be keeping an eye on certain criteria to make sure that we do not completely flip into the ROI without the social benefit and the protection of the environment.

Professor Uauy: SMEs are really important. We had the example of Tropic. It arrived in the park with three people; now there are over 160 people and it is in *TIME* magazine. That is a huge success story and shows that when we invest well we can do it.

The other point is about public good. When we think about where we put our public money to incentivise companies, the problem is that a lot of companies will not invest in the public good that will come out of it because they are worried about their return on investment, where it is, and who will pay for that. But if we can co-invest for public good traits that will address issues to do with healthy diets and productivity in the UK, that would perhaps be a way. For example, increasing fibre content, reducing the amount of sugar in our foods and increasing vitamin D are all important for our long-term productivity as a country and our country's health, but at the moment we cannot capture that value because it is not there. Breeders will not breed for that if they cannot catch a value, so we need to find mechanisms whereby they can get a benefit as well with public good traits. That is a big challenge that we have as a society.

Q24 **Samantha Niblett:** What role does Government have in that? My mind is instantly thinking that, if we have pension funds, can we be investing in pots that are doing good things for the long-term benefit of humanity?

Professor Uauy: Exactly.

Q25 **Samantha Niblett:** You touched on the importance of regulation and regulating these companies, but it feels as though we are between a rock and a hard place. Some countries and Governments are saying we should rip up regulation and let business do whatever it likes; other countries say we should be regulating in a fair way. If we are so reliant on the private sector, how do we make sure that regulation is not so stringent



that we put off private sector investment that does the job you want it to do to protect humans?

Dr Elouafi: You have to get the right regulation tools to make sure you do not stop innovation but incentivise it, and also invest public money where the impact is not so clear to the private sector. Public procurement could definitely help create markets for neglected and under-utilised species, or could create a market that will allow co-operatives to become a private sector or that will allow SMEs to grow. Public procurement, public policy and regulation could incentivise diversification of our basket but also diversification in terms of economic actors in the field.

- Q26 **Martin Wrigley:** I am fascinated by this. Professor Uauy, you came back to the IP question several times, and I think this is fundamental to why the process is not trusted. There are examples like Nestlé. There is too much sugar in food mostly because those people who are developing food do it to make more profit; they make it sell, or whatever it may be. If you have the profit motive behind gene modification technology, it will not be trusted and you will lose out and not be able to deploy it. That is the fundamental question; I am probably just reiterating it in less informed ways. The issue is about the use of this technology. There was a big company—I hesitate to name it—involved in early gene modification of wheat.

Chair: It began with an “m”.

Martin Wrigley: The wheat did not produce seed that could be reused. That is the fundamental fear. If you give this away for a profit motive and allow that to be the only thing that drives it, you could destroy the entire thing.

Professor Uauy: That is why public-private partnerships are so important. For example, on the vitamin D tomato, we at John Innes are working with companies to try to develop that. That has public health benefits. It is not driven necessarily by profit or just yield, but is really about nutrition. We need to find alternative mechanisms because, unfortunately, the way we currently do it means we are just valuing yield. We need to start valuing also nutritional density and quality. Those things require a systemic approach in that sense.

- Q27 **Chair:** As a defender of the good profit motive, I think the problem is monopolies. In that case, one company dominated the entire supply chain and exploited that dominant position. Before we wrap up, I want to ask both of you to give us some recommendations that you would suggest we take to Government for how to unlock the real power you have both spoken about—the power of the UK as a science, research and innovation engine—in tackling this great global challenge. You also eloquently described quite a gap in terms of the translation globally, out in Nairobi, Asia Pacific, the Philippines or South America, and, if we do not step in with responsible innovation, how others—commercial actors with monopolistic aims, bad state actors, or people dominating—will step



in. What would you urge us to urge the Government to do? They have set out a food security strategy and industrial strategy. They have even mentioned agri-tech; and they have set out a big trade and investment strategy. As a trade envoy, I am on the frontline of it. What do the Government need to do to deploy British science to help tackle global food security?

Professor Uauy: I have a weighty list of things.

Q28 **Chair:** If you want to write to us with a long list that would be fine, but for today what do you say?

Professor Uauy: I will write a long list. I think we need to continue funding for the UK-CGIAR long-term partnerships. The UK-CGIAR Centre is a model of how we can take it forward. Being able to bridge natural and social science is really important. For all the questions we have asked here about the social science, we need to be sure that we are connected and working together. Getting the regulatory environment harmonised will be essential internationally, so we need to take leadership as the UK. We are England, but as the UK we need to take leadership.

We need to be thinking about investing in public-private partnerships for breeding here in the UK, as we are doing, for example, with Tropic. We are working on sugar beet with them. That is an example of working together for public good. We can also think about how we generate the evidence for public good. How can we generate evidence to show that if we increase high fibre, that will have a public health benefit, so that all wheat in the UK should be high fibre—and if we do it, that everyone needs to move in that direction? We need to generate evidence showing how we can use the technology for public good and then companies need to move there.

Dr Elouafi: I think it is about investing more in science and technology. I do not think it is time to back out or reduce it internally and externally. Really, the solution will come through more research and understanding of the natural pathways. There is also continued investment in international development, because the by-products—maybe by-benefits or co-benefits—are a better life for the British people. I hope you saw the study we did on the impact of investment in CGIAR. Every household in the UK benefits by having to spend £46 less per year on food. There is a direct benefit to households, but also to the farmers in the UK. We hope that the reduction in ODA would not mean less investment in CGIAR and its partners, like AGRA and other African organisations, because we need to continue supporting international development to have a better life for the people in the south and reduce migration or security issues.

Chair: The former Minister wants the last word.

Q29 **Daniel Zeichner:** I am going to be unkind now. Everyone will always say we should invest more in research, but there is not necessarily going to be more. Are you convinced that the set-up we have in the UK at the



moment is the most rational, efficient and effective way? I am not convinced. You will know that things could be done better. Can you give us any clues?

Dr Elouafi: Definitely. Again, I think it is about partnership. We do not need to do everything by ourselves. There are certain things that are done better in institutions A and B. I think that open science, open access and innovation right now have shown that is the best way to go forward.

Q30 **Chair:** Thank you both. It has been a really helpful and open conversation. I think the message for our viewers is that global food security is an urgent national and global security challenge. If this planet fosters large-scale famine and food insecurity, we will see migration on a scale we have not even begun to dream of. Europe, the Mediterranean and the middle east will be awash with people leaving the areas worst affected by climate change. I think you have shone a light on the urgency of connecting our science base, world-class as it is, to the reality on the ground in Africa, Asia and the Americas. We have heard a powerful story that, if we retreat from that space, we will let in bad actors and bad technology and let down the people we need to succeed for global security. Do feel free to write to us with detailed recommendations, which we will pick up through the course of our inquiry. Thank you very much on behalf of the Committee.

Dr Elouafi: With pleasure.

Chair: Thank you very much on behalf of the Committee. That brings to a close our first session.

Examination of witnesses

Witnesses: Imran Afzal and Dr Cooper.

Q31 **Chair:** Welcome to the second part of this morning's opening session on food security. The Science, Innovation and Technology Committee is looking at the scale and urgency of the global challenge and the UK's role in helping to tackle it. Welcome to you both and thank you for coming.

Imran Afzal is CEO of the National Alternative Protein Innovation Centre and Dr Hannah Cooper is assistant professor in agronomy at the University of Nottingham. As the Science, Innovation and Technology Committee, we are looking at how the UK can play a bigger role in tackling food security, and how we can deploy both our science and our leadership in the regulation of science in globalisation and the impact of technology transfer of science. We have just heard in our first panel some of the challenges around the world in getting next-generation crops into the hands of African, Asian and South American farmers.

Can I start, as I did in the first session, by reminding all of us of the global challenge? Sir John Beddington, former chief scientist, told us in 2010 that we had to double global food production by 2050 on the same land area using half as much water and energy or face mass famines and



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mass migration with hundreds of millions of people on the move. Essentially, in this country we have not really responded to that. In fact, agricultural productivity has fallen; our reliance on imports has gone up; and our farmers are increasingly wondering whether they are really viewed as a key industry.

The Government set out a food security strategy and an industrial strategy that references agri-tech, and a trade and investment strategy. We are interested to see how we can harness that. First, can I ask you to say something about the scale of the global agri-science research market and the opportunity in the UK, as you see it, starting perhaps with Hannah and then turning to Imran?

Dr Cooper: Thank you very much for the invitation. Cristóbal and Ismahane were talking about some absolutely fantastic technologies being developed and used, but none of this will work if our growing medium—soil—is degraded. My background is in soil physics and soil health, so hopefully by the end of today I can convince you that soil is the most important thing.

Talking domestically to start with, the UK has about 17 million hectares of soil in terms of agricultural production. We have about 5 million hectares for arable cropping, 12 million hectares for grazing, and about 500,000 hectares in terms of woodland. As for some of the challenges we are facing, about 2.9 million tonnes of soil are eroded every year, and about 5 million hectares are at risk of erosion.

Q32 **Chair:** In the UK?

Dr Cooper: Yes. So it is a huge domestic challenge as well, and it is one we are all battling to remedy with low-tech sensors and technologies, and high-tech enablers. If we look internationally as well—obviously, we are not alone—in sub-Saharan Africa nutrient depletion affects about 135 million hectares. To go back to what Ismahane was talking about in terms of global yield potential, sub-Saharan Africa is currently producing about 2 tonnes per hectare of maize but has the potential to produce 10 tonnes, so there is a yield gap of 8 tonnes per hectare. If we look to the States, some areas are producing about 12 tonnes of maize per hectare, but their potential is 16 tonnes, so there is a yield gap of about 4 tonnes per hectare. Equally, soil erosion there is contributing to a reduction in yields of about 10% to 25%. So, domestically and internationally, the threat to soil health is a really big challenge.

Q33 **Chair:** You will be pleased to know that we have quite a few questions on soil health which we will pick up with you. Thank you very much. Imran?

Imran Afzal: To introduce myself properly, NAPIC is the National Alternative Protein Innovation Centre. We have been running for about a year. We are an IKC. I do not whether everyone is familiar with innovation and knowledge centres, but we are funded by UKRI. We are housed within academia. We have four universities, which I can tell you a bit more about, but, ultimately, the purpose of an IKC is to take the



science, translate that and produce an impact on the commercial side of things. I want to state that I am coming into this wearing that hat. Could you reframe the question to remind me what you were asking?

Q34 Chair: In the challenge of doubling global food production, what is the role of alternative proteins? Is it a silver bullet?

Imran Afzal: It is not a silver bullet, but I certainly believe that alternative proteins play an important part in this transition. We know that in this country we imported £64 billion-worth of food in 2024. We know that the global demand for meat is expected to grow by 50% in the next three years. That will have huge impacts on the planet and, frankly, it is beyond the planetary boundaries that we currently set. These are the challenges.

Furthermore, one local statistic I want to share is that half of the wheat we grow in the UK is used to feed livestock. When you first hear that figure it is surprising. Alternative proteins do have a significant role to play, but we face a number of challenges. As for some of the questions Samantha asked earlier, I do not know whether we will have the opportunity to talk about how we work with academia and the commercial sector, because I think it is a really important question pertaining to alternative proteins.

Chair: We are going to dive into alternative proteins, soil and then the commercialisation stuff. Allison is going to take us away.

Q35 Dr Gardner: Dr Cooper, you do not need to tell me about soil health. I can rant about the impact of coniferous forests on soil mite populations as much as you want. Imran, it is very apt that alternative proteins have come up. I have been a vegetarian for 45 years and, because of a health issue, I have had to wrestle with the idea of whether I need to start eating meat again, so this is very close to my heart. Could you tell us what alternative proteins are, and why they are a good thing for global biosecurity, environmental impact but also potentially for health?

Imran Afzal: There are different definitions of alternative proteins but, to try to keep this direct, these are ultimately proteins from non-animal sources. There are different technologies at play when we talk about alternative proteins. At one end, you have plant-based proteins, which people will be very familiar with—for example, pulses and so on. We migrate into products of traditional fermentation and then move on to biomass fermentation, which you are familiar with, with corn and microprotein products of that ilk. Then we are into precision fermentation. That will produce certain examples such as dairy proteins, caseins and things like that. If we keep going down that pathway, we are into cultivated cell products. That is the kaleidoscope of different proteins that comprise alternative proteins.

Q36 Dr Gardner: Could you stress why this is important in terms of climate change and what the impact may be of developing it? I remember a



recommendation that we need to look at and legislate for protein diversification and have a protein transition plan because of the benefits this could have for our food security but also the environmental impact. Could you tell me why this is a good thing for us to be focusing on as a really important strategy for future food security and climate change?

Imran Afzal: Frankly, the planet cannot support the way we are consuming protein at the moment, so we need to make changes. There are significant barriers to transitioning to alternative proteins, which we can talk about.

Q37 **Dr Gardner:** Could you expand on the barriers?

Imran Afzal: There are a number of barriers. We are seeing that the price of alternative proteins has been one barrier; taste has been another challenge; accessibility—getting them to market—is another challenge. Within the UK, the start-up CEOs I talk to in the alternative protein space complain, frankly, about access to pilot-plant and scale-up facilities. Getting those products to market is a huge challenge for them, and that remains the case.

On the regulatory side of things, the guys from Tropic who were here earlier talked about this a fair bit. Kudos to the Food Standards Agency, which has been working in this area. A cell-cultivated protein sandbox has been stood up. I think it started work just a few months ago. Where EFSA will take five years to approve novel food, the ambition there is to cut the time in half to two and a half years instead. That is another barrier we need to face.

Q38 **Dr Gardner:** Can I dig into that? You say two and a half years, but this is an urgent issue. I know that the FSA put these alternative proteins in an unspecified category called novel foods. I know that, in DEFRA, if any innovation is plonked into this novel category it can languish there. I am aware from my colleague Daniel Zeichner that gene-edited micro-organisms are not in precision breeding legislation as such. So in terms of regulatory barriers, what legislative changes do you think would help to speed that process along? Can you recommend any?

Imran Afzal: If we focus on the CCP sandbox, regulators—or the agencies, I should say, more specifically—need three things. They need more funding. More money needs to go into these endeavours. They need more expertise, and, by that, I mean more people who bring the expertise. They need bench hours and resource in terms of looking at the dossiers that come into them so that there is no backlog. If those three things were put into the system we would see results, ultimately, or we would help shrink the time it takes from two and a half years to—

Chair: I should add something. I talked to the Food Standards Agency yesterday about this, and the crucial thing is applications. It is lacking companies coming forward with bids for things to go through that test bed that we set up. I know we are going to get into this later. This is about public consumer confidence, and the retailers need to be confident



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that there is a market for it.

Dr Gardner: Well, there is a market, because I do not want to have to start eating steak again.

Chair: Yes, it sounds like there is a market here.

Q39 **Dr Gardner:** I am fed up with chickpeas. Dr Cooper, you may want to come in on this. When we talk about developing a protein transition plan, how can we bring farmers with us given the environmental impact, the impact on farming and the provision of that? How can we support farmers if we say, "Right, we're going to transition to alternative proteins. We're going to reduce the amount of wheat you produce for feedstuff and move away from beef herds"? How can we make sure that we bring farmers with us in this process?

Dr Cooper: It is a really good question. Cristóbal and Ismahane touched on this earlier. It is all about co-development and bringing everyone in at the very first stage. I also think it is about strengthening some of the incentives, such as outcome-based payments and things like that, with transparency and open communication from the get-go, and co-development: "If we were to implement new policies and mechanisms, what would they look like? What would be useful to you on the ground at that moment?"

Q40 **Chair:** In order to do that, we need some data, don't we? If we were to reward farmers and pay them more for reducing greenhouse gas emissions, you would very quickly conclude as a farmer, "Oh, I really want to get away from feeding my cattle wheat grown here." If we had some data, we could start to reward those outcomes. Where are we on the journey to having proper data to capture the greenhouse gas emissions of the entire food supply chain?

Dr Cooper: Across the entire food supply chain, it is quite tricky in terms of monitoring and verification, but AI is playing a huge role in speeding this up. Large datasets are already available. Some of the work that I have carried out has shown that changing from conventional tillage to the reduced disturbance side of things, so zero tillage, can reduce your greenhouse gas emissions by about 60% over 15 years and at the same time increase the soil carbon. The AHDB is carrying out lots of work on greenhouse gas inventories. It is all about the monitoring, the measuring and the verification, which is a key point, as well.

Q41 **Chair:** Can I just be clear on synthetic proteins? We are talking, effectively, about the replacement of meat and the replacement of plant products. It is both, is it?

Imran Afzal: Yes.

Q42 **Chair:** Where are we in the UK? Are we strong in both? Are we stronger in synthetic meat or in synthetic plant proteins?



Imran Afzal: I will not underplay the barriers, because they are there for plant-based proteins, but in terms of TR levels, we are higher up when it comes to plant-based proteins. When we are talking about fermentation technologies and precision fermentation, cultivating those are lower in TRLs so they will take longer to develop.

Q43 **Chair:** I met people from a company in Norfolk recently making gluten-free snacks from pea flour from peas grown in Norfolk. It is brilliant. To your point, they had to ship the equipment to Ireland and import German machinery. We were hopeless at that supply chain piece of putting the flour in and processing it.

Imran Afzal: Can I add to that point? I read a report recently about pulses. A lot of pulses grown in the UK are fed to animals, pigs in particular. It has been identified that in the UK we do not have the infrastructure to fractionate pulses. We can dry them, we can dehull them and we can produce low-value feed for pigs, but if we had the infrastructure to fractionate—and by that I mean break apart the pulse so that we can extract the protein and fibre—we would massively increase the value of that pulse. The point that you just raised there, George, is a classic. We do not have the stuff to do the transformation. It is not rocket science. It is where the Government need to come in and invest because the private sector probably won't. A farmer is not going to change to growing more pulses unless they know they can get more value.

Chair: We have segued beautifully into soil. Those legumes are doing the soil good as well. Samantha wants to make a quick point on this farming element.

Q44 **Samantha Niblett:** It links in to your point. I have a farmer in my patch in South Derbyshire who asked me a really good question. I scratched my head and I thought, "Well, I wonder why." He said, "When we're incentivised to grow flowers in fields as part of the SFI scheme, they're flowers. We're not creating any food. They're flowers, unless of course we're taking the seeds and what have you." His question was, "Why can't we be incentivised to use those fields to grow legumes?" When we talk about our power as parliamentarians when it comes to regulation and incentives, is that something in your armoury of recommendations?

Chair: That is one for you, Hannah, is it not, from an agronomy point of view?

Dr Cooper: Yes, it is a really good question. Within the SFI, there are a couple of incentives for increasing legumes within the crop rotation. The PGRO, the Processors and Growers Research Organisation, is doing some work at the moment looking at legumes within rotations, the legacy benefits and things like that. It is also reaching out to stakeholders in the UK within the PGRO network, talking to farmers on the ground about what works in certain areas, when and why—it is not one size fits all. Definitely in terms of incentivisation, the legacy effects for soil health of getting that nitrogen into the soil will then potentially increase yields for



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the following crops—for a wheat crop—so you are putting fewer inputs into the soil in terms of fertiliser. I definitely think it is something to look for.

Chair: You are reminding the world that the agriculture revolution started in Norfolk, with “Turnip” Townshend using sheep, clover and legumes to turn sand into much more productive land to grow wheat. It was a good cycle.

Dr Cooper: Yes.

Chair: Daniel, I know you want to come in on this, and then we will go to Martin on soil.

Q45 **Daniel Zeichner:** Farmers often worry about these conversations. It sounds as if we are moving away from the things that they do. I constantly reassure them that we will need them to continue to produce. I have two questions. First, it seems to me that animals are a key part of improving soil health, and perhaps one of the challenges for our part of the country is that specialisation has meant that we do not have mixed farming in the way that we used to. Hannah, can you comment on that?

My second point goes back to the huge amount of grain that is grown for animals at the moment. Imran, can you tell us what that could do for protein production if it was not put into poultry, pigs and beef but was put through some of these new technologies, which will mean that we will still need it but it is used for a different purpose? There are two questions there.

Dr Cooper: To go to your question on mixed farming, agroforestry is a really hot topic and a buzzword at the moment, and there are lots of sites popping up domestically and internationally as well. As part of ELMS, there was a pilot that had an agroforestry field site—I cannot remember over how many years—that showed there was a 20% increase of soil organic carbon and a 30% reduction in erosion. That shows that implementation of these mixed farming systems can work really nicely. Another example is that, in Kenya, they introduced some agroforestry with maize. Over five years, that increased the soil organic matter by 0.5%, which sounds small but makes a really big difference, and increased their maize yield by about 8%. There is certainly lots of scope in terms of increasing mixed farming and agroforestry both domestically and internationally.

Q46 **Daniel Zeichner:** Is there a role for animals in that as well?

Dr Cooper: Yes, for sure. You would have cattle there as well. It is all about mixing the trees, the cattle and the crop together in different combinations, depending on what works for the site and the environment that you are in.

Imran Afzal: Ultimately, it is about feeding human beings protein. At NAPIC, we believe in a blended-protein approach. We are not advocates



of purely having alternative proteins; we believe in having alternative proteins along with conventional sources of meat. A huge amount of agricultural land is used to feed livestock and it is inefficient, as we know, and it is very deleterious to the environment. I do not have the stats at my fingertips here, but we know that when we use less land and water we reduce zoonotic risk, antimicrobial resistance and all those things that play a huge role in terms of impact on the planet and how much protein we can put on the table.

Chair: I have a very agricultural constituency. I think it is No. 5 for pig and poultry processing; it is a food-processing constituency. I am sure that the consumer trend is that people basically want to move away from factory farming. They want to get to celebration festival meat for really special occasions. Synthetic protein gives us the opportunity for curries, burgers and sausages that can be synthetic and shatter the cost and environmental footprint. I think consumers are beginning to get excited about that. Of course, now, Martin, we are coming to soil, because this also has a huge benefit in terms of soil. In my patch, we have free-range pigs. The effluent run-off is bad. The disease risk is bad. They are doing their best, but it is not that sustainable long term.

Q47 **Martin Wrigley:** Thank you, Chair. Dr Cooper, thank you for your opening remarks. They somewhat took the wind out of my sails because you quoted everything that I was going to ask you about, which was interesting. The thing that struck me most is the obvious yield gap. We know that something has to be done about it. Why isn't it being done?

Dr Cooper: That is a really good question. It is mainly because one size does not fit all. That is what people are looking for: one great technology or one great method that might solve all these problems. There is a multitude of different technologies. Low-tech technologies combined with high-tech enablers will play a key role. In certain areas, cover cropping can increase microbial abundance by 27% and activity by 21%. In other areas, reducing your tillage might help in terms of improving your soil health and the yield gap. There is a lot of work going on about co-developing with farmers from the get-go, looking at commercial farms and building farmer networks.

Lots of institutes and universities in the UK are really good—Rothamsted and the University of Nottingham in particular—at developing these farmer networks and trialling approaches across different microclimates, soil textures and cropping rotations. Then we need to be able to use this higher-tech, remote-sensing AI to then predict, "Right, we've seen this in this area and have a nice dataset forming now. Can we then use these different parameters to predict what will happen with scenario B here? Out of the lower-tech, cheaper technologies with some of the higher-tech sensors, what might work best in that scenario?"

Q48 **Martin Wrigley:** You are right about people looking for that silver bullet. Talking to farmers in my area, they are doing some of these things. They know they need to do them and they are trying to make them work. Are



there more tools, more analyses, more things that we need to provide to farmers so that they know the best things to do on their land?

Dr Cooper: Yes, definitely. There are quite a few things that we could certainly help with. First, as to mechanisms, a lot of these transitions do not happen overnight. Some of the research has shown that if you change a system it can take five to 10 years for the soil to respond in a positive way. You might even see a dip in yield in the first five years, but the soil health is slowly recovering, and the structure and the microbiome are recovering. There could be a mechanism in place to help farmers transition. A lot of farmers I have spoken to won't obviously change their whole farming in one go; they will take a field out of rotation and trial a method. If they do not see an improvement in the first one to two years, at the end of the day it comes down to crop yield. There could be a mechanism in place to help them transition in the longer term, not just over one or two years but in a five or 10-year cycle.

I also think the UK could become an international capability in terms of long-term field trials. Rothamsted is the oldest agricultural institute in the world with Broadbalk. The University of Nottingham has established its own long-term field trials. Leeds also has long-term field trials. If we want to be able to farm for the now as well as for the future, we need to have longer-term field trials in place to help with the resilience and testing of these farming practices. Having a combination of longer-term field trials across the different microclimates, alongside working with the commercial farmers, would be an important mechanism that we could help with.

Bioinnovation is going to be really important as well. We are getting a plethora of data now, especially on the microbiome, with all these technologies coming through. There is bioinnovation in terms of using AI to look at the microbiome, predict its resilience or predict its nutrient cycling and things like that. There are an awful lot of things that we can do to help and improve.

Q49 **Martin Wrigley:** What does Government need to change? The farmers I spoke to complained about short-term incentives because they could not plan across generations as to what they wanted to do with their farms. They did not know from year to year, or from day to day sometimes, whether the incentives were actually in place. Do we need to set up something? You are talking about needing five to 10 years to make changes. That is beyond the scope of a single Parliament. What sort of longer-term incentives do we need?

Dr Cooper: Definitely, so in the longer term—over five to 10 years—if we look to some of the policies that Australia has implemented, it has a national soil monitoring programme, which was \$200 million over 10 years, from 2021 to 2031. It also provides an open data infrastructure. For the farmers who have signed up to this, it is all open FAIR data, so there is transparency and it is a 10-year mechanism.



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For another really nice example of policy, we can look to the Netherlands. The Soil Protection Act of the 1980s is already ingrained in its legislation. It also recently put in a circular agriculture strategy, which is over another 10 years. Yes, it is outside the parliamentary cycle, but it is possible as well. With farmers, it is that regulatory uncertainty. If they want to transition to a more sustainable technique but the benefits are in the future, we need something there for them to say, "No, try it, and hopefully you should see these benefits after so long."

Q50 Adam Thompson: Good morning, both. Hannah, can I first say that it is very nice to see a former colleague? A lot of the decade that you spent at Nottingham doing CT scans on soil, I spent doing CT scans in a slightly different building on bits of metal. It is nice to see you.

Dr Cooper: Yes, you too.

Adam Thompson: Following on from Martin's point, what in your professional opinion are the biggest threats to soil health? What are we doing to solve those threats?

Dr Cooper: Some of the biggest soil threats are the reduction in soil organic carbon, through intensive agriculture or changes in climate. Globally, soil holds about 2,400 gigatonnes of carbon, whereas the atmosphere has only 800 gigatonnes. If we lose just 1% of organic carbon in our topsoil through erosion, that is 24 gigatonnes of carbon into the atmosphere, which is two thirds of our annual fossil fuel release. The potential in soil is huge in terms of organic carbon.

Some of our other threats are contamination in terms of metal contaminants, PFAS and microplastics. Some research recently came out that said about 300,000 hectares of soil in the UK are contaminated with PFAS. It is suggested that if your soil has seen sewage sludge and biosolids, you have 700,000 microplastics per hectare. The remediation of this is extortionate. A lot of technology is going on at the moment to try to reduce the costs and the timescale of this remediation. You are looking at excavating large amounts of soil and chemically washing it, but then you have the waste water to deal with.

Those are some of the biggest threats. Obviously, climate change is a huge threat as well. We are seeing the changes in the variability of rainfall and drought. How are the soils responding to this? There are an awful lot of challenges.

Q51 Adam Thompson: Thank you. I made a visit recently to a new water treatment plant in my constituency in Church Wilne, where they talked extensively about PFAS and how challenging they are to remove from water run-off, so I am well aware of that. Earlier, in the previous panel, we had a conversation about research partnerships internationally. Could you comment on how you at Nottingham and other institutions across the UK are working internationally to solve some of the problems that you have just highlighted?



Dr Cooper: We are really good at this in the UK but could be better in terms of mechanisms for these research partnerships. To give you some examples, there is a project called LegumeSELECT looking at increasing legumes in the rotations in Kenya, Ethiopia and Zimbabwe. On the mechanisms there, we are working closely with local farmers on the ground, with the breeders and with the local governance. We are doing the mechanistic work in the UK, testing what would work, and then going back and doing the applied side, making sure it works in situ and things like that. There are an awful lot of mechanisms; Cristóbal will be aware of them. We are working with CGIAR and CABI quite closely. We have a project at the moment on rice with IRRI. There are lots of mechanisms.

There is something else that we could improve on. Within the UK, we are really good at the DLAs, the doctoral landscape awards, and the DTPs and things like that, with lots of institutions and universities within the UK. A nice mechanism might be to do a global north and a global south partnership or something like that. If you start from the PhD level, you are building those relationships and that knowledge transfer from the get-go. That might be quite a nice mechanism.

Q52 **Chair:** Thank you. You are an agronomist. Can I ask you about the land sharing/land sparing debate? There have been three big reports within the last 18 months saying that the only way, globally, that we will hit that target of doubling global food production is by increasing production on the best land both globally and in the UK, not chopping down the rainforest and extending agriculture everywhere. Derrick Wilkinson, the former NFU chief economist, has just issued a report saying that he thinks we are on track, if we don't do something about it, to see a 30% reduction in agricultural land in the UK because it is going into housing and solar and coming out of agriculture. Can you say what the land use policy implications are of us hitting this target both in the UK and internationally? What do we need to do on land use policy if we are going to drive sustainable agricultural intensification?

Dr Cooper: I run an agronomy field course and we go down to Norfolk. A farmer there is very much of the same opinion. He has some really productive soils. He is on his 11th year of continuous wheat, and he is seeing really great yields, with high inputs as well as high outputs. On land use, maybe we need some stricter regulations on what is deemed agriculturally suitable and things like that. We talked about the yield gap potential. We still have a yield gap potential in the UK. With some of these higher-tech solutions coming through, we should also be able to increase the productivity of land.

On land use, we also need to be careful of what is going to happen in the future. With potatoes, you will have a reduction in your earlies in East Anglia and they will move more to the north. There also need to be some predictions in terms of what land use is going to be suited to which crops in the future.

Chair: It certainly links back to Samantha's point: the science is



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suggesting that paying farmers on really productive land to grow some wild flowers has a minimal environmental impact but quite a big impact on productivity. We would be better using marginal land and really doing habitat renewal. Perhaps we will come back to that.

Q53 Adam Thompson: That is a great segue, George. To the point that George just made and to the one a minute ago about the research collaborations, is there anything more that you think Government could be doing to support the things that George just raised and research collaboration internationally? Is there anything that we can take away to give to the Government?

Dr Cooper: In terms of international research collaborations?

Adam Thompson: Yes, or national.

Dr Cooper: I talked earlier about the long-term experiments bringing together the different national capabilities. PhenomUK is a really nice example of this. Applying that mechanism to different areas within agriculture and food production would work really nicely. Institutes and universities can tend to be quite siloed in their research. Institute A might be working on something; Institute B might be working on something quite similar. If we work together within this kind of mechanism or infrastructure, we might get more out of it. Looking to PhenomUK and what is happening there, bringing together the institutes and universities on a common problem and having that mechanism in place would be really useful.

Adam Thompson: I should say that I was once funded by PhenomUK as well, so good stuff.

Q54 Dame Chi Onwurah: I am really interested in soil fertility, which we have talked about, and the different methods for improving soil health: what I would call low-tech methods such as biochar and increased organic material versus AI managing every aspect of the microbiome. What are those trade-offs? Is it a matter of time or cost? Is it going to be a mix of high tech and low tech, or low tech in certain areas and high tech in others?

Dr Cooper: It is a good question. I think that, probably, elements of everything that you just said will come to fruition. A nice example that I read is that in one of the provinces in India they deployed IoT sensors, the high-tech part, alongside some organic mulching, the low-tech part. This helps 75,000 farmers to increase their water use efficiency by 40% and increase their net income by about 8%. That is a case study of where low tech and high tech come together quite nicely. In terms of using high tech only, such as remote sensing, those sorts of technologies can work individually for predicting flood and erosion risk, and things like that.

I think it will be a combination of low tech and high tech, and then high tech as well. It depends on accessibility, connectivity—that is a big one—and affordability. Even with some of the low-tech solutions that we are



talking about—Cristóbal and Ismahane spoke about this earlier—such as getting seeds to some areas, they are just not accessible. It is about connectivity and everyone having a mobile phone. A lot of companies are using apps to be able to help the local farmers, so it is getting a lot better, but it is about equity as well. There are certainly still a lot of barriers to the adoption of low, high or a combination.

- Q55 **Dame Chi Onwurah:** Thank you. I would like to ask Imran Afzal a question about alternative proteins. The centre of Newcastle has the Town Moor, which has been continuously grazed for over 800 years. It is a mainly low-tech, managed, mixed grazing environment. Should I be telling the freemen who run the Town Moor that the future holds alternative protein steaks that will match the quality of the steaks coming from the Town Moor now and at a much reduced environmental and financial cost?

Imran Afzal: At NAPIC, we are very much about doing the translation of science and coming at this from a blended protein perspective. I keep going back to that because it is important for us to say that. Where we talk about farmers growing livestock, clearly at some point they will need to look at how they grow livestock and whether they should be taking on other forms of production.

- Q56 **Dame Chi Onwurah:** As you say, the costs currently of alternative protein, particularly cell growth, are significant. Do you see them coming to a point where they are comparable with traditional growing?

Imran Afzal: Over time, we will see—

- Q57 **Dame Chi Onwurah:** What time period might that be?

Imran Afzal: That is a really good question and one that a lot of investors have as well regarding when cost parity will be achieved. I think it will take many years, if we are talking about cell-based media and that type of technology. Precision fermentation is a bit closer. Then there is plant-based. I think it was the Green Alliance that said that the price of meat per kilo was £1.18 or £1.14. It had increased per kilo from last year, and plant-based protein—

- Q58 **Dame Chi Onwurah:** I am talking about cell cultures, not plants.

Imran Afzal: Okay. Cell-cultured will take many years, but I do not know exactly.

- Q59 **Dame Chi Onwurah:** Some people might think “many years” in a political cycle would be 10. Some people might think “many years” would be 1,000 in terms of how long the freemen have been grazing the Town Moor. What do you consider “many years”?

Imran Afzal: Certainly more than five years—certainly more than an election cycle—and maybe going into a decade.

Chair: That is interesting. I recently visited—as I am sure you have—a



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company making synthetic meat using meat cell cultures. When they fried it for me and said, "You taste it," it tasted like chicken. I literally couldn't tell the difference.

Dame Chi Onwurah: Did you ask them what the price was per kilo?

Q60 **Chair:** The price point is probably still too high, but it is there. It is ready. Why do you think it will be five years? Is it a volume-price issue?

Imran Afzal: It is scaling the technology. We do not have the infrastructure in this country. We have the science. We have all the right ingredients, but we fall down in having the ability to scale this technology. That is a challenge.

Q61 **Chair:** Internationally, who is leading in that field?

Imran Afzal: There is lots of investment. There is the United States. Canada recently put in a centre in Regina, Saskatchewan. I understand it is a biofermenter of 25,000 litres. Those are the countries that immediately spring to mind. The Netherlands, Germany and Belgium are the nations that are doing well.

Q62 **Chair:** If the issue is scale, we set out a £2 billion bioengineering strategy that will include regional incubators. Should we be encouraging Government in our recommendations to fund regional biocubators to support this industry?

Imran Afzal: The short answer is yes, I believe so.

Q63 **Daniel Zeichner:** I have a couple of questions. I was intrigued, Imran, by your earlier point about fractionating pulses and your view that the private sector is unlikely to invest in that, and it would need Government intervention. This will be a theme of a number of my observations. Why not? What would be needed to get people to invest in it in the future?

Imran Afzal: I come from a company background having worked in global CPG companies in the past. They obviously want to turn a profit, which is no bad thing. For a CPG company to invest in infrastructure, it is very challenging because of the ROI and being able to prove it. We are talking about the big agro-companies—I won't name them but the ABCDs, for example, of this world. I have spoken to them numerous times about alternative proteins. For them to invest in infrastructure in that space, they have to be confident that the people at the end, the CPGs, will buy the stuff that they are producing. Without that confidence that they will be buying, you have a brake or a barrier to overcome. In shorthand, that is why I do not believe private investment into this type of infrastructure is going to materialise. It is really challenging for those reasons.

Q64 **Daniel Zeichner:** Given the potential benefits of boosting the production of pulses for a whole range of reasons, it seems to me that we need to look more closely at this. I just don't think Government can always step in and make the investments that the private sector is not prepared to



make, because in the end that benefit will go to the private sector.

Imran Afzal: I hear the point. We are talking about growth. We are talking about creating jobs. We are talking about growing our economy. For me, those are prudent things to invest in, particularly alternative proteins. For us, this really is a huge opportunity in terms of being a global leader, but if we don't invest now we are going to get left behind. I know that we talked about alternative proteins in the food strategy. The industrial strategy kind of talks about them, but we really need to place our bets. Government can invest, I believe, to get an ROI. With investment in facilities like the pulse factory, you can see where that is going—you can see where the money is going to come back into the coffers. That is low risk. Being very prudent and making the investments in the right place, but thinking strategically about our place in the world, about global food security, about the UK's food security and growing our economy, are the things that Government should get behind.

Q65 **Daniel Zeichner:** I have one final point. I was pleased by your positive view of the role that the Food Standards Agency is playing. Is it not the case that we have fallen behind some of our European competitors over the last few years on some of these issues? What do we need to do to catch up?

Imran Afzal: To be honest with you, I do not know the ins and outs of the discussions that we have. There is a policy group within NAPIC that reports into our industry advisory board, and within that group we have DEFRA, FSA and other entities that are part of it. The reason we come together is to talk about what we can do in this space to make life easier for start-ups and get approvals done faster. I do not have the necessary expertise or experience to talk about comparisons to other jurisdictions like the EU, Singapore, Israel and other places.

Chair: Thank you very much. I am conscious of our and your time. With Treasury questions in four minutes, I know colleagues are itching to get in and encourage the Chancellor to back agricultural research, science and technology. I thank you both.

In this second panel, you have really taken us down into some of the detailed issues on the ground of how we help farmers to embrace these technologies. It sounds like we can be very optimistic about the science and the technology from the data, from agronomy, from tractor cabs and satellite-guided rigs. For precision farming and the synthetic proteins—whole new classes of product—we are hearing that the real issue is the global competition, moving at pace and how we help our farmers to get access to these technologies and deploy them, and that requires a policy framework. Thank you. You have helped us to frame our thinking for our food security inquiry.